TOMSK POLYTECHNIC UNIVERSITY

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PROFESSIONAL ENGLISH FOR MASTERS OF HEAT POWER ENGINEERING AND POWER ENGINEERING INDUSTRY

Recommended for publishing as a course book
by the Editorial Board of Tomsk Polytechnic University

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Krainov A.V.

К775 Professional English for Masters of Heat Power Engineering and Power Engineering Industry: course book. – Tomsk: TPU Publishing House, 2013.– 174 p.

Teaching materials aimed to the skills development of using English in the scope of professional communication. It contains the basic theoretical data, formulated tasks and questions for class and self-study work of students, the set of test materials for the evaluation of their knowledge. Domestic and foreign technology combination of teaching foreign language at high technical school is being used.

The course book is intended for masters of heat power engineering and power engineering industry. The complexity of presentation allows the use the course book in the frame of joint international educational programs, in the sphere of elite technical education and in advanced training or use it as self-study.

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PREFACE

“Professional English” is intended for masters of the Heat Power Engineering and Power Engineering Industry who study English on the basis of the multi-level approach with the focus on international standards.

The Course book includes 2 modules – “Professional Environment” and “Professional Activity” – each of which consists of 3 units covering the topics included in the syllabus programme for the course “Professional English” for intermediate and upper-intermediate masters.

The Course book includes material which helps masters to develop necessary skills to acquire the English language for professional purposes. The course is composed on the basis of the communicative competence and functioning approaches. The organization of the material allows to master students communicative competence in listening, speaking, reading and writing. In addition, each unit includes tasks to develop the linguistic competence of the masters.

One of the benefits of the course is that it uses authentic materials, contemporary internet resources and is rich in visual aids – pictures, photos, charts and tables. It also includes the regional and university components of the syllabus programme. The tasks are composed in accordance with the recent functioning methods and technologies such as project work, case-study, etc.

The author is grateful to Associate Professor Petrovskay T.S. (Deputy Vice-Rector for Academic and International Affairs), Professor Kuznetcov G.V. (Deputy Head of Energy Institute, the Chief of the Theoretical and Industrial Heat Engineering Department), Professor Loginov V.S., Professor Borisov B.V. and Associate Professor Zagromov Y.A. for their recommendations in compiling this course book.

MODULE 1

PROFESSIONAL ENVIRONMENT

CLASSBOOK

UNIT 1. CAREER PLANNING

Grammar: Modals, word combination deals with/concerned with
Speech strategy: Engineer career planning

1. Warming up activity:

1. What is engineering?
2. What do modern engineers produce?
3. What is the role of power thermal engineer in the society?

2. Look at the following pictures. They will help you to identify the activity of the engineer.

READING

Text A

3. Scan the text and do some exercises after it. What is engineering?

Engineering is the field of applying science and mathematics to develop solutions that have a practical end. Engineers design and manufacture machines, process, systems and even economical structures [1]. In a sense, engineers are inventors. They dream up ideas and make them a reality for the rest of us. By util-

izing science and math, they develop, improve the quality of life for society. Engineering is a highly rewarding career for creative and innovative individuals. And as you can imagine, there is a great deal of prestige involved with being an engineer. Since engineers are often responsible for directly creating a new product or service, they are in high demand in the corporate world and command fairly high salaries.

VOCABULARY

4. Match the words from the first column (1-9) with those from the second one (a-i).

1. Engineering	a. Wage
2. Develop	b. Human being
3. Design	c. Formulate
4. Invent	d. See
5. Individual	e. To be in charge of
6. Imagine	f. Invention
7. Responsible	g. Manufacturing
8. Product	h. Plan
9. Salary	i. Extend

5. Tick the following sentences true (T) or false (F).

1. Engineering is the field of applying science and mathematics to develop solutions that have a practical end.
2. In a sense, engineers are not inventors.
3. They dream up ideas and make them a reality for the rest of us.
4. And as you can't imagine, there is a great deal of prestige involved with being an engineer.
5. Engineers are in high demand in the corporate world and command fairly high salaries.

6. Complete the chart with noun forms.

Verbs	**Nouns**
Develop	development
Solve	
Invent	
Create	
Imagine	
to be responsible	

7. Complete these sentences. Use verbs and nouns from the chart. Make sure you use the correct form of the verb.

E.g. Engineering development is highly demanded nowadays.

1. In order to make ____ you have to think properly.
2. ____ which are produced in TPU have a great success.
3. Innovation, _____ these are two points which characterize modern engineers.
4. _____ is one of the features, characterizing modern engineer.
5. The position of the engineer acquires_____ imagination, invention.

8. Translate the following sentences.

1. Engineering is the field of applying science and mathematics.
2. Engineers design and manufacture machines, process, systems and even economical structures.
3. Engineers dream up ideas and make them a reality for the rest of us.
4. By utilizing science and math, engineers develop, improve the quality of life for society.
5. Engineers are often responsible for directly creating a new product or service.

SPEAKING

9. Discuss in pairs what is engineering whether it is popular or not in the modern society. Pay attention to the Language Box.

LANGUAGE BOX

-If I understand you correctly, you are saying/asking...
-I didn't quite catch that.
-Could you go over that again? /Sorry, could you say that again/repeat that, please?
What exactly did you mean by …?

Avoiding giving an answer:
-I'm afraid that's not the field of my research.
-I'm afraid I'm not able to answer this question at present.

10. Rearrange the words in the correct way and comment on it. Do you agree or disagree?

rewarding, is, individuals, a highly career, for, and, innovative, engineering, creative

READING

Text B

11. Skim the text and entitle each paragraph.

Engineering specialists

There are more than 25 recognized career tracks for the engineer. And you can rest assured that as technology advances, engineering specialties will only grow in number.

A few of the major engineering specialties include; aerospace, chemical, civil, electrical industrial, materials, mechanical, power thermal and software engineering [2]. Learn a little about each specialty.

Aerospace engineers create aircraft and spacecraft. Aeronautical engineers are those that work with aircraft while astronautics engineers are those that work with spacecraft. Aerospace engineers also work with and develop satellites and missiles. As you can imagine, many are employed by the military and the government.

Chemical engineers usually manufacture products and design processes for chemical manufacturing. Therefore, chemical engineering requires an understanding of chemistry and even molecules and their interactions. Chemical engineers may specialize in a particular field or chemical process.

Civil engineers maintain and develop public transportation systems. They construct roads, bridges, dams, tunnels, airports and irrigation and sewage systems. They also create water treatment processes and test buildings. Civil engineering is one of the oldest engineering specialties.

Electrical engineering is one of the biggest engineering fields and includes all power systems, circuitry, microprocessors, computer chips, digital broadcasting and telephone switching systems. Electrical engineers traditionally focus on the generation and supply of power.

Industrial engineers create assembly line systems to help with manufacturing processes. They utilize energy, people, machines and information to help organize the manufacturing of a specific product. Industrial engineers must solve organizational problems and create an efficient production process. Many industrial engineers are in management positions. Materials engineers develop and test materials for creating products. This includes the development of ceramics, metals, plastics, glass and other materials. They help construct buildings, highways and manufactured goods from the materials.

Mechanical engineers are specialized engineers who work with mechanical devices. These may include elevators, refrigeration and air-conditioning equipment, robots and electric generators. Mechanical engineers design tools used in other engineering disciplines. As you can imagine, mechanical engineering is another one of the broadest engineering specialties. Learn more about a mechanical career.

Software engineering is also called web, IT engineering or software programming. Software engineers create programs for use on computer platforms or on the internet.

Power thermal engineers are engaged in producing boilers, reactors, some equipment which is widely used in modern industry. They design the projects of power thermal, nuclear stations.

VOCABULARY

12. Fill in the gaps, putting down the words in the correct form.

Mechanical engineers are ___ (to specialize) engineers who ___ (to work) with mechanical devices. These may ___ (include) elevators, refrigeration and air-conditioning equipment, robots and electric generators. Mechanical engineers design tools ___ (use) in other engineering ___ (discipline). As you can imagine, mechanical engineering is another one of the broadest ___ (engineer) specialities. Learn more about a mechanical career.

Language development deals with/concerned with.

13. What is the link between column A and column B?

Power thermal	devices
Mechanical	machines

14. Column A lists a branch of engineering or a type of engineer. Column B lists things they are concerned with. It is possible to show the link between them in the examples (Ex.13).

1. Power thermal engineering **deals with** devices (turbine, boiler, pumps etc.).
2. Power thermal engineers **deal with** devices.
3. Power thermal engineering **is concerned with** devices.
4. Devices **are the concern of** power thermal engineers.

15. Match the words from the left column A to the right column B.

A	B
1. Power generating	A. Fossil material
2. Power thermal installation	B. Steam generator
3. Heating and ventilating	C. Gas turbine
4. Electricity generating	D. Device
5. Boiler	E. Station
6. Nuclear fuel	F. System
7. Nuclear reactor	G. Unit

SPEAKING

16. Create a working team of your group mates. Elect a leader and discuss engineering specialties.

LANGUAGE BOX	
Career track	To be engaged in
Technology advances	Focus on
Develop satellites	Mechanical devices
Engineering specialities	
Manufacture products	
Design processes	

READING

Text C

17. Skim the text the information will help you to cover the tasks after it.

EDUCATION REQUIREMENTS FOR ENGINEERS

The minimum requirements for becoming an engineer consist of a bachelor's degree from a university accredited engineering program. A degree in engineering might go a long way, but it is also possible to become an engineer with a degree in math, physics or even computer science.

Keep in mind that there is quite a bit of math involved with most engineering programs or similar degrees. You can expect to take the following courses; algebra, geometry, trigonometry and calculus [3]. You will also be expected to take a large variety of science coursework. Typical science courses for engineering majors include; biology, chemistry and physics. Depending on your area of emphasis, you may also need to take some computer programming or computer applications coursework. With the heavy course load involved in an engineering program, you should come prepared. Most university engineering programs require students to complete two years of high school algebra and one year of trigonometry for admissions. Engineering programs commonly require one year of both chemistry and physics for admissions as well.

After college, many engineering graduates choose to pursue a job. It is possible to graduate and start earning $40000 a year right out of college. A smaller subset of engineering graduates pursue in advanced degree in engineering (i.e. a Master's or Ph.D)[4].

VOCABULARY

18. Complete the chart below by inserting the missing form.

Verb	Noun	Adjective
prepare		
	expectation	
		requiring
	load	
depend		
		educating

19. Fill in the gaps in the sentences with the help of the words from the chart above.

1. With the heavy course ___ involved in an engineering program, you should come ___.
2. Most university engineering programs ___ students to complete two years of high school.

3. It is possible ___ and start earning $40000 a year right out of college.
4. ___ your area of emphasis, you may also need to take some computer programming or computer applications coursework.
5. ___ requirements for engineers are given for every student in technical university.

20. Match the verbs below to the correct prepositions. Then make up sentences with them.

consist	from
include	on
depend	in
graduate	of

SPEAKING

21. Discuss in pairs what education requirements for engineers existing in technical university? Pay attention to the words in brackets.

(profound knowledge in a variety of fields, to be one's favorite, specialize in, ambition, socially important, discuss professional matters, to be well aware of the fact that, to become an engineer).

GRAMMAR BOX

Must, can, could, be able to, may, might, will, shall, should, to have (to) are modal verbs.

They express meanings such as obligation, necessity, certainty, ability and possibility, lack of necessity, offers, suggestions, requests, logical assumption, permission, prohibition, advice and criticism.

e.g. Modern engineers can produce technical and engineering products.

You should follow the advice of the manager coming to the conference.

All operators in the boiler room must follow safety regulations instructions.

22. Fill in the gaps, paying attention to the box, try to translate the sentences.

Should, can, might, may

1. A degree in engineering ___ go a long way, but it is also possible to become an engineer with a degree in math, physics or even computer science.
2. You ___ expect to take the following courses; algebra, geometry.
3. You ___ also need to take some computer programming or computer applications coursework.
4. With the heavy course load involved in an engineering program, you ___ come prepared.

23. Fill in the proper modal verb.

1. A power thermal engineer ___ go a long way, in order to become a specialist and occupy the position of the top manager.
2. The future engineer ___ take the following courses; algebra, geometry, trigonometry and calculus.
3. Depending on your speciality, you ___ to take some computer programming or computer applications coursework.
4. With the English course load involved in an engineering program, you ___ prepared.

READING

Text D

24. Complete the blanks in the diagram 1 using information about TPU from the text below.

SIBERIAN DIPLOMA

The Tomsk Polytechnic University is one of the oldest and largest technical universities in our country. It was founded in 1896. At first it was called Technological Institute. Since 1992 it has been called university. In 1996 it was given the status of especially valuable object of culture of Russian Federation. On the base of Polytechnic University over 20 higher educational establishments were arranged in the towns of Siberia. But it started on the 29th of April 1896 when Nicolai II signed an edict permitting the establishment of Technological Institute in Tomsk.

No other institute in the country can be compared with Tomsk Polytechnic University in training engineers for the industry of Siberia and Kazakhstan. Many of its graduates have become prominent scientists and public figures. Among them are academician M.A. Usov – the founder of Siberian Geological School, N.N. Semenov – the Lenin and Noble prizes Winner who developed the theory of chain reactions, K.I. Satpaev – former president of the Kazakh Academy of Sciences, N.I. Kamov – the chief designer of helicopters, N.V. Nikitin – the designer of TV tower in Ostankino, N.U. Urvantsev – the first prospector of ores in Norilsk area, academician Vinogradov – an outstanding mathematician, the Lenin and State prizes winner and others. In 1904 S.M. Kirov attended the Thechnological Courses at the Institute. Therefore in 1934 our Institute was called after his name.

Among the graduates there are over 300 academicians. Speaking of the staff of the University we cannot but mention the names of the three rectors and great scientists of the University – professors E. Zubashev, A. Vorobyov and Yu. Pokholkov. Talented organizers, they contributed much to the development and prosperity of the University. At present, Tomsk Polytechnic University includes eight institutes, eight faculties, three Research Institutes and other departments.

There are

- The Institute of Language Communication
- The Institute of Geology and Oil & Gas Industries
- The Institute of Distance Learning
- The Institute Cybernetic Centre
- Professional Development Institute

- The Institute of Electrical Engineering
- The Institute of International Education
- The Institute of Engineering Pedagogy
- Applied Physics and Engineering
- Electrophysics and Electronic Equipment Mechanical Engineering
- Chemistry and Chemical Engineering
- Thermal Power Engineering
- Economics and Management
- Humanities
- Natural Science and Mathematics Research Institutes; Nuclear Physics, High Voltages, Non-Destructive Testing.

The University Campus includes 19 laboratories and academic buildings. The Library resources total 2,7 million books of diverse kinds of literature. Our University numbers 1 994 research and faculty members; among them 1 449 instructors, including 174 Ds.Sc. and 803 Ph.Ds. Three of them are members of the Russian Academy of Sciences, 125 belong to Russian Academies of Public Professions and International Academies, three are winners of State awards, nine are holders of Governmental awards and two are laureates of Russian and international awards. Education is offered in 25 educational lines and 79 educational disciplines. There are 12 300 full-time students and 11600 students utilizing other educational forms. The main directions of the research activity correspond to careers education of our specialists. 70 educational programmes are offered to 580 postgraduates and 24 educational programmes to 50 doctorates. Ten academic councils for defending doctor's dissertations and four councils for defending candidate's dissertations function at the University.

The University intensively develops international ties. These include relations with scientific institutions in the USA, England, Germany, France, Japan, Cyprus, South Korea, China, India, Czech Republic and other countries.

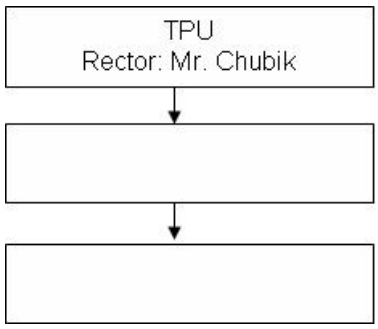


Diagram 1. *Structure of organization*

SPEAKING

25. Give a talk on the topic "I am a student of the Power Thermal Engineering Faculty" making use of the (diagram 1) above. Special attention should be given to describing responsibilities of the future engineer.

CONSULT your teachers of the faculty website to make your work complete and rewarding.

READING

Text E

26. Scan the text and find necessary information which suits to the power thermal engineering.

DEPARTMENT OF THERMAL ENGINEERING AND DESALINATION TECHNOLOGY

In the Kingdom of Saudi Arabia, the limited natural fresh water resources, the climatic conditions, the fast paced local industrial growth and the power generation to support desalination, air conditioning and industrial systems represent a major challenge, which thermal engineers have to face. This paved the way for establishing the Department of Thermal Engineering and Desalination Technology at King Abdulaziz University in Jeddah.

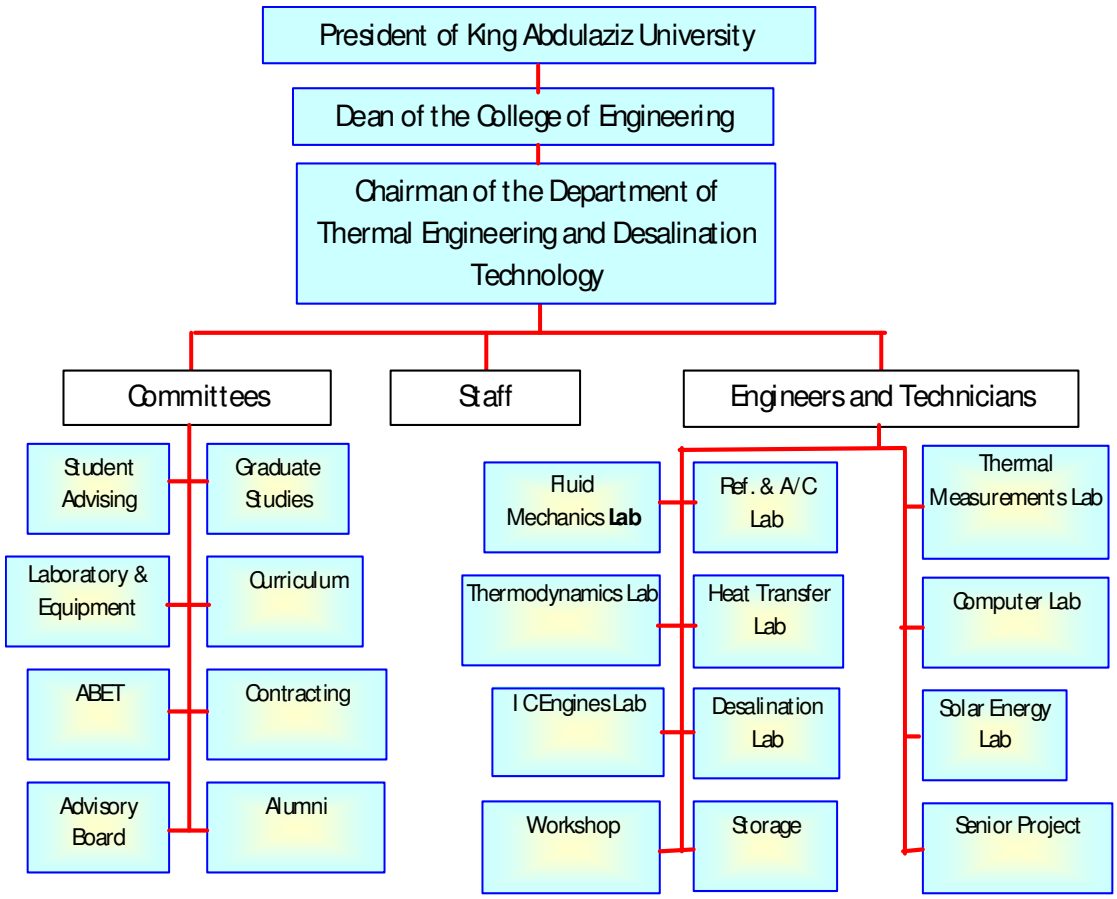
Thermal Engineering is a stimulating and very rewarding career in the field of Mechanical Engineering, with a large number of different pathways to be taken. It is however, a physically and emotionally demanding career, which needs to be entered into with care and thought after obtaining a realistic understanding of the skills of a thermal engineer, the conditions under which he works, the life style constraints of the profession and the necessary commitment to a lifetime of learning. The five-year Thermal Engineering and Desalination Technology program at King Abdulaziz University provides the knowledge, theoretical and practical skills, professional development and a commitment to lifelong learning, which enables a graduate to commence a career as a competent Mechanical Engineer.

The Department of Thermal Engineering and Desalination Technology offers a strong Mechanical Engineering Program with special emphasis on thermal applications such as refrigeration and air conditioning, desalination and energy conversion systems [1]. These areas have been emphasized in appreciation of their importance for the life, comfort and development of the people of the Kingdom and the neighboring countries.

A dynamic curriculum revision and upgrading system consistent with the development of technology, the needs of the country and local industry has been established in the Department. As a result, the changes made in the current study plan in comparison with the old one reflect the emphasis on the above-mentioned issues. The current study plan has been devised to provide our students with a state of the art education and training to enable them as graduates to practice engineering in the 21st Century.

Much learning takes place in the laboratory, including industrial training settings. A major emphasis is placed on developing effective engineering communication skills, decision-making skills and on becoming competent users of engineering information and computing knowledge. Students are offered a common advice about how their studies are progressing and are also encouraged and advised on how to maximize their learning.

Departmental Structure



WRITING

27. Make up a scheme of the power thermal engineering faculty, using the following words and phrases.

1. Thermal power engineering faculty
2. Nuclear and Thermal Power Plants (department)
3. Automation of Thermal Engineering Processes
4. Thermal Engineering
5. Thermal Physics and Hydromechanics
6. Steam Generators

READING

Text F

28. Scan the text that will help you to answer the following questions. For better understanding consult vocabulary notes below the text.

1. What is British English for resume?

2. What application documents are required of those who apply for a job?
3. What information should be listed in your resume?
4. What kind of impression should a resume make on the reader (the staff officer)?
5. What is the main objective of a resume?
6. Who is usually responsible for looking through resumes received by a company?
7. What kinds of sections does a resume usually consist of?

Writing a resume

When you are looking for a new job, you must prepare a short written account of your education and work experience. It is called «curriculum vitae» (also C.V) in British English and resume in American English [5]. Many companies expect all your personal information to be entered on a standard application form. Unfortunately, no two application forms are alike, and filling in each one may present unexpected difficulties. Some personnel departments believe that the resume (CV) and application letter give a better impression of a candidate than a form.

The resume that accompanies the letter provides an overview of what you have already done. The resume should create one dominant impression: that you are a highly motivated person who has the ability and maturity to do a job well. Before you compose your resume list all of the pertinent information about your education, your job experience, your goals and your personal interests. Then select the information that is appropriate for the job you want emphasizing the accomplishments that differentiate you from other candidates. If you have received academic honors or awards, or you have financed your own education, include this information as well.

Remember, the resume is a screening device. Big corporations get hundreds of thousands of them every year. The personnel manager or the staff officer has to read a lot of them a day. So you have got ten, may be twenty seconds, to show him/ her that your resume is worth a second look.

There is no single correct format for a resume (curriculum vitae). Whatever its layout it should be brief - one or two pages are sufficient - easy to read and well organized. An employer should be able to see at a glance what your qualifications are. Many resumes contain the following sections: personal information, education, languages you speak (if necessary), work experience, interests, refers.

Vocabulary notes

a short account	a short description = overview
resume ['rezjumei]	CV
to create an impression	to produce / to make an impression (on smb)
impression	effect that is produced in the mind by a person, event
experience, etc. e.g.	strong
wrong	not correct

favorable	beneficial, positive
good	approving
pleasant	lovely, enjoyable
erroneous e.g. She created the erroneous impression that her family is wealthy.	wrong, incorrect
highly motivated e.g. He is highly motivated by work.	oriented
to list	to put or include in a list
goal	aim, purpose
appropriate	suitable
accomplishments	achievement
academic honors or awards	reward
a screening device	
sufficient	as much as is needed for a purpose
at a glance	at once, with one look
qualification(s) and gained a certain level of knowledge	proof that one has passed an examination

LISTENING

29. Listen to the text "Vernadsky's curriculum vitae" and write it.

1. What is the biggest challenge facing the power thermal industry today?
2. The power thermal industry has met a global demand in developing new sources of energy and delivering it the market, hasn't it?
3. What engineering skills are available in order to attract the problem today?

SPEAKING

30. Discuss in groups the "pros" and "cons" of foreign educational system in the sphere of preparing engineers and the educational system of Russian higher technical school. Present the project "Me and my speciality". You can use the information from the texts above.

31. Role-play:

A. You are going to plan your career as a future engineer present some steps of it. What is it necessary to do at first, second and so on? Discuss the CV's steps with your group mates.

B. You have an experience of operating engineer at the power thermal station. Share your opinions with the colleagues. Present your CV.

UNIT 2. JOB APPLICATION

Grammar: Participle
Speech strategy: Hiring, job application

1. Warming up activity: Look at the diagram and speak with the partner "What is hiring?", "Who are we hiring?"

2. Skim the following text and answer the questions:

1. Might be pay levels controlled in challenging times?
2. When are employers eager to pay above and beyond the market average?
3. Why did a global oil and gas company hire a business-development executive at a salary "significantly above the market average"?
4. Is interviewing for a job today a significant process?
5. What is necessary to know in order to start negotiating salary?
6. Does diligence and the scope of responsibilities affect the salary?

READING

Text A

NEGOTIATING SALARY IN TOUGH TIMES

You've prepared for your next job interview by researching the company, brushing up on your sales pitch and pressing your suit. But one key task remains: Figuring out what to expect in compensation.

In a tough economy, you don't have a lot of wiggle room when it comes to negotiating base salary, says David Wise, senior consultant at Hay Group Inc., a management-consulting firm [6]. In fact, pay levels might be even more scrutinized and closely controlled in challenging times.

But, just like with any rule, there is an exception: If you have the kind of skills that are in short supply and are critical to a business's bottom line, employers are often willing to pay "above and beyond the market average," says Ravin Jesuthasan, a practice leader at Towers Perrin, a Connecticut-based consulting firm.

Employers are also increasingly sweetening job offers for high-demand jobs with benefits previously reserved for already employed workers, such as flexible schedules and work-from-home arrangements, says Kenan Abosch, leader of the compensation-consulting practice at Hewitt Associates Inc., a provider of human-resources services based in Illinois. "If a company has someone they're really hot to get, because it's a pivotal role, they'll go the extra mile", he explains.

Are you in demand? The answer varies by industry. For example, executives with global sourcing experience are highly sought after at consumer-goods companies, because more employers are outsourcing their manufacturing overseas. And risk managers are on the most-wanted lists of food concerns due to recent historic increases in commodity prices.

Max Donley, vice president of human resources at MedImmune Inc., says "compensation [restrictions] would be taken off the table" in negotiations for senior director of cancer biology, a job that has been open for six months. "It's a very high demand position in the bio-tech industry and very few people have the skills", he says.

A global oil and gas company recently hired a business-development executive at a salary "significantly above the market average because of his exceptionally strong negotiating and selling skills", says Michael Wing, a recruiter for executive-search firm Loewenstein & Associates Inc. in Houston.

If you have a unique background, be sure to highlight that in your resume and cover letter, advises Mr. Abosch. "Make it easy for an employer to spot", he says. "Interviewing for a job today is as much about marketing as it is about background and experience", he says.

But what if you lack the kind of expertise that employers are bending over backwards for? To gain negotiating leverage, you first need to understand how salaries are set. Employers typically start out by reviewing pay surveys from consulting companies and executive-search firms, says David Insler, a senior vice president at Sibson Consulting, which specializes in human-re-sources, benefits and compensation consulting. (Sibson does not collect or sell pay data.) If you're eager to get your hands on the surveys employers use, pre-to pay a bundle-and far more information you probably need. If you did get a coveted peek, bear in mind that employers mainly use the market averages shown in survey data for

benchmarking against a candidate's current pay, says Mr. Wise. "Most [employers] start with what you're making now and provide something above that to entice you", he says. If you're making a lateral move, expect something between what you make now and a 10% increase, Mr. Wise says.

Another trick job-seekers can use is to do their due diligence on a job's size, based on the scope of its responsibilities, says Mr. Wise. "The bigger job is the one that's going to receive more pay".

VOCABULARY

3. Try to remember the words and use them further in your speech.

job interview	put questions to applicant
figure out	determine
tough economy	hardened economy
base salary	wage
management-consulting firm	company involving into consulting services
flexible schedules	pliant schedules
reserved benefits	reserved perks
to be in demand	to be popular
hot to get	desirable to get
Global sourcing experience	world-wide sourcing experience
the most-wanted lists	significant list
bio-tech industry	sphere of industry connected with biology
significant salary	attractive salary
strong negotiating	serious negotiating
sell skills	present skills
unique background	profound knowledge
negotiating leverage	negotiating ways
entice	tempt
the scope of responsibilities	the sphere of responsibilities

4. Match the words (1-9) from one column to the words (a-i) from the other column.

1. remain	a. wait for
2. figure out	b. work
3. scrutinize	c. required
4. job	d. wage
5. critical	e. point out
6. expect	f. stay
7. salary	g. investigate

8. pivotal 9. seek	h. find i. central

5. Rearrange the sentence.

you**,** a unique, background, to, highlight, in, your, resume, that, If, and, letter, cover

6. Match the words (a-i) from one column to the words (1-9) from the other column.

a. consumer	1. level
b. pivotal	2. goods
c. pay	3. salary
d. highly demanded	4. responsibility
e. human	5. background
f. market	6. resources
g. unique	7. job
h. review	8. role
i. scope	9. company

SPEAKING

7. Make up sentences using the word collocations above.

E.g. If you have a unique background and professional skills you will be demanded on the labor market.

8. Try to produce a talk on the following points.

Discussion points

1. Job seekers can use their diligence on a job's size based on the scope of its responsibilities. Is it a possible step to get an attractive salary?
2. Why do you think it is necessary to highlight a unique background in your resume and cover letter?
3. Finding an attractive job is necessary to have strong negotiating and the ability to sell brains and skills.

READING

Text B

9. Scan the text and entitle it.

Thermal Energy International Inc. is pleased to announce the establishment of ForEverGreen Energy Inc., a green energy services subsidiary. ForEverGreen Energy Inc. will own and operate Thermal Energy assets to be used under the

Thermal AUD(TM) (Alternate Utility Delivery) program, which will let Thermal Energy's customers benefit from energy savings without capital investments.

Thermal Energy will derive revenues from the sale of assets to, and investments in ForEverGreen. "The creation of ForEverGreen is a very important step in diversifying Thermal Energy's business from individual sales to long-run, multi-year profits from assets owned by this energy services company," said Thermal Energy President and CEO Tim Angus, who will also be president of the new company.

The Thermal AUD(TM) offering through ForEverGreen provides customers with a risk-free way to generate immediate energy savings and positive cash flow from operations starting with the first day of the agreement, all without any up-front or large capital investments. It provides a further opportunity for customers to meet or exceed emission reduction targets and achieve energy reduction targets, while preserving capital for other projects.

"ForEverGreen and Thermal AUD(TM) represent excellent value and opportunity both for our customers and shareholders", said Denis Forget, recently appointed as Thermal Energy's Chief Operating Officer ForEverGreen's Board of Directors comprises Mr. Angus, Mr. Forget, TEI Chairman John Parker and Director Clint Sharples and Mr. Jean H. Paradis. Mr. Paradis, who has been retained by Thermal Energy for business development and as project finance director has more than 40 years experience in start-up, development and management of major engineering and construction companies providing global services for design-build, finance and operation of projects [7].

He is the former president of Montenay Inc. in Canada (now a subsidiary of Veolia Environmental Services) and has worked in senior and executive capacities with Pricewaterhouse Coopers, the SNC Group (now SNC-Lavalin) and other engineering firms.

VOCABULARY

10. Learn the words.

to announce	to declare
establishment	setting up
subsidiary	affiliate
operate	produce
benefit	perks
revenue	income
important	main
company	firm
agreement	contract
provide	give
target	aim

opportunity	possibility
construction	building
global	international

11. Fill in the gaps with the words from the brackets in a proper form.

1. Thermal Energy International Inc. is pleased to announce the _____ (establish) of ForEverGreen Energy Inc., a green energy services subsidiary.
2. Thermal Energy _____ (derive) revenues from the sale of assets.
3. The company _____ (provide) a further opportunity for customers to meet or exceed emission reduction _____(target) and achieve energy reduction targets.
4. Mr. Paradis, who has been retained by Thermal Energy business development and as project finance director has more than 40 years experience in start-up, development and management of major _____(engineer) and construction companies ____(provide) global services for design-build, finance and operation of projects.

SPEAKING

12. Discuss in pairs professional companies mentioned in the above text, their profile and their completion on the global market.

LANGUAGE BOX

I think, as far as I can see, to my personal opinion, in general, frankly saying

READING

Text C

13. Skim the text about Thermal Energy and extract the information about the company and its profile.

Thermal Energy International Inc. is an innovative technology company providing custom energy and emission reduction, and bioenergy solutions. Headquartered in Ottawa, Canada, TEI is a designer, design build developer, fabricator, owner, operator and supplier of proprietary and patented energy conservation, renewable energy and environmental technology solutions, and offers advanced process and applications engineering services. The Company is a proud member of the Chicago Climate Exchange. Company is a trademark of Thermal Energy International and is used under exclusive license from Gardner Energy Management Ltd [7].

VOCABULARY

14. Find equivalents from the texts B, C.

1. Теплоэнергетическая международная корпорация
2. Открытие дочерней компании
3. Владеть и оперировать основными средствами
4. Капитальные вложения
5. Извлекать выгоду
6. Выгода, доход, прибыль
7. Развитие и управление
8. Энергосбережение
9. Инженерно-строительные компании
10. Инновационная технология
11. Штаб-квартира
12. Уменьшение тепловых потерь
13. Высокотехнологичный процесс

15. Make up sentences using the word-combinations.

1. Establishment of the company
2. Operate assets
3. Energy service company
4. Provide opportunity
5. To meet targets
6. Shareholders
7. Finance director
8. Subsidiary company
9. Start up development and management
10. Headquarter
11. Trademark

16. Answer the questions about the text "Thermal energy".

1. What is the thermal energy company?
2. Thermal energy is innovative technology company, isn't it?
3. Is it situated in Canada?
4. The company is engaged in energy savings, emission reduction and bio-energy solutions, isn't it?
5. Is Thermal Energy a fully accredited professional engineering firm?
6. Give some arguments to prove it.

WRITING

17. Draw a scheme of the Thermal Energy Company and discuss the profile of the company with group mates.

READING

Text D

18. Scan and entitle the text.

Power thermal engineering is a subset of general engineering [2]. Engineers use science and mathematical principles to solve technical problems. Since they often create new products to solve these problems, they are in high demand.

Engineers are essentially inventors. By dreaming up ideas and turning them into a reality they push technology to its limits. Therefore, there is a great deal of prestige to be gained by becoming an engineer.

Power thermal engineers are specialized engineers who work with mechanical devices. These may include elevators, refrigeration and air-conditioning equipment, robots and electric generators. Power thermal engineers design tools used in other engineering disciplines.

As you can imagine, power thermal engineering is one of the broadest engineering specialties.

SPEAKING

19. You are at a job interview. What information do you think the interviewer would want from you and what questions would you ask? Use the key words below to form questions as in the example.

LANGUAGE BOX

Qualification, experience, working hours, overtime, shifts, requirements, strength, weakness, salary, CV.

Interviewer: What relevant experience do you have for this post?

Getting a job	job qualities and experience
Job post	be efficient, be adaptable, be creative
Advertise job	be easy to get on with, have good qualities
Prepare CV	have a degree in, be able to work under pressure
To attend an interview	have the right experience
Interview someone for a job	offer a job

READING

Text E

Document study: An application letter and curriculum vitae.

20. Work through the letter of application and the curriculum vitae [8] that follow it. After you have skimmed through the documents give your opinion about the following.

1. Do you think the applicant is suitable for the job she is seeking (looking for)?
2. What are her merits (advantages)?
3. Is she likely to get the job?

4. What impression did the applicant make on you? Is it favorable or unfavorable?

21. Consult the dictionary if you have difficulty in understanding the documents.

Julia Glazer 16,
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Leeds LS 3 LDY (L52 8BL)
United Kingdom
Tel: (UK) 0113-2442504
Fax: (Germany) 07472-23867
e-mail: law 3 j h @ uk.ac.leeds.
novell.lucs-01
7 February 1997
Dear Sir/ Madam,

May I introduce myself to you? I have studied at Gottingen and Leeds Universities and now I am a final year student at Leeds University, where I will graduate in July 1997. I would like to spend next year improving my Russian, therefore I would like to stay in Russia for some time. I have learnt Russian for about five years in evening classes once a week at University.

Since I am bilingual in both English and German (I grew up and was educated in Germany), I thought I might use these language skills to teach. Would you require someone as a language and teaching assistant in your foreign languages department?

As to my qualifications and previous work experience, I will have an English law degree and if it was necessary, I would get the TEFL (Teaching English as a Foreign Language) qualification after a one month course, which I intend to do over the summer. I have taught German in exchange for French and Russian to foreign students at Gottingen University in Germany and I had plenty of opportunity to practice my communication and translation skills.

I would be very grateful if you could offer me such work, even on a semi-voluntary basis.

Yours faithfully Julia Glazer.

CURRICULUM VITAE

NAME:	Julia Glazer
DATE OF BIRTH:	06/12/71
NATIONALITY:	German
MARITAL STATUS:	Single
PERMANENT ADDRESS:	Mauerstrafie, 7272 159 Neustetten 4, Germany
CURRENT ADDRESS:	Cookridge Street16, Leeds L52 8BL UK
EDUCATION:	

1. School

1983-1993 Eugen Bolz Gymnasium
Rottenburg, Germany School - leaving examination results (in 1993):
-overall qualifying mark: 1.1 (top 5%)
-exams in Maths, Chemistry, History, English, Latin

2. University
   a) September 1993 - October 1994 - Gottingen University
   b) Since October 1994 – Leeds University - law student
      first year results – 73% – 70%, second year results – 68% – 60%

LANGUAGES:

1. German (mother tongue)
2. English
3. French (7 years at school, advanced level)
4. Russian (upper intermediate level)

WORK EXPERIENCE:

1. June-Sept.1993,Himmelwerk,Kilchberg.
   Position: assistant accountant in a medium - sized firm.
   Skills: computing skills; given tasks to work on independently, I was left on my own to find my way through various computer programmes.
2. Sept. 1994- March 1995-Social Services, London Borough of Greenwich.
   Position: community Services Volunteer, personal care assistant; this involved caring for a physically disabled lady.
   Skills: I had to cope with long hours and almost no spare time for myself; the commitment and responsibility involved were a very valuable experience.
3. August- Sept. 1995 - German Embassy, Washington DC, USA.
   Position: internship at press office. This involved teamwork, helping to produce press releases and to organize press conferences, answering phone calls and letters, news presentations at the morning conferences, weekend duties (replying to letters and complaints, legal research, translating).
   Skills: I improved my communication and presentation skills in public relations duties. I had to deal with vast amount of text and paperwork.

INTERESTS: Travelling, horse-riding, river-trips

REFERENCES:

1. Dr H. Storey, Leeds
2. Mr. W. Hinds Law Faculty, Leeds, 3423

22. Completing an application form.

READING

Text F

23. Skim the text that will help you to answer the following questions.

1. If you want to put in your application for employment or studies abroad, what sort of documents do you have to submit to the selection committee or board?
2. Should you follow any rules when completing an application form?
3. What should be translated directly from your native language into English when filling in an application form?
4. Why do you think the 'statement of purpose' section is a very important part of your application?

If you are going to apply to a training programme or to request employment [8] (or to pursue a specific career) you must have some practice in completing an application form. You have to practice the vocabulary that will help you to read all instructions and information correctly before completing the application.

Neatness is important. Every question must be answered completely and carefully. Before filling in (filling out - AmE) the original application you have to answer the questions on a separate sheet of paper. All forms in the application are to be completed in English and must be typewritten or hand printed in black ink.

The supporting documents submitted together with the application usually include letters of recommendation, certified transcripts in the native language and English, certified copies of all diplomas in the native language and English, financial and eligibility form and resume.

There are certain rules and accepted principles you have to observe when completing an application form:

1. Write your full, legal name and underline your family name (surname). Do not translate your name into English. For example, 'Maria' should be written as such and not translated as 'Mary'.
2. Write your current job title and state the type of organization that employs you. For example, a person who works for a joint venture would write, 'Marketing Director, Joint Venture'. Applicants who are currently studying full-time at a university or institute would write 'Undergraduate student' or 'Graduate student' and give the name of the university, institute or academy they are enrolled in.
3. Write your complete mailing address. Be sure to include your postal index. Do not translate street or city names into English.
4. When writing about your education, list all educational institutions you have attended, beginning with the one you attended most recently. Translate directly from your native language into English all words pertaining to your education. DO NOT USE BRITISH OR AMERICAN EQUIVALENTS. In other words, do not write 'Bachelor's Degree' or 'Master's Degree'. Degrees should be translated as 'Attestat', 'Diplom' and 'Kandidat Nauk', etc.
5. To calculate your overall qualifying marks (Grade Point Average - AmE), you sum up the marks you received during the period of your study at each institution and then divide that sum by the total number of courses.
6. The statement of purpose is very important part of application, since it will explain to the selection committee or board why you are applying for the type of programme or the type of job you have selected, in your statement of purpose you should explain your interest in the field of specialization or area of employment, your future plans and career goals.

WRITING

24. Using information of the above texts try to write the accompany letter.

LANGUAGE BOX

To arrange (meetings/conferences/shows)

To work out arrangements for (meetings/presentations/press conferences)

To be successful in meetings/conferences

To arrange for (an interview/an appointment)

To analyze/examine (the market for producing power thermal equipment)

To apply (new ideas to practice/theory to practice/new developments to practice)

To deal with, to handle, to perform one's duties, to be concerned with

LISTENING

25. Listen to the dialogue "Applying for a job" and fill in the gaps.

Interviewer: Come in. Please sit down. It's Miss Wallace _____?
Miss Wallace: Yes, that's right. Good afternoon.
Interview: Good afternoon.Well, I've looked through your application. Can I just check the information?
Miss Wallace: Of course.
Interview: Now, you are 22 _____?
Miss Wallace: Yes, I am.
Interviewer: You aren't married _____?
Miss Wallace: No, I'm not, but I'm engaged.
Interviewer: You didn't go to technical college or university _____?
Miss Wallace: No, I didn't.
Interviewer: But you learned to type at secondary school, _____?
Miss Wallace: Yes, I did.
Interviewer: You can speak French and Italian, _____?
Miss Wallace: Yes, I can, but I can write them better than I can speak them.
Interviewer: I see. You've been to Switzerland, _____?
Miss Wallace: Yes, I have. And Italy.
Interviewer: And you can take shorthand, _____?
Miss Wallace: Yes, I studied at school.

26. Read the text. Are the following statements true (T) or false (F).

1. Graduates holding technical degrees usually avoid improving their business

knowledge further and earning an MBA.

2. Management positions at senior level are often filled with MBA graduates.
3. People usually begin to study for an MBA immediately after graduating from university.
4. To complete an MBA programme one has to write a dissertation.
5. Successful career in management is only based on successful completion of an MBA programme.

Key to terms and abbreviations

Graduate – a person who has completed a university degree Degree – a university diploma BA – Bachelor of Arts degree (usually gained after four years at university) BSc – Bachelor of science degree (GB) BS – Bachelor of science degree (US) MBA – Master of Business Administration

27. Skim the text and discuss in groups what MBA is and why it is so important nowadays.

WHY AN MBA?

There are now over thirty to forty thousand MBA students in the UK and annual output from business schools is approximately 9.000. Increasing number of graduates with technical degrees or traditional professional qualifications want to move into general management but do not possess the basic skills, while others want to broaden their business and commercial understanding.

The MBA, a postgraduate degree, is fast becoming established as a necessary condition for a career in management. Research carried out by the Association of MBA in 1977 found that 20% of members hold board directorship, an additional 27% are employed at senior and management level.

Basically, the MBA is designed to expose individuals to the full range of skills required for general management or for functional management. MBA's are among the better qualified graduates. With regard to original disciplines of study, the largest group is those who studied engineering for their first degree (BA, BSc, BS) followed by those who graduated in science.

The average age of a full-time MBA candidate is 27 years old on commencement of study, and the average part-time student is usually 32 years of age. Business schools are offering MBA programmes [9] which reflect the needs and realities of business and industry.

The taught programme consists of subjects essential for understanding the operations of any enterprise. These are usually Accounting and Finance, Qualitative analysis, Economics, Marketing, Organizational Behavior, Human Resource Management, Information Technology and Strategy. Usually, the programme culminates with a dissertation or a company-based project.

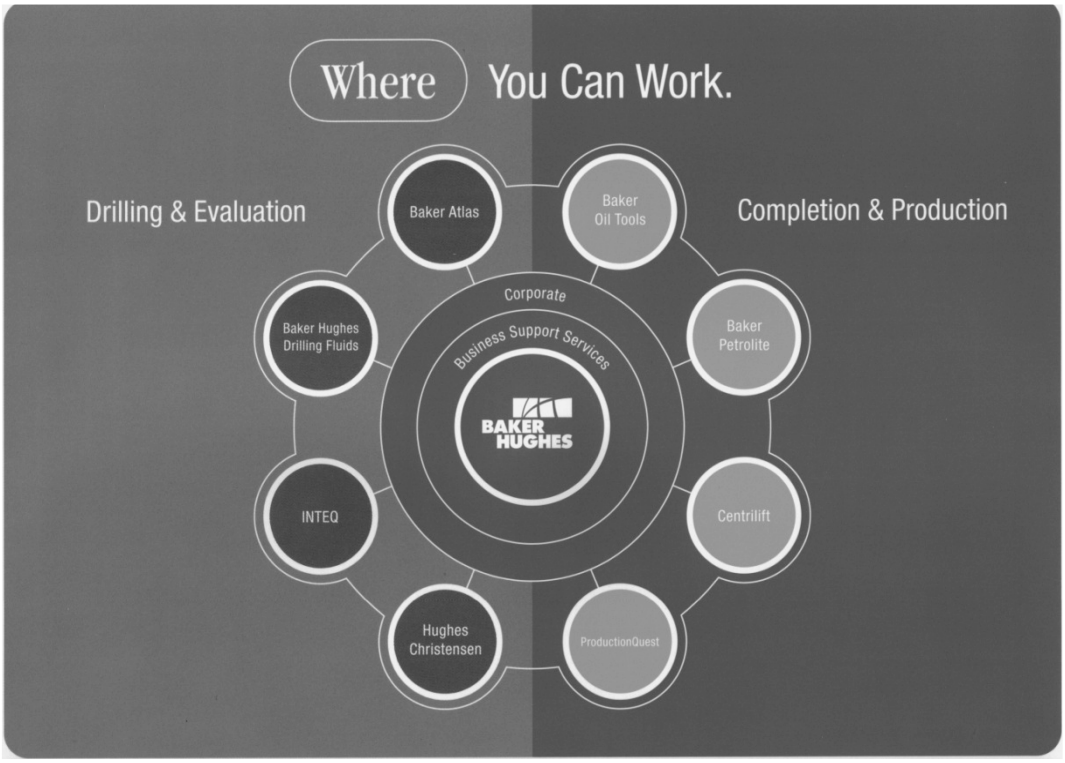
Since most people take an advance their careers in the long term, employer perception is crucial.

SPEAKING

28. Transfer situations: Work in a group.

Give the opinion about the acting company (observe the scheme). Talk about the profile of the company, its departments and relations between them. Draw a scheme of the power thermal engineering company and discuss the company problems, the working conditions and the profit.

E.g. – I think we have to change the structure of the company.
– Why do you think so?
– The working conditions are not very good.



29. Scan the text [10] and do the tasks after it.

EFFICIENCY IN FREE ENGINEERING

Unlike the scientist, the engineer is not free to select the problem which interests him; he must solve the problems as they arise and his solutions must satisfy conflicting requirements. Efficiency costs money, safety adds complexity, performance increases weight. The engineering solution is the optimum solution, the most desirable end result taking into account many factors. It may be the cheapest for a given performance, the most reliable for a given weight, the simplest for a given safety or the most efficient for a given cost. Engineering is optimizing.

To the engineer, efficiency means output divided by input. His job is to secure a maximum output for a given input or to secure a given output with a minimum input. The ratio may be expressed in terms of energy, materials, money, time or men. Most commonly the denominator is money; in fact, most engineering

problems are answered ultimately in dollars and cents. Efficient conversion is accomplished by using efficient methods, devices and personnel organizations.

The emphasis on efficiency leads to the large, complex operations which are characteristic of engineering. The processing of the new antibiotics and vaccines in the test-tube stage belongs in the field of biochemistry, but when great quantities must be produced at low cost, it becomes an engineering problem. It is the desire for efficiency and economy that differentiates ceramic engineering from the work of the potter, textile engineering from weaving and agricultural engineering from farming.

Since output equals input minus losses, the engineer must keep losses and waste to a minimum. One way is to develop uses for products which otherwise would be waste. The work of the chemical engineer in utilizing successively greater fractions of raw materials such as crude oil is well known. Losses due to friction occur in every machine and in every organization. Efficient functioning depends on good design, careful attention to operating difficulties and lubrication of rough spots whether they may be mechanical or personal.

The raw materials with which engineers work seldom are found in useful forms. Engineering of the highest type is required to conceive design and achieve the conversion of the energy of a turbulent mountain stream into the powerful torque of an electric motor a hundred miles away. Similarly many engineering operations are required to change the sands of the seashore into the precise lenses which permit us to observe the microscopic amoeba in a drop of water and study the giant nebula in outer space. In a certain sense, the successful engineer is a malcontent always trying to change things for the better.

Notes:

1. torque: combination of forces producing a rotating or twisting motion.
2. amoeba: single – celled life – form having no definite shape.
3. malcontent: a person who is never satisfied with what is achieved.

30. Tick the sentences true (T) or false (F).

1. The engineer is free to select the problem which interests him.
2. Efficiency costs money, safety adds complexity and performance increases weight.
3. Engineering is not optimizing.
4. Efficient conversion is accomplished by using efficient methods, devices and personnel organizations.
5. The emphasis on efficiency leads to the large complex operations which are characteristic of engineering.
6. Efficient functioning doesn't depend on good design, careful attention to operating difficulties.
7. The engineer must not keep losses and waste to a minimum.
8. The successful engineer is a malcontent always trying to change things for the better.

31. Translate the following sentences.

1. The engineer is not free to select the problem which interests him; he must

solve the problems as they arise.
2. The engineering solution is the optimum solution.
3. Engineering is optimizing.
4. To the engineer, efficiency means output divided by input.
5. Efficient conversion is accomplished by using efficient methods, devices and personnel organizations.
6. The emphasis on efficiency leads to the large, complex operations which are characteristic of engineering.
7. The engineer must keep losses and waste to a minimum.
8. Engineering of the highest type is required to conceive, design and achieve the conversion of the energy of a turbulent mountain stream into the powerful torque of an electric motor a hundred miles away.
9. The successful engineer is a malcontent always trying to change things for the better.

32. Match the synonyms from the column A to the column B.

A	B
1. Solve	A. Appear
2. Arise	B. Decide
3. Solution	C. Hopeful
4. Factor	D. Demonstrate
5. Reliable	E. Finish
6. Express	F. Get
7. Accomplish	G. Do
8. Produce	H. Machine
9. Achieve	I. Decision
10. Motor	J. Sign

WRITING

33. Write five sentences incorporating these words.

34. Often the same base can be used in verb, noun, and adjective form. Complete the following chart with the missing noun and verb forms.

Verb	Noun	Adjective
change		
	solution	
		operative
	desire	
express		
		productive
	success	

SPEAKING

35. You are a future power thermal engineer. Discuss in pairs what is

engineering, what qualities does the engineer posses in order to be successful.

Discussion points

1. Explain clearly and as fully as possible, why is the engineer not free to select the problem which interests him?
2. What does efficiency mean to the engineer?
3. Give clear illustration of the emphasis on efficiency. What does efficient functioning depend on?
4. Find the lines in the text which give us information that any problem involving the low – cost production of large quantities of any item is an engineering problem even if the item itself originated in the work of other disciplines. Explain how any given result of (a) medical research, (b) agricultural research, (c) nuclear physics, (d) optical research is likely to need solutions requiring the skills of an engineer.
5. Explain in details why:
   a) “efficiency costs money”;
   b) “safety adds complexity”;
   c) “performance increases weight”.
6. You have read that engineering solution to most problems is the “most desirable end result taking into account many factors”. Does this apply to your own discipline? If so, explain in what way.
7. What do you understand by the definition “engineering of the highest type”?
8. What is your opinion with regard to the last sentence in the text, that “the successful engineer is a malcontent always trying to change things for the better”?

36. Scan the text [11] and determine what careers are available for you as a future engineer.

CAREER’S ADVICE

The first thing you have to be sure about is just what you want from a job, what you're good at how you like working, what your goals are. Some people are more the "investigative" types - geologists, health sciences, engineers most of the sciences. Others are more "hands on" kind of people. Materials on that will be over here. More of the engineering people, it's called "realistic," it's "hands on" deals with the product has a tangible outcome. The other people are more intangibly oriented, interested in ideas, seeing what happens, theoretically oriented. You can use, like this sort of thing, it's a page which describes the personality types so you can find out what your objectives are.

Over here there are directories the people use to locate employers and find possibilities. We have salary surveys. This one is a College Placement Councils survey and this is done every quarter so it is good. And these are offers, so it's not something a student has made up, it's what the company actually offered.

This computer has job listings on it and they come in by way of the modem at least once a week. More job listings here, in this section of the library. Here are scientists other than engineering and we have engineering here. And this is mate-

rial from employers who are coming here to recruit on campus, background on the companies etc. You asked me about prospect for women in the sciences. Women have done comparatively pretty well in the technical areas. But I think that in terms of on the job, their experience is not equal. I think they probably feel harassed in some cases and have a difficult time in some of the male dominated jobs. People will probably say it depends on their attitude and a number of other things, but I think it's not easy for a woman still in some of the technical fields.

Other problems? In terms of ageism, that's probably been harder to describe because usually people are not competing for the same positions at different ages. It' not readily apparent. However the current recession has created a difficult situation. We have a lot of engineers with loads of experience out looking for jobs and at the same time we have new people and I think sometimes the employer will hire the new person because they can hire them cheap and get them to do the work whereas if they try to do that with someone more experienced, they'll get pushed all the time to increase their salary.

Trends? There's less loyalty than ever employers are rapid to let people go if they really don't need them it doesn't matter who they are or what their field is, so there is not a lot of job security where there once was and engineering has probably never enjoyed enormous amounts of security anyway. They work out a contract with a group of people and when the contract is over, they let them go, so that's not entirely new, but it's happening in other fields like IBM and other large technical firms are all of a sudden doing that.

The easiest way to understand Affirmative Action is that we are trying to make opportunities for people who haven't had them historically and that means gathering a large enough pool of people from under-represented groups and doesn't mean that all things being equal, that you choose from the under-represented group if there is someone qualified. I think it's fraught with all kinds of problems. I think it'd be difficult to make that policy work real well. It has some merit, no doubt and it also has some difficulty in making it work on a day-to-day basis without winding up discriminating in another way. I think probably the most curious part of it to me now is that I hear white males singing the "poor white me" kind of problem. I think the reality is that they are not being discriminated against in any situation. Well, certainly you can find individual cases, but they still have many more opportunities as a class than anyone else. I think some people are stirring the pot trying to make it look much more serious.

A college degree is an investment in oneself. If someone is looking at college for only the engineering background they will gain, it's probably a mistake. Monetarily it's worth about 50 percent more than if you didn't go to college and in a technical field probably more than that, but there's more to it than that. Technical people have most difficulty with communication skills. Frequently people choose technical fields, when they're not real skilled in social skills, may be in language sometimes and it is going to be easier to hide out in the lab or somewhere else so they're not building some of those skills that are so useful. People in the technical areas would do well to look down the road and see that most of the work they do is going to have to rely on their ability to communicate with others and describe the problems, to share solutions, ideas and come up with creative solutions.

How to avoid making terrible mistakes? People fear mistakes and don't do anything sometimes, but almost anything you do is going to be a learning experi-

ence. It's kind of like looking at your feet and saying "I have a wrong foot and a right foot" but we actually have left feet and right feet and when you're on your left foot you learn something. Trying things out is probably better than doing nothing. You learn from it and you're ready to make headway from that.

Discussion points

1. According to the classification of the abilities given in the passage say what kind of man you are.
2. Tell about your own experience if you have ever searched for a job. Was it through the agency or by yourself?
3. Are there any preferences in age or sex in the employees market of our country?
4. Do you agree that technical people have got some difficulties in communicating and learning languages? If so, what is your attitude to the experiment on teaching languages in TPU?
5. What problems of a general kind might be met by the specialists while they are planning their career? You can easily find them in the texts of the unit.

Discussing the topic "Job satisfaction"

37. Work in pairs or groups. Arrange "job satisfaction features" in the order of importance. If you have good grounds for this or that arrangement produce them participating in discussion. Make use of the relevant "features" and appropriate expressions for discussion from the boxes below.

Being able to learn new things Earning plenty of money Being part of a team Meeting people through work Having pleasant colleagues Being praised by my superiors or bosses	A pleasant working environment Using a foreign language Financial independence Good chances of promotion Professional growth Being a boss/exercising power Status of my organization
The most important thing for me is… The second important thing for me is…. I don't consider this aspect of my future job very important because….. I'm afraid you are mistaken/wrong when you say that…. I think your opinion is absolute nonsense because…. It matters very little for me…. It matters very little in my job…. …. is less significant than…. …. is more significant/ more important than…. I don't attach too much importance to…	

38. Part of any job interview or any talk to a counselor in a job agency is centered round job satisfaction or job dissatisfaction. Working in pairs, make conversation in which (A) is trying to find out reasons for changing

the job or job preference while (B) is giving his/her explanations (The situation may be real or imagined). First make sure you are familiar with the relevant active vocabulary, then talk on the topic using prompts in columns (A) and (B).

Key vocabulary

Promotion, chances of promotion, prospects of promotion
Great/heavy responsibilities, is responsible for…
Independence, making independent decisions
Challenging job, job is challenging
Varied/exciting/job experience
Demanding boss/ manager
Monotonous/boring job
To work long hours
Exciting experience
Creative abilities
Interesting job
Demanding job

(A)	(B)
1. Why did you change your job? Didn't you like your job? Why? Why did you leave the company for which you worked so long? Why did you leave your job? What didn't you like in your job? Did you become too boring, too monotonous? Were there any prospects of promotion in the company you worked for? 2. Do you like working: In a team? Alone? Indoors/outdoors? With computers? Long hours? In a big company? 3. What kind of job do you think is suitable for you?	1. I had to change my job because: There wasn't inner freedom; The salary was… The working hours were… The journey to work was… The job was too… My responsibilities were too… I was responsible for too many… I wasn't earning a good… The money wasn't good enough; I didn't have enough free time… I didn't have enough responsibility. 2. Yes, I do/No I don't like. I like/I don't like being away on a business trip (at least once a month/ every week/twice a month) I'd like to: Start my own (advertising); Company/ my own business; Do consultancy work in computers; Have a lot of responsibility and

What job suits you best?	a lot of freedom. 3. I enjoy: Having responsibility for… Taking decisions on my own; Having more independence; Working in a small-sized company; Working with computers; Working in a team; Doing a challenging job
I**nvent:** Push yourself to create innovative ideas Develop the path to the future you desire **Explore:** Experience innovation with the best minds of the industry **Achieve:** achieve a fulfilling career of which you are proud	

LISTENING

39. Listen to the text "INSPIRING THE NEW GENERATION" and cover the questions.

1. What is the biggest challenge facing the power thermal industry today?
2. What skills are necessary to have for modern engineer in order to meet demands of thermal power industry?
3. Do people have responsibility for all the problems associated with energy?

GRAMMAR BOX

The Participle is a non-finite form of the verb having the function of the verb and an adjective.

Participle I (Present participle) **-ing** Non-finished process In the sentence it can be	**Participle II** (Past participle) **-ed$_{2,3}$** Finished process In the sentence it can be
-adjective (причастие, стоит либо перед существительным, либо после него) A **fading** flower lies on the table.	**-adjective** (причастие) **Lost** time never comes again The **faded** flower lies on the table. **-adverb** (when, if, unless)

-adverb (обстоятельство образа действия, причины, времени) Studying English we must learn the words. **Entering** the port the ship reduced her speed. Ships **being built** today must be very modern.	When **asked** he answered at once. **Having entered** the port we started to unload cargo. Ships **having been built** last century were made of wood.
NO PREPOSITIONS ARE USED WITH PARTICIPLES	

40. Find the participle and give Russian equivalents.

1. Heating a substance, we cause a more rapid motion of its molecules.
2. The results obtained during the last experiment are very important.
3. When living in Moscow, Yablochkov often met with well-known scientists and inventors of that time.
4. The experiment described attracted everybody's attention.
5. We saw many electrical installations, some of the devices being connected to the ground.
6. Two small metal balls are hung from the copper rod, one being supported by a silk string and the other one being supported by a thin copper wire.
7. When following along the conductor, the current heats it.
8. The technology having reached a high stage of development, new methods of work became possible.
9. Electrons forming an atom are in motion.
10. When finishing his experiment, he carefully noted the results.
11. Silver being very expensive, we only rarely use it as a conductor.
12. Using the energy of the atom we produce electric energy at atomic power station.
13. While explaining the results of the experiment the professor wrote many formulas on the blackboard.
14. They continued testing until the sample was destroyed.
15. Scientific experiments have been finished for three days.

41. Role-play:

1. You are recruiting manager try to persuade a specialist to join your company.
2. You are a power thermal engineer try to be hot to get for the company.

UNIT 3. COMMUNICATION AT THE WORKING PLACE

Grammar: Adverb and the way of its translation
Speech strategy: Professional communication

1. Warming up activity.

1. What is professional communication from your point of view?
2. Is professional communication an essential part of a modern engineer?
3. Professional communication is a kind of trust between people do you agree or disagree?

"In today's fast-paced networked economy, professionals must work harder than ever to maintain and improve their business skills and knowledge. But technical mastery of one's discipline is not enough. The key to professional success is the ability to earn the trust and confidence of people [11]. Trust is paradoxically more important than ever".

READING

Text A

2. Skim the text [11] and do some exercises after it.

TIM'S STORY

Charlie once observed Tim White (Then publisher of *the Albany Times Union*, later of the *San Francisco Examiner*) runs an offsite meeting of this management team of a dozen people. Throughout this meeting Tim conveyed a sense of technical mastery, calm and wisdom. Yet he did so hardly ever expressing an opinion, making a technical point, or articulating a decision. Instead, almost all of his input consisted of visually and verbally scanning the table, seeking emotional expressions on the faces of his team.

"Joe, you don't agree with that, do you?" he might say or "Bob, you've got some pretty strong feelings about this one, don't you?" The meeting was highly successful. Not only were decisions made, but everyone felt involved and consulted and that the process was "fair".

Tim did not lack for technical competence and he had strong opinions, but achieved most off his ends by devoting his attention almost entirely to observing, understanding and articulating the needs of others. He achieved high-content results almost entirely through low-content leadership.

It is this ability to stay focused on other people, in the face of a swirling set of demanding distractions that is so problematic for many of us. Success at being other focused is not a function of formal business tools but of personal psychology.

VOCABULARY

3. Learn and remember the words.

observe	watch, monitor
convey	express, communicate, suggest
mastery	authority
articulate	to pronounce very clearly
seek	look for
achieve	to reach
High-content	high essence
low-content	low essence
management team	group of managers
fair and square	very honestly
swirl	whirpool
distraction	relaxation

4. Underline the following words in the text then match a verb and a noun to make word partners.

e.g. run meeting

Verb	Noun
Run	Understanding
Convey	Meeting
Make	Mastery
Achieve	Point

5. Complete the sentences with word partners from the box above. Be careful with the tense.

1. Tim White_____an offsite _____ of his management team.
2. Tim_____a sense of technical_____, calm and wisdom.
3. He_____a technical _____ or articulate a decision.
4. Tim_____ _____ of the people.

6. Complete the chart below by inserting the missing form.

Verb	Noun	Adjective
observe		
	meeting	
		articulating
	expression	
		successful
manage		
	distraction	

7. Fill in the gaps in the sentence with the help of the words from the chart above.

1. Throughout this _____ Tim conveyed a sense of technical mastery, calm and wisdom.
2. He did so hardly ever _____ an opinion, making a technical point or _____ a decision.
3. It is this ability to stay focused on other people, in the face of a swirling set of demanding _____ that is so problematic for many of us.
4. The meeting was highly _____.

SPEAKING

Discussion points

1. In what way can you explain "*a sense of technical mastery*"*?*
2. Did Tim manage to capture the employee's attention? If so try to prove your opinion.
3. Success at being other focused is not a function of formal business tools but of personal psychology. Comment on the sentence and express your own opinion.

LANGUAGE BOX

Expressing your own opinions and attitudes
I think/feel/believe(that)
I strongly believe (that)
In my opinion/in my view/to my mind/from my point of view
I am totally against/ I strongly disprove of
The way I see it is that
I comparison to

READING

Text B

8. Scan the text and discuss in pairs whether the company structure plays an important role in business or not. Try to give your own arguments.

ORGANIGRAMS OF ORGANIZATIONS AND BUSINESS COMPANIES

"Organigram" (management organigram) is a drawing or plan that gives the names and job titles of all the staff in an organization, company or department, showing how they are connected to each other. Another name for an organigram is "the organization chart". The organigram shows the chain of command in an organization in a company [9]. It shows who is responsible to whom, who reports to whom, who is responsible for running the company, who is in charge of this or that department, how the activities in a company are organized.

Most organizations/companies have a hierarchical or pyramidal structure with a single person or a group of people at the top and an increasing number of people below them. The chain of command runs down the company structure so that all employees know who their superior or boss is, to whom they report and who their immediate subordinates are, to whom they give instructions.

An inevitable problem with highly structured organizations is that people at lower levels are unable to make important decisions, but they are obliged to pass on responsibility to their boss. One solution to this problem is matrix management, in which people report to more than one boss. Another, more recent, idea is to have a network of flexible groups or teams instead of the traditional departments, which are often at war with each other, they are formed to carry out a project, after which they are dissolved and their members reassigned.

To manage the company the shareholders elect a group of people called the Board of Directors. Directors sitting on the Board determine the overall policy of the company, they make the rules and important decisions. In some companies there are also non-executive directors who are not managers of the company; they are outsiders, often directors of other companies who have particular knowledge of the industry or of particular areas.

Large British companies ("corporations" in American English) have a chairman of the board of directors who oversees operations and a managing director (MD) who is responsible for the day-to-day running of the company. In smaller companies the roles of chairman and managing director are usually combined. Americans tend to use the term president rather than chairman and chief executive officer (CEO) instead of managing director. The CEO or MD is supported by various executive officers or vice-presidents, each with clearly defined authority and responsibility (production, marketing, finance, personnel and so on).

Top managers are appointed (and sometimes dismissed) by a company's board of directors. They are supervised and advised by the board. The directors of private companies were traditionally major shareholders, but this does not apply to large public companies with wide share ownership. Such companies should have boards made up of experienced people of integrity and with a record of performance in a related business and a willingness to work to make the company successful. In reality, however, companies often appoint people with connections.

VOCABULARY

9. Make up your own sentences with the words below.

Job title
Department
Chain of command
To be responsible for…
To be responsible to/to report to smb.
To report directly
To run the company
To be in charge of
Immediate subordinates
To carry out a project

To appoint smb.

e.g. Mr. Harper is responsible to the head of the department.

10. While reading the following text, draw the organization chart below.

I think we have a fairly typical organization for a manufacturing firm. We are divided into Finance, Production, Marketing and Human Resources departments [12].

The human resources department is the simplest. It consists of two sections. One is responsible for recruitment and personnel matters; the other is in charge of training.

The marketing department is made up of three sections: Sales, Sales Promotion and Advertising, whose heads are all accountable to the marketing manager.

The production department consists of five sections. The first of these is Production Control, which is in charge of both Scheduling and Materials Control. Then there's Purchasing, Manufacturing, Quality Control and Engineering support. Manufacturing contains three sections: Tooling, Assembly and Fabrication.

Finance is composed of two sections: Financial Management, which is responsible for capital investments, fund control, credit and Accounting.

LISTENING

11. Listen to the dialogue "The Staff Review" twice and fill in the gaps.

1. We are just going to go_____ this form.
2. Here, I'll write them_____ this piece of paper.
3. Are you sure_____ that?
4. Now, let's get_____to the second question.
5. I'm not very good at getting my ideas_____.

SPEAKING

12. Work in pairs discussing the organizational structure of a local power thermal station you know about. Your partner will have to ask questions about the company's structure and its activities. You must be ready to discuss most of the following questions with your partner. Consult vocabulary notes below if necessary.

Type of company

Is this a limited liability company? (a joint stock company, a private company, a joint-venture company, a subsidiary company of a large holding company [13]). Is it a close company?

What area or areas does the company work in? Does it belong to "goods-producing" companies or retailing or wholesale companies? Is it a service-producing firm? Does the company work in the field of coal-mining, chemicals,

engineering, food processing, heavy machinery, electronics or power thermal engineering?

What product does the company make/produce/manufacture? What services does it offer? Who owns the company? How are profits shared? Where is the company located? When did the company start?

Company structure

Who makes major decisions in the company? Could you tell me something about the way the company is actually organized? How is the company structured? Could you describe the chain of command in the company?

Who is in charge of marketing and sales in the company? Who takes care of the company's staff training? Who reports to the managing director? Is there a separate department concerned with (dealing with) Research and Development (R&D)? Who controls finance/manages the company's finance? How many structural units does the company consist of? Does it have a special purchasing department or section to buy the materials for production?

Size of company

Is it a small sized company, medium-sized company or large-sized company? Is the company expanding? Is/are the company's staff excellent? How many people does the company employ? Does the workforce exceed 200? Do employees of the company take part (participate) in the decision-making? Are there any trade union representatives in the company? Are they expecting staff reductions in the near future?

Company performance

Is the company doing well or badly? Did the turnover increase last year? Does the production remain steady or they suffer a downturn? Is there a steady increase in the production? Do things look bad and the company is threatened with the bankruptcy? Is the company highly competitive?

Do you expect any changes in the company structure? How would you describe the company's financial situation? Do profits go up or down? Does the company enjoy a period of growth and expansion? Do the management people plan to increase production? Does the company have a secure future? How do you see the future of the company developing? What up-to-date equipment will the company install next year?

READING

Text C

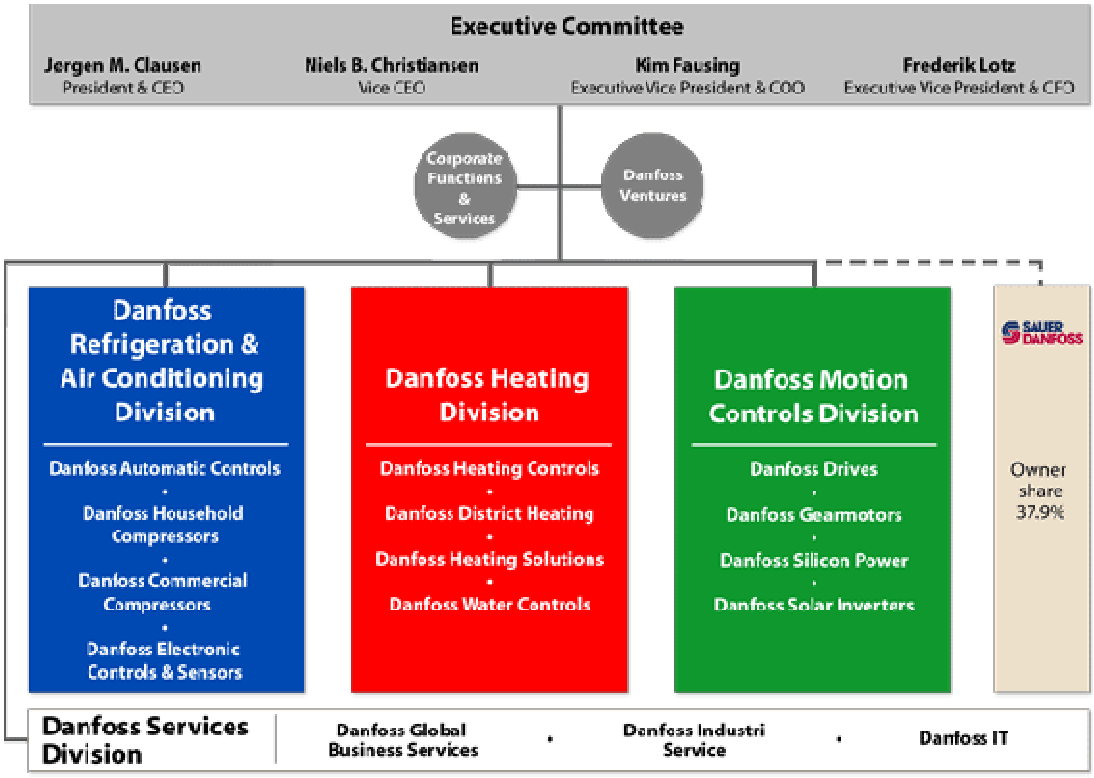
13. Scan the text paying attention to the structure of the company.

DANFOSS GROUP

Danfoss is one of the largest industrial companies in Denmark [14, 15]. The global group is a leader within research, development and production, sales and service of mechanical and electronic components for several industries.

Danfoss's activities are divided into three main business areas: Refrigeration & Air Conditioning, Heating & Water and Motion Controls, each leading within its industry. Danfoss has a large ownership share in one of the world's leading manu-

facturers and suppliers of mobile hydraulics, Sauer-Danfoss. Danfoss seeks to obtain its goals with a minimal consumption of raw materials and energy, the least possible impact on its surroundings and the most efficient use of resources. Danfoss has a long tradition for a social responsibility towards both employees and the surrounding environment.



SPEAKING

14. Work in pairs. Discuss the structure of Danfoss Company. Your partner will have to ask you questions about the company's structure and its activities. You have to mention the following points: type of the company, the company structure, the company size, the company performance.

LANGUAGE BOX

Limited (liability) company
Joint venture
Subsidiary company
Holding company
Close company
Industrial company
Competitive company
To enjoy a period of growth and expansion

READING

Text D

15. Give a talk or prepare a small report on the topic "Corporate culture". Pay attentions to social and environmental responsibilities in the company. Use the information from the text below.

CORPORATE CITIZENSHIP

Environmental and social responsibility is one of Danfoss's core values. Since 2003 Danfoss has published a Corporate Citizenship report that describes the developments within three fields: People and Values, CSR (Corporate Social Responsibility) and Environment [15].

People and Values

Continued growth and profit relies on satisfied and committed employees who do their utmost to reach the targets that have been laid out. "People & Values" is about cross-cultural understanding, good leadership at Danfoss, Danfoss in China, Danfoss business system, training, workplace of the year, talent management etc.

CSR – Corporate social responsibility

Danfoss has joined UN's Global Compact Initiative which comprises ten principles for good company ethics. Global Compact covers human rights, labour rights, environment and corruption. The ten principles are used as a framework for reporting Danfoss's social and environmental responsibility.

Environment

A central element in Danfoss's environmental policy for many years has been that the Group aims to be ranked among the environmental leaders. This is achieved by restricting the use of materials or processes that may pose a risk to people and the environment. Environmental targets and environmentally friendly technologies have been used in the company.

VOCABULARY

Learn and remember the words.

core	main
responsibility	duty
profit	benefit
commit	obligate
utmost	furthest
target	aim
comprise	contain
cross-cultural	involving or bringing the difference between cultures
framework	structure
restrict	limit

16. Which of these responsibilities do you think Danfoss should have?

LANGUAGE BOX

1. There should be good communication between the company and its work-force.
2. The company should pay suppliers on time.
3. The company should have an equal opportunities policy; in other words, people of all races and both sexes should be equal.
4. It should train its employees.
5. It should try to protect and improve the environment.
6. It should make a profit so it can pay dividends to its shareholders and continue to provide jobs for its workforce.
7. It should help with the local education of young people.
8. It should be active in the local community.

LISTENING

17. Listen to the text "Danfoss helps Chilean salmon industry from start to finish" and figure out what other business does the company have? While listening fill in the table what equipment and processes are mentioned in the text?

Equipment	Process

SPEAKING

18. Work in pairs or groups and arrange the talk on the topic "Operational meeting on heating components and its application in power thermal industry". The below suggested memorandum will help you to do it.

DANFOSS INDUSTRIAL COMPANY

MEMORANDUM
To: Chief of operational department
From: Manager Danfoss heating control
Date: 18.10.08
Subject: Heating components
Danfoss Heating offers components and solutions for generation, distribution and use of heat while achieving comfort and energy savings. The findings of a recent survey show that the customers are dissatisfied in the following areas:
-Quality equipment
-availability for Russian market
-very high price
-delivery terms
Following discussions, I recommend that we do the following things (in order of priority)
We should negotiate and meet the requirements of the customers.

LISTENING

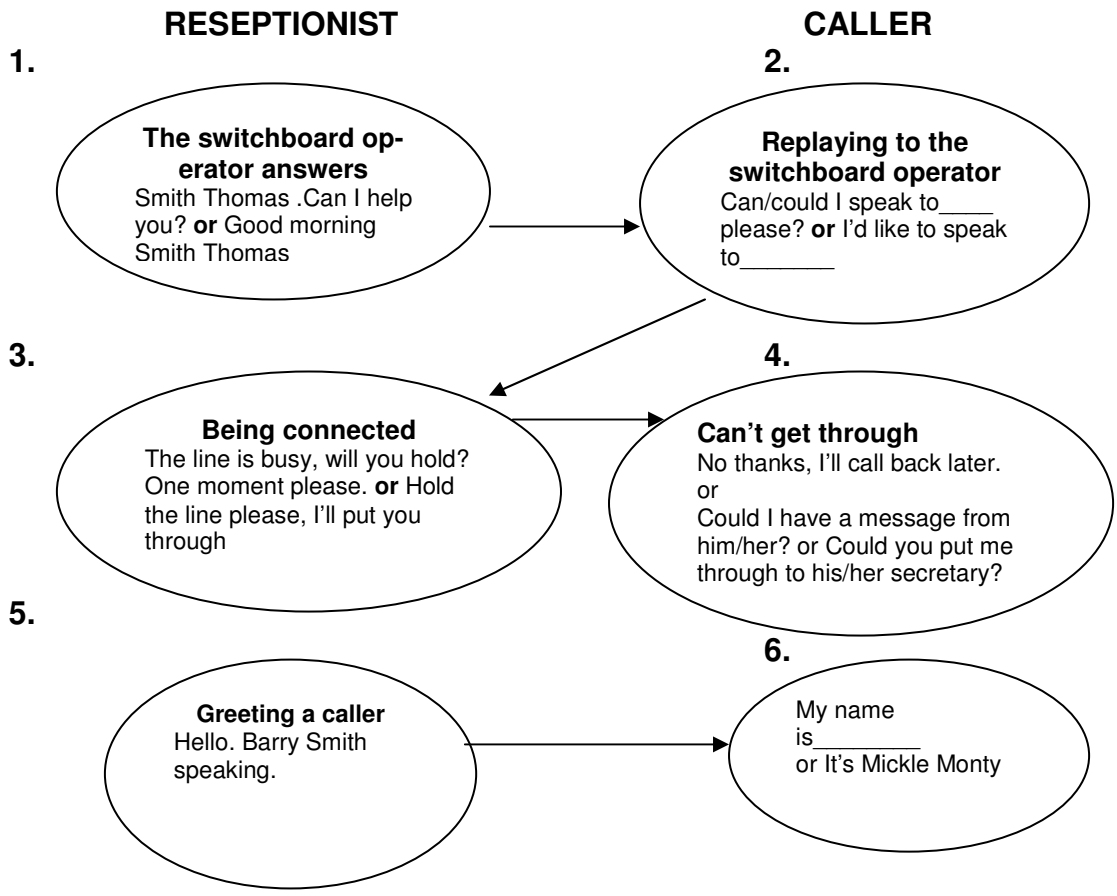
19. Listen to the dialogue "A Busy Office" and do the exercise below.

e.g. "I can't do it." (he says) – He says he can't do it.

1. "That'll be all right." (she thinks)
2. "it's important." (she knows)
3. "I'm busy." (he is afraid)
4. "She won't do it again." (she's sure)

SPEAKING

20. When you make a phone call to a person in company, you often have to call a switchboard or general number first then ask the receptionist for the person you want to speak to. Learn the diagram properly and act out the telephone call with your partner.



GRAMMAR BOX

Adverb is a word or a group of words that serves to modify a whole sentence, a verb, an adverb or an adjective.

e.g. Our method interprets real symmetries *correctly*. This method is *easily* extended to higher dimensions.

e.g. The device is *very* sensitive to noise. наречие находится перед определяемым словом.

e.g. From the *very* beginning geometry was based on experience, than on axioms.(следует переводить слово *very – самый, тот самый)*
С самого начала геометрия основывалась на опыте, чем на аксиомах.

Наречия, входящие в состав многочленного сказуемого. При переводе такие слова следует выносить в начало предложения.

e.g. A statistical approach has *recently* proved valuable.
Недавно выяснилось, что статистический метод может быть полезным.

21. Read the sentences paying attention to the adverbs and give Russian equivalents of the sentences.

1. The perimeter and area can be computed simultaneously.
2. This method is easily extended to higher dimensions.
3. The number of samples is small.
4. The phases of research have traditionally been identified as follows.
5. The broader the knowledge available the sooner are the difficulties explained.
6. Separate molecules moving randomly create heat energy.
7. Actually, you have to understand properly the boiler operation system.
8. The factory – fresh grey nail gradually takes on a reddish color.
9. Electrical energy is easily convertible.
10. The company should have an equal opportunities policy; in other words, people of all races and both sexes should be equal.
11. In today's fast-paced networked economy, professionals must work harder than ever to maintain and improve their business skills and knowledge.
12. He did so hardly ever expressing an opinion, making a technical point or articulating a decision.
13. The meeting was highly successful.
14. He achieved high-content results almost entirely through low-content leadership.
15. Probably the most important use of heat in the modern home is producing heating.

READING

Text E

22. Read the text [13] and pay attention to the bold words.

THE ROLE OF THE CHAIRPERSON

Hilary Rhodes is a management consultant who specializes in meeting skills: A good **chairperson** has to be a **good organizer**. What they do before the meeting is as important as the meeting itself.
They should make sure **the agenda** (the list of things to be discussed) is complete by asking those involved what should be on and then **circulating** (distributing) it to everyone concerned. They should check the **venue**, making sure the room will be free, without interruptions, until the end of the meeting.

During the meeting

The chairperson should be a **good timekeeper**. They should start the meeting on time, without waiting for **latecomers**. They should appoint a **minute-taker** to **take the minutes**, making sure that opinions and **action points** (where participants agree to do something) are noted.

They should make sure each point on the agenda is **allocated** the **time** it deserves and should keep to the t**imetable**. When the time allocated to one point is up, the chair should make sure that discussion **moves on to the next point**, even if the issue has not been completely covered or **resolved** (decided).

The chair should make sure that each participant has the chance **to make their point** and should deal **tactfully** with disagreements, making sure that each side feels their point of view has been noted. They should also try to avoid **digressions**, where people get off the point. Finally, they should ensure the meeting **finishes on time** or early.

Follow-up

After some meetings, it's necessary for the minutes to be circulated, especially if there are **action points** that particular people are responsible for. At the next meeting, the chair should ask for the minutes to be read out and see if all agree that it is **an accurate record** of what happened and see if there are any **matters arising** (any points from the last meeting that need to be discussed). And they should check what progress has been made on the **action points** from the previous meeting.

READING

Text F

23. Replace the bold phrases in this article with the correct expressions from the text “The Role of the chairperson”.

I DON'T KNOW HOW TO CHAIR A MEETING!

I've been asked to chair a meeting about the Christmas office party, but I'm incredibly nervous as I've never chaired one before. Is there a secret for success? YOU may never have chaired a meeting but as you've probably been to lots you'll have seen it done well and badly. Think about the things that please and annoy you and build on them. (1) **Make sure everyone has the agenda well in advance** and check that you know enough about the participants and issues to be discussed. Arrange for the (2) **room** to be cool rather than warm; people will be less likely to go to sleep. See yourself as a referee whose job it is to ensure fair play through careful watching and listening. You must ensure that the time have a chance to (3) **say what they want**; deal (4) **in a diplomatic way** with the argumentative and to be kind to the (5) **person you have asked to take notes**. Getting that individual on your side is essential if you want the record to reflect your desired outcomes. It's normal to suggest what should be left out of the minutes and how any difficult bits should be phrased. Make sure you stick to the (6) **time you have allowed for each point** and keep things moving by not letting people (7) **wander off the subject**. Get decisions made and recorded, even if it's only to postpone matters until the next meeting. If someone is being difficult, defuse things by offering to continue the discussion personally at a more appropriate time. If the meeting is likely to be more than a couple of hours long, try to include a break at the mid-point; it acts as a marker and stops people getting restless. Aim to leave everyone feeling they have had a chance to say what they wanted to say and gain lasting and well-deserved popularity by finishing (8) **when you said the meeting would finish**.

24. Match the verbs (1-7) with the nouns (a-g) that they go with.

1. take	a. a minute-taker
2. appoint	b. the minutes
3. circulate	c. time
4. allocate	d. the agenda
5. move on	e. to the next point
6. avoid	f. on time
7. finish	g. digressions

25. What do you think are the most important skills for someone charring a meeting?

26. Organize the conference and discuss the issue “Modern company, firm, enterprise of the power thermal industry”. Pay attention to the structure of the company, operation, management.

MODULE 2

PROFESSIONAL ACTIVITY

CLASSBOOK

UNIT 4. PROFESSIONAL ACTIVITY OBJECT

Grammar: Gerund, word-formation
Speech strategy: What is the object of professional activity?

1. Warming up activity:

Exchange your opinions with your group mates about the "object of professional activity". The prompt is given below.

object ['ɔbdʒekt]: 1) a tangible and visible thing; 2) a person or thing seen as a focus or target for feelings, thought, etc. (collins, dictionary).

2. Answer the questions before reading the text.

1. What words are associated in your memory with the word "pump"
2. Give the examples of using pumps in everyday life
3. Do pumps play a very important role in the thermal power engineering industry?

READING

Text A

3. Scan the text and do exercises after it.

A heat pump is a machine or device that moves heat from one location (the 'source') to another location (the 'sink' or 'heat sink'), using work [10]. Most heat pump technology moves heat from a low temperature heat source to a higher temperature heat sink. Common examples are food refrigerators and freezers and air conditioners and reversible-cycle heat pumps for providing thermal comfort. Heat pumps can be thought of as a heat engine which is operating in reverse. One common type of heat pump works by exploiting the physical properties of an evaporating and condescending fluid known as a refrigerant. In heating, ventilation, and cooling applications, a heat pump normally refers to a vapor compression device that includes a reversing valve and optimized heat exchangers so that the direction of heat flow may be reversed. Most commonly, heat pumps draw heat from the air or from the ground. Air-source heat pumps with a coefficient of performance (COP) 3 are developed in Japan at –20 °C.

VOCABULARY

4. Match the sentences (1-7) from one box to the sentences (A-G) from another box.

1. A heat pump is a device ___.
2. Heat pump technology ___.
3. Food refrigerators and freezers and air conditioners ___.
4. Heat pumps can be thought of as a heat engine which ___.
5. One common type of heat pump works by exploiting the physical properties of an evaporating and condescending fluid ___.
6. In heating, ventilation and cooling (HVC) applications, a heat pump normally refers ___.
7. Most commonly, heat pumps draw heat ___.

A. Moves heat from a low temperature heat source to a higher temperature heat sink.
B. To a vapor compression device.
C. That moves heat from one location (the 'source') to another one.
D. Known as a refrigerant.
E. From the air or from the ground.
F. Are heat pumps for providing thermal comfort.
G. Which is operating in reverse.

5. Rearrange the sentence. What physical laws can be applied to?

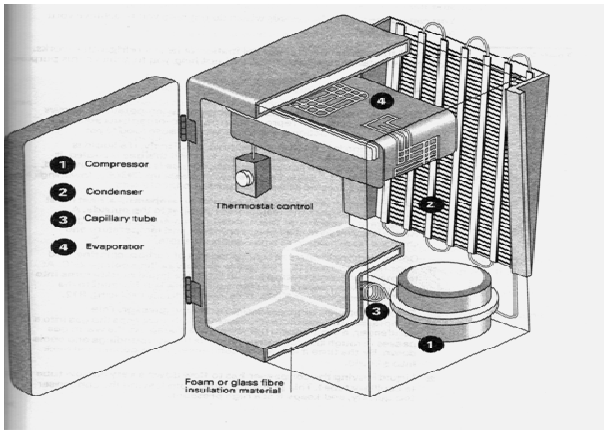
In heating, valve, a heat pump, normally, refers to a vapor, compression, device, that includes, ventilation, a reversed, and, optimized, and cooling applications, heat exchangers

SPEAKING

6. Discuss in pairs what is the operational function of the pumps. Use the words below in your speech.

It appears to …, It seems that … (кажется, что…)
It tends to be … (имеет тенденцию к…)
It is said that … (говорят, что…)
Some of the evidence shows … (одно из доказательств указывает на…)
Shown by … (представленный, показанный)
Exemplified by … (приведенный в качестве примера)
Illustrated by … (представленный кем-либо…)

7. Study the picture 1. It explains how a refrigerator works. Discuss with your colleagues the function of each of the numbered components using the information in the box.



Picture 1. *Refrigerator*

Low temperature, heated liquid, to change to gas or vapor, constant temperature, expand gas, compressed gas, refrigerant, compressor, pump, condenser, absorb

WRITING

8. Write the order-letter to "Siemens", which produces different types of pumps to send you the pump specification. Useful words and expressions are given in the frame below.

I wish to inform you, I'm pleased to tell you, let me know, please let me know if I can be of assistance, let me know if I can help you, I regret that happened, I hope to hear from you soon, regards, could you possibly, I'm sending you, I'm writing to enquire about, please find enclosed, dear Sir or Madam

READING

Text B

9. Skim the text [10] and entitle it.

According to the second law of thermodynamics heat cannot spontaneously flow from a colder location to a hotter area; work is required to achieve this. Heat pumps differ in how they apply this work to move heat, but they can essentially be thought of as heat engines operating in reverse. A heat engine allows energy to flow from a hot 'source' to a cold heat 'sink', extracting a fraction of it as work in the process. Conversely, a heat pump requires work to move thermal energy from a cold source to a warmer heat sink.

Since the heat pump uses a certain amount of work to move the heat, the amount of energy deposited at the hot side is greater than the energy taken from the cold side by an amount equal to the work required. Conversely, for a heat engine, the amount of energy taken from the hot side is greater than the amount of energy deposited in the cold heat sink since some of the heat has been converted to work.

VOCABULARY

10. Fill in the gaps. *E.g. extract-extraction-extracting.*

require		
	pump	
		heating

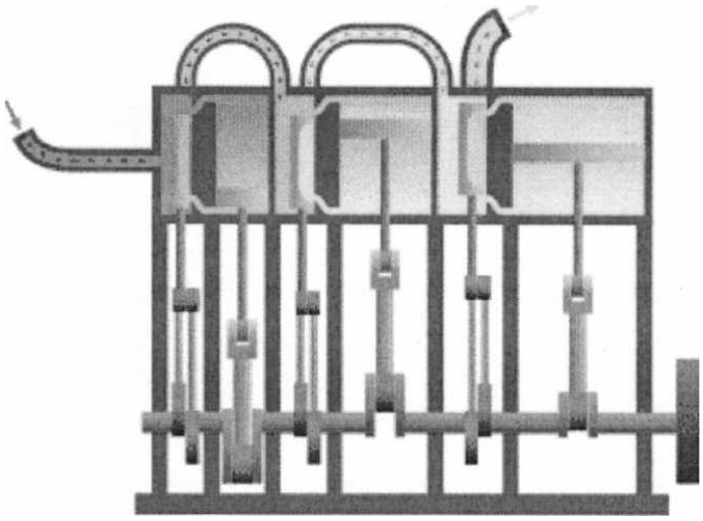
11. Match the words (1-5) from the left column to the words (a-e) from the right column. *E.g. 1-d.*

1. law	a. pump
2. heat	b. source
3. cold	c. energy
4. thermal	d. thermodynamics
5. amount	e. of work

SPEAKING

12. Discuss in pairs in what industrial processes thermodynamic laws are used. Why is it so important to possess knowledge of thermodynamic?

13. What is illustrated in the picture 2 below, describe it in brief in pairs.



Picture 2. *Device*

14. Answer the following questions.

1. What is the origin of the word "thermodynamics"?
2. What is postulated by laws of thermodynamics?
3. Why is Sadi Carnot considered to be the "father of thermodynamics"?
4. Name the second law of the thermodynamic?
5. Name three variations of thermodynamic discipline. Characterize them in brief.

READING

Text C

15. Read the text and answer the questions.

THE OPERATION OF THE HEAT PUMP

One common type of heat pump works by exploiting the physical properties of an evaporating and condensing fluid known as a refrigerant [16]. Main components of heat pump are:

1. condenser,
2. expansion valve,
3. evaporator,
4. compressor.

The working fluid, in its gaseous state, is pressurized and circulated through the system by a compressor. On the discharge side of the compressor, the now hot and highly pressurized gas is cooled in a heat exchanger called a condenser until it condenses into a high pressure, moderate temperature liquid. The condensed refrigerant then passes through a pressure-lowering device like an expansion valve, capillary tube or possibly a work-extracting device such as a turbine. This device then passes the low pressure, barely liquid (saturated vapor) refrigerant to another heat exchanger, the evaporator where the refrigerant evaporates into a gas via heat absorption. The refrigerant then returns to the compressor and the cycle is repeated.

1. What is refrigerant?
2. Draw the principal scheme of a heat pump
3. What is the function of the working fluid?
4. What is the role of the heat exchanger?
5. What is the application of the turbine?
6. Can you give the function of the evaporator?

SPEAKING

16. Discuss in pairs the operational cycle of the heat pump. Pay attention to the box.

LANGUAGE BOX
Commonly used present passive (обычно используется пассивный залог) **(is / are + verb stem +ed)** Describing a process (описание процесса) First (во-первых…), Then, Next (затем…), Finally (в конечном счете…)

Abstract	Summary	Annotation
Is a shortened version of the paper written for people who never read the full version.	Restates the main findings and conclusions of a paper and is written for people who have already read the whole thing.	What is it about; goals.

WRITING

17. Read the text [10], entitle and write the annotation.

The internal combustion engine (ICE) is an engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine the expansion of the high temperature and pressure gases, that are produced by the combustion, directly apply force to a movable component of the engine, such as the pistons or turbine blades and by moving it over a distance, generate useful mechanical energy. The term *internal combustion engine* usually refers to an engine in which combustion is intermittent, such as the more familiar four-stroke and two-stroke piston engines, along with variants, such as the Wankel rotary engine. A second class of internal combustion engines use continuous combustion: gas turbines, jet engines and most rocket engines, each of which are internal combustion engines on the same principle as previously described. A large number of different designs for ICEs have been developed and built, with a variety of different strengths and weaknesses. While there have been and still are many stationary applications, the real strength of internal combustion engines is in mobile applications and they completely dominate as a power supply for cars, aircraft, and boats, from the smallest to the biggest.

READING

Text D

18. Read the article [17], explain the purpose of the suggested work, entitle each paragraph and find unknown words.

Conjugate heat exchange and hydrodynamics for a viscous incompressible fluid moving in a rectangular cavity

(1) *Numerical simulation was performed of the motion of a viscous incompressible no isothermal fluid (heat carrier) in an open rectangular cavity under conditions of forced convection and conjugate heat exchange. The effect of the jet dynamic parameter (Reynolds number) and fluid flow conditions on the character of motion and heat exchange of viscous incompressible no isothermal fluids in rectangular cavities is studied. A hydrodynamic pattern of viscous flow in an open*

cavity under forced convection conditions (in the conjugate and no conjugate formulations of the problem) is obtained. The effect of parameters of the model on the character of motion is studied. Temperature profiles for the solid and fluid phases are obtained. The effect of parameters of the model on the character of temperature distribution in both phases is studied.

(2) Over the past forty years there has been steady interest in convective flows in cavities of various types, which is explained by the practical importance of the problem: cavities are used as heat-transferring, heat-insulating and structural elements in power and process installations of various purposes, electronics and heat exchangers.

Studies of the frontal interaction of a viscous incompressible nonisothermal jet with a variously shaped bounded volume is of great scientific and practical significance because such flows are widely used in engineering processes of various complexity levels in metallurgical, power, etc., industries.

Simulation of heat exchange for a viscous flow in a rectangular cavity involves solution of complex problems of forced convection of an incompressible fluid. Since the complexity of viscous incompressible no isothermal flows in bounded volumes makes it impossible to develop reliable analytical methods to calculate such flows, numerical simulation is required.

(3) We consider the unsteady interaction of a subsonic laminar viscous jet of an incompressible no isothermal fluid with an open rectangular cavity (Picture 1). Numerical solution of the hydrodynamic problem was implemented in region 2, bounded by the inflow region 1, the line of symmetry 3, the side wall 6, the bottom of the cavity 4 and the region of exit 7 from the rectangular cavity.

We use a mathematical model based on the Navier-Stokes equations in the variables "vortex-stream function" at moderate Reynolds numbers (100≤Re≤800), the energy equation and the heat-conduction equation for the material of the rectangular cavity with corresponding initial and boundary conditions:

$$\frac{\partial\omega}{\partial\tau}+u\frac{\partial\omega}{\partial x}+v\frac{\partial\omega}{\partial y}=\frac{1}{\mathrm{Re}}\left(\frac{\partial^2\omega}{\partial x^2}+\frac{\partial^2\omega}{\partial y^2}\right) \tag{1}$$

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}=\omega \tag{2}$$

$$\frac{\partial\theta}{\partial\tau}+u\frac{\partial\theta}{\partial x}+v\frac{\partial\theta}{\partial y}=\frac{1}{\mathrm{Re}\cdot\mathrm{Pr}}\left(\frac{\partial^2\theta}{\partial x^2}+\frac{\partial^2\theta}{\partial y^2}\right) \tag{3}$$

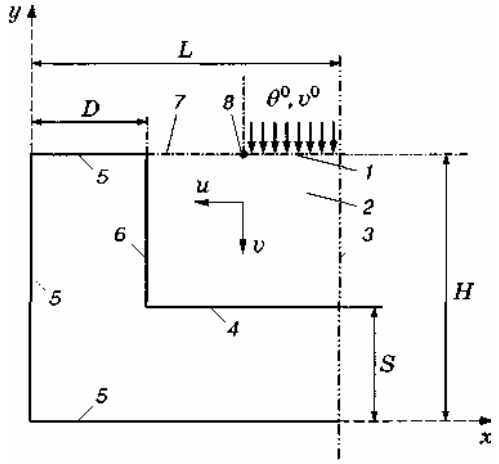
$$\frac{\partial^2\theta_1}{\partial x^2}+\frac{\partial^2\theta_1}{\partial y^2}=\frac{\partial\theta_1}{\partial\mathrm{Fo}} \tag{4}$$

Here Pr and Fo are the Prandtl and Fourier numbers, respectively.

At the bottom of the cavity (y = S and D < x < L), we specify no penetration and attachment conditions and the boundary condition of the fourth kind for the

energy equation. On the side wall of the cavity (x = D and S < y < H) the same conditions.

On the symmetry axis of the jet (x = L and S < y < H), we specify the conditions of heat-flux continuity and nonpenetration. At the exit from the rectangular cavity, we use the "drift" conditions du/dy = 0 and dv/dx = 0 for the velocity components and a "soft" boundary condition for the temperature (second derivative



Picture 1. *Diagram of the flow in a rectangular cavity and geometry of the computation domain: 1) entrance to the cavity; 2) hydrodynamic region; 3) symmetry axis; 4) bottom of the cavity; 5) outer walls of the cavity; 6) side wall of the cavity; 7) region of exit from the cavity; 8) boundary between the exit and entrance regions*

of temperature with respect to y). On the outer boundaries of the cavity, heat insulation conditions are specified:

$$y = \mathrm{H},\ 0 < x < \mathrm{D}: \quad \lambda_1 \frac{\partial \theta_1}{\partial y} = 0;\ y = 0,\ 0 < x < \mathrm{L}: \quad \lambda_1 \frac{\partial \theta_1}{\partial y} = 0; \tag{5}$$

$$x = 0,\ 0 < y < \mathrm{H}: \quad \lambda_1 \frac{\partial \theta_1}{\partial x} = 0;\ x = \mathrm{L},\ 0 < y < \mathrm{S}: \quad \lambda_1 \frac{\partial \theta_1}{\partial x} = 0. \tag{6}$$

In the fluid flow in the cavity, two regions are distinguished: the entrance to the cavity 1 and the exit from the cavity 7 (Picture 1). The position of the point of separation of the entrance and exit regions is found from the following integral relation, which defines the flow rate as the main integral characteristic of the flow:

$$\int_{x_2}^{x_0} \mathrm{v}_+(x, y)dx = \int_{x_0}^{x_1} \mathrm{v}_-(x, y)dx \tag{7}$$

Here x_1 is the fixed extreme point of the entrance region that lies on the symmetry axis, x_0 is the coordinate of the point of separation of the regions with different fluid flow directions in the cavity $(x_2 < x_0 < x_1)$, x_2 is the coordinate of the fixed extreme point of the exit region that lies on the side wall of the cavity, $\mathrm{v}_-(x, y)$ is the transverse component of the fluid velocity in the direction from the entrance to the bottom of the cavity, $\mathrm{v}_+(x, y)$ is the transverse velocity component of the fluid flow in the direction from the bottom of the cavity to the exit region.

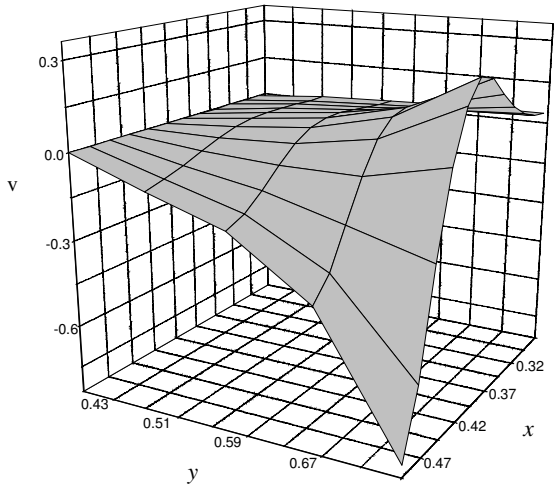
The initial conditions are written as

$$\psi(x, y,0) = \psi^0(x, y); \quad \theta(x, y,0) = \theta^0(x, y) \tag{8}$$

The Navier-Stokes equations in the variables "stream function-vortex", the energy equation and the heat-conduction equation [Eqs. (l) - (4)] are solved by the finite-difference method. The difference analogs of the Navier-Stokes equations are solved by the explicit iterative method. The difference analogs of the energy equations and thermal-conduction equations are solved by the sweep method. A difference scheme of second-order accuracy was used. The calculations were performed on a uniform difference grid.

(4) Flows of various fluids, in particular, water, molten lead and fluid steel were studied over a wide range of Reynolds numbers and other parameters of the model. Pictures 2, 3 show numerical results for fluid steel at a temperature of 1500°C. As follows from analysis of the steady-state flow field for various values of the geometrical characteristics of the cavity (in particular, L/H = 1/2, 2/3 and 1) over a rather wide range 100 ≤ Re ≤ 500, the fluid reaches the bottom of the cavity, rotates and flows out through the entire region 7 (see Picture 1). Thus, in the viscous incompressible no isothermal flow in the cavity, we can distinguish two stages.

The first stage includes the passage of the fluid from the entrance region to the bottom of the cavity and interaction with the bottom. The interaction of the jet with the bottom of the cavity is accompanied by deceleration of the flow and occurrence of a region of elevated pressure, which leads to spread of the fluid along the bottom of the cavity.

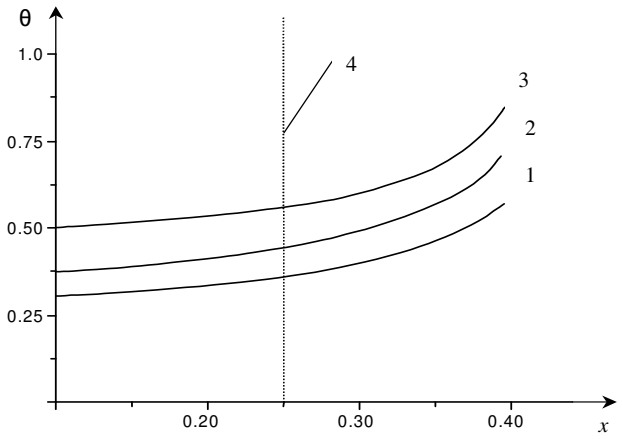


Picture 2. *Distribution of the transverse velocity component for steady flow (Re = 200)*

At the second stage, the fluid moves from the bottom of the cavity to the exit with formation of a region of reverse flow. At this stage, deceleration of the fluid continues, which also leads to which a region of elevated pressure arises. The direct and reverse regions flow corresponding to the above stages of fluid flow in the cavity are evident in Picture 2.

Picture 2 shows the distribution of the transverse velocity component v(x,y) at time t* for Re = 200. We note that with increase in Reynolds number, the profile of v(x,y) at t the initial sections of the cavity becomes close to a constant value,

while at Re = 100 and 200, the profiles of the transverse velocity component are almost parabolic.



Picture 3. *Solid- and liquid-phase temperature distributions along the x coordinate for steady flow: Re= 300, Pr = 0.979, α=0.3 α_*, L/H = 1/2 and y = 0.40 (1), 0.52 (2) and 0.68 (3) at the same sections*

An analysis of the distribution of the transverse velocity component shows that in the flow field, two maxima are formed, which correspond to the direct and reverse flows. From Picture 2, it is evident that at the first stage, as the incompressible fluid jet moves to the bottom of the cavity, the transverse velocity component decreases with increase in the longitudinal component, which is clearly seen in the region of $0.41 < y < 0.55$. At the second stage, as the jet moves to the exit section, the longitudinal velocity component decreases, which is clearly seen in the region of $0.32 < x < 0.41$, $0.41 < y < 0.55$. At the same time, the transverse velocity component begins to increase and its most intense increase is observed in the region of $0.59 < y < 0.75$, $0.30 < x < 0.40$. According to Picture 2, the maximum value of the outflow velocity is $v_{max} = 0.24$.

The motion of the viscous incompressible fluid in the rectangular cavity was studied under conditions of conjugate heat exchange. The temperature dependencies in the solid and liquid phases were obtained for various dynamic parameters and variation of the parameter α (α is the length of the entrance region).

Picture 3 shows solid- and liquid-phase temperature profiles at various sections of y at the time t* for Re = 300, Pr = 0.979, $\alpha=0.3\ \alpha_*$ (α_* is the length of the penetrable region of the cavity y = H, $D < x < L$) and L/H = 1/2. It should be noted that with increase in α and decrease in geometrical parameters, the behavior of temperature fields along the height of the cavity changes insignificantly.

From the results obtained it follows that the behavior of the temperature profiles at various sections of the cavity remains unchanged with variation of the parameter Re. In the present work, we also solved the no conjugate problem. On the walls of the cavity, we imposed heat insulation conditions (no heat transfer to the cavity walls).

The difference in the temperatures obtained in the conjugate and no conjugate formulations of the problem is ±23%, which confirms that solving the problem in the conjugate formulation is reasonable.

(5) The results of numerical analysis given here suggest that the range of application of the mathematical apparatus can be further extended to solve problems of convective flows in open cavities under conditions of jet in flow and conjugate heat exchange. The present work is a continuation of the studies in which it was first shown that the mathematical tool can be used to solve problems in the conjugate formulation for regions having more complex geometry than a channel or a streamlined body. Optimization of grid parameters gives stable solutions of problems in regions of more complex geometry.

The present study showed that stable solutions of the problem considered can be obtained over a rather wide range of Reynolds numbers ($100 \leq Re \leq 1000$).

19. Answer the questions.

1. Define the heat carrier behavior flow.
2. What equations are given to mathematical statement of problem?
3. Are stationary or non-stationary processes regarded? Give your arguments.
4. Describe the units where can be the similar processes realized.
5. What do boundary conditions determine?
6. How many directions are depicted in this technological cavity?
7. What substances can be regarded as a heat carrier?
8. For what heat carrier graphical dependencies are obtained?
9. What type of distribution has the chart transverse velocity component in the range of Reynolds's numbers?
10. What test problems are used for the evaluation of getting data? Enumerate them and define the behavior of the stream for everybody.
11. In what way does the length of the penetrable region influence to the conditions of the heat transfer?
12. What temperature does the heat transfer have in this article?
13. Why the thermal physical characteristics are defined as constant parameters and don't depend on the temperature change?

READING

Text E

20. Skim the text [18] and do some exercise after it.

A HEAT PUMP SYSTEM

In HVAC applications, a heat pump normally refers to a vapor compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of heat flow may be reversed. The reversing valve switches the direction of refrigerant through the cycle and therefore the heat pump may deliver either heating or cooling to a building. In the cooler climates the default setting of the reversing valve is heating. The default setting in warmer cli-

mates is cooling. Because the two heat exchangers, the condenser and evaporator, must swap functions, they are optimized to perform adequately in both modes. As such, the efficiency of a reversible heat pump is typically slightly less than two separately-optimized machines. In plumbing applications, a heat pump is sometimes used to heat or preheat water for swimming pools or domestic water heaters. In somewhat rare applications, both the heat extraction and addition capabilities of a single heat pump can be useful and typically results in very effective use of the input energy. For example, when an air cooling need can be matched to a water heating load, a single heat pump can serve two useful purposes. Unfortunately, these situations are rare because the demand profiles for heating and cooling are often significantly different.

21. What other types of pumps do you know? Give their classification.

VOCABULARY

22. Fill in the gaps putting down the words from the brackets in a proper form.

1. A heat pump is a machine or device that ___ heat from one location (the 'source') to another. (move)
2. A heat pump normally ___ to a vapor compression device. (refer)
3. A heat engine ___ energy to flow from a hot 'source' to a cold heat 'sink'. (allow)
4. The refrigerant then ___ to the compressor and the cycle is repeated.(return)
5. The reversing valve _____ the direction of refrigerant through the cycle. (switch)
6. The condensed refrigerant then ___ through a pressure-lowering device. (pass)

Word study (Verbs and related nouns)

23. Form new words with the suffix –or, –er. *E.g. refrigerate – refrigerator.*

Condense, compress, exchange, evaporate, operate, radiate, freeze.

24. Tick the sentences true (T) or false (F).

1. A heat pump is a machine or device that moves heat from one location (the 'source') to another location.
2. Most heat pump technology doesn’t move heat from a low temperature heat source to a higher temperature heat sink.
3. Heat pumps can be thought of as a heat engine which isn’t operating in reverse.

4. One common type of heat pump works by exploiting the chemical properties of an evaporating and condescending fluid.
5. In heating, ventilation and cooling applications, a heat pump normally refers to a vapor compression device.
6. Most commonly, heat pumps draw heat from the air or from the ground.
7. According to the second law of thermodynamics heat cannot spontaneously flow from a colder location to a hotter area; work is required to achieve this.
8. A heat pump requires work to move thermal energy from a cold source to a warmer heat sink.
9. The heat pump uses a certain amount of work to move the heat.

25. Answer the questions.

1. What is the heat pump?
2. Give the construction of the heat pump.
3. What sphere is it widely used?
4. What is the operation of the heat pump?
5. What laws of thermodynamics are widely used in the pump operational system?

GRAMMAR BOX

Gerund is not finite form of the verb, which has the function of the noun and the verb.
E.g. Heat- to heat-heating

The -ing form is used:

a. As a noun. *E.g. Heating is very essential in Siberia.*
b. After prepositions. *E.g. The house is without heating.*
c. After love, like, enjoy, dislike, hate and prefer. *E.g. She likes conditioning air.*
d. After certain verbs (consider, avoid, deny, look forward, to fancy, admit, suggest). *E.g. The engineer spent some hours ventilating the shop.*

WRITING

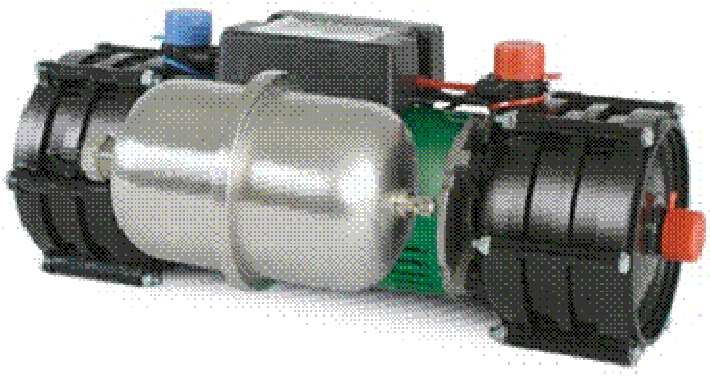
26. Using the examples above write down your examples with the gerund.

27. Using the language box give the specification of the pump. Pay attention to picture 3.

LANGUAGE BOX

Stating the purpose
Introducing the subject
I'd like to talk (to you) today about…
I'm going to present my research paper/inform you about/describe…

The subject of my academic paper/my presentation is… My purpose/objective/aim today is... This morning I'm going to be talking to you about/telling you/showing you/reporting on… the summary of my research work



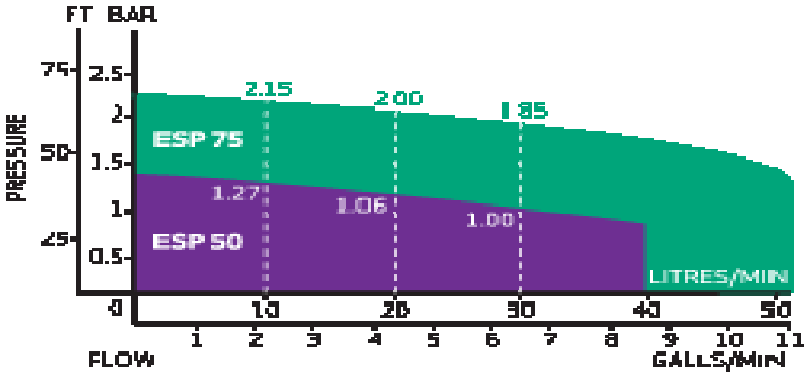
Picture 3. *Pump*

- What kind of pump do you see?
- What is it application?
- What is it performance?
- What are construction parts of the pump?

Designed specifically for one/two bathroom systems where there is a need to boost baths, basins or showers which may be above and/or below the cold water storage tank(s). Typically - flats, loft and barn conversions.

SPEAKING

28. What graphical dependendeces are describing the heat pump operation? Pay attention to picture 4. Discuss in pairs.



Picture 4. *Graphical dependendeces are describing the heat pump operation*

Performance
Closed head pressure
Max amps/watts
Rating
Extremely Quiet
80ft head (2.40 bar)
1.8 amps/430 watts
Applications
For flats and houses where the requirement is for a positive and/or negative heat pump.

LISTENING

29. Listen to the text twice "What is boiler?" and find whether the sentences are true (T) or false (F).

1. A boiler is a device for generating steam, which consists of two principal parts: the furnace and the boiler proper.
2. The steam or cold fluid is then recirculated out of the boiler for use in various processes in heating applications.
3. The boiler receives the feed water, which consists of varying proportion of recovered condensed water (return water) and fresh water.
4. The make-up water is not usually natural water either in its raw state or treated by some process before use**.**
5. Feed-water composition therefore doesn't depend on the quality of the make-up water and the amount of condensate returned to the boiler.
6. The steam, which escapes from the boiler, frequently contains liquid droplets and gases.
7. The water remaining in liquid form at the head of the boiler.
8. The impurities must be blown down by the discharge of some of the water from the boiler to the drains.
9. Proper treatment of boiler feed water is an important part of operating and maintaining a boiler system.

30. Transfer situation. Work in group. One group is going to visit the plant, producing the pumps and boilers. You are interested in the heat pumps, explain why. Try to show the necessity of these pumps.

31. Another group is going to show the samples of their products. Talk on the following: specific characteristics of the pumps, its design, cost, availability. Look through the drafts of the contract.

adapt equipment to sb's uses – приспособить оборудование к чьим-либо требованиям
adjustment – регулировка
sufficient – достаточный
break down – поломка
complete set of documents – полный комплект документов
concerning – что касается

study the requirements – изучать требования
pay the expenses involved – оплатить связанные с этим расходы
charge – брать плату
account (a/c) – счет
order – заказ
supplement – дополнение
mutual agreement – совместное соглашение
quantity – количество
purchase – покупать
begin with – сначала
come to terms about the price – прийти к согласию относительно цены
advance payment – предварительная оплата
suit – приближаться, подходить (в переносном значении)
sign – подписывать
FOB (free on board) price – ФОБ цена
CIF (cost, insurance, freight) price – сиф цена
be not in favor of sth – не быть настроенным
cover the expenses – покрывать расходы
stipulate – договориться
date of shipment – дата отгрузки
provision – положение контракта
goods – товары
delay – отложить, задержать
penalty – штраф
total value of the contract – общая стоимость контракта
refund – возмещать стоимость
fail to do sth – не сделать ч\л
irrevocable – безотзывный
confirmed – подтвержденный
indivisible – неделимый
letter of credit (l/c) – аккредитив
reliable – надежный
in duplicate – в двух экземплярах
equal validity – одинаковая юридическая сила

32. Translate the following sentences into Russian.

1. Dear Sirs, let me introduce Mrs. Vane, the Managing Director of our firm.
2. I'm glad to meet you in person at last.
3. I studied the advertising material and the draft contract prepared by your specialists.
4. Do you have any objections as regards the contract?
5. Have you adapted the equipment to our uses?
6. We haven't discussed the delivery date.
7. Where is the complete set of documents concerning this business transaction?
8. I studied thoroughly the requirements of the market.
9. I think we'll come to terms about the prices and advance payment.

33. Fill in the gaps in the outline draft contract choosing from the words given below.

terms – условия, сроки
arbitration – арбитраж
matter – случай
charges – расходы
pay penalty – штраф
delivery – поставка
contract – вызывать в суд, обращаться
parties – стороны

DRAFT CONTRACT

Between Valeo Ltd., hereinafter referred to as "the Seller" and Mercury, hereinafter referred to as "the Buyer". The Seller undertakes to supply the Buyer with 12 000 pumps to 765 and to pay all and insurance.

The terms of ___ (1) and immediate payment of charges by confirmed and irrevocable ___ (2) are to be standard. A ___ (3) clause will be included in the contract. It will be against the Buyer for ___ (4) payment.

In the event of non-payment, the Seller shall be entitled to ___ (5) for the goods. In case of a dispute between the ___ (6) to the contract the ___ (7) will be taken to independent___(8). All the ___ (9) of the contract must be complied with by both parties.

34. You want to make an order to purchase spare parts from the factory. Use the scheme provided below.

Coliseum Motors
1 rue des Bagndes 75023 Paris, France
To: Camford Spares Ltd. Purchase order No
Oxbridge House
Bletchley
Avon XL82 95 AG Date: 6th March 1999
England
Please supply the following

Quantity	Catalog /item	Description	Unit cost	Total cost
5	931 A	fan motor assembly	199.99	999.95
100	1052 C	radiators	45.00	4500.00
25	193N	front fog lights	6.50	162.50

Total: 5 662.45

Packing: 5 cartons Marks: CMX 1-5
Delivery address: Authorized signature:
Coliseum Motors 1 rue des Bagndes 75023 Paris, France

WRITING

35. You have to write the text of the draft contract for the negotiations. The topic: purchasing contract, goods - technical equipment for Thermal power plant; you are the representative of the Buyer. Use the information provided below.

READING

Text F

36. Read the text [5] for full understanding.

CONTRACT

MANCHESTER **FEBRUARY 24, 2007**

GreenGlass Ltd., hereinafter referred as: "Seller", with residence in Manchester, U.K., represented by Managing Director Mr. Goldsmith and Thermal power plant "Teplo", hereinafter referred to as: "Buyer" with residence in Tomsk, Russia, represented by General Director Mr. Petrov.

Both parties recognizing plenipotentiary representatives of the firms agreed in concluding and signing the contract which involves the following provisions:

1. Subject of the contract

The “Seller” shall sell and the “Buyer” shall purchase the new technological equipment for thermal power processing industry, Model ZX245.

2. Terms of delivery and payment

The “Seller” is obliged to deliver the new processing equipment Model ZX 245 within 30 working days after the signing of the contract if the payment was realized by the “Buyer” in the form of irrevocable, confirmed, indivisible letter of credit to the account of the “Seller” not later than in 10 banking days after the contract was signed to the amount stipulated in the Supplement to the Contract.

3. Transportation

The equipment shall be shipped and delivered on FOB conditions to the port indicated by the “Buyer”. The “Seller” shall be in charge to pay all the expenses connected with transportation up to the frontier and then the “Buyer” shall undertake all the taxes and duties existing on the territory of Russia.

4. Insurance

The equipment is insured by the “Seller” to the amount of 1 000 000 USD. In case of any damage during the transportation the losses shall be refunded to the “Buyer”. The “Seller” shall provide the “Buyer” with 1 year guarantee for the equipment and all the necessary technical documentation. In the case of break down the specialist of the “Seller” shall be ready to assist to the “Buyer” free of charge within 2 years after the date of purchase.

5. Penalty

In the case if the “Seller” couldn't deliver the equipment in the mentioned above terms without any particular reason, the “Seller” should identify the “Buyer” all possible losses including 0.5 % penalty every day of the shipment delay, and the Contract should be considered annulled. In the case the “Buyer” failed to pay

the contract within the term stipulated by the Contract, the “Buyer” should identify the “Seller” all the possible losses including 0.5 % penalty every day for the delay of payment.

6. Arbitration

All disputable questions if any should be presented to the Arbitrage Court of Great Britain or Russia by the agreement of the “Seller” and the “Buyer”.

7. Force major

In the case of the war, earthquake, flood or changes in the legislation or any other reasons which arise in the countries and couldn't be overcome by the parties because they are force major and last more than 30 days the parties have the right to inform each other about these conditions and not to fulfill their obligations under the Contract. The Contract was done in duplicate. Both copies have equal juridical validity.

37. Before writing your own contract read the lexical commentaries for better comprehension.

hereinafter referred to as – называемый в дальнейшем
represented by sb – представленный кем-л., в лице кого-л.
with residence – с местонахождением
agree in concluding and signing the contract – договориться о заключении и подписании контракта
plenipotentiary representative – полномочный представитель
involve provision – содержать положение
be obliged to deliver – быть обязанным поставить
ship – отгрузить
supplement –дополнение
fob conditions – фоб условия
undertake taxes and duties – брать на себя оплату налогов и сборов
insure – страховать
damage – ущерб
indemnify losses – возместить убытки
delay of payment – задержка платежа
disputable questions – спорные вопросы
arbitrage court – арбитражный суд
force major – форс мажор
earthquake – землетрясение
flood – наводнение
overcome – преодолеть
fulfil obligations – выполнять обязательства
duplicate – в двух экземплярах
equal juridical validity – одинаковая юридическая сила
on behalf of – от имени

38. Create the project “Buying the thermal power equipment”.

UNIT 5. PROJECT AS AN OBJECT OF PROFESSIONAL ACTIVITY

Grammar: the Passives, word formation
Speech strategy: Product importance

1. Warming up activity: What do you know about a product?

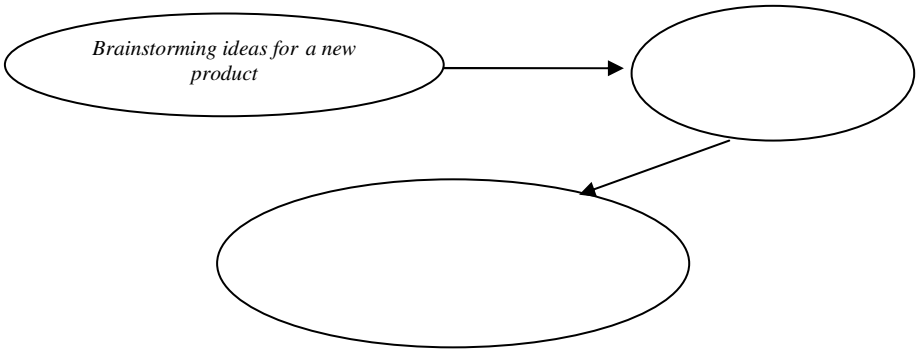
artifact (AE) - product
(Something natural, something made to be sold, a service, the result of natural process)

SPEAKING

2. Put the stages in order and complete the flowchart about developing a product for your company or a company you know. Add any other stages that are necessary.

1. Planning marketing strategy
2. Brainstorming idea for a new product
3. Advertising
4. Going into production
5. Designing the product
6. Deciding on product specification
7. Market research
8. Budgeting
9. Launching the product

3. Compare your ideas with a partner. Are your ideas the same or different?



READING

Text A

4. Scan the text [11] and do exercises after it.

MASS PRODUCTION

I'm Steve and I am the head of heat exchanger production at a manufacturing plant. Plant sounds more modern than factory or works. On the assembly line we mass produce heat exchangers. The plant is highly automated: we use a lot of machinery. These machines are expensive to buy but very cost effective – we don't have to pay those wages! We use industrial robots. These robots are part of the CADCAM system of computer-assisted design and manufacturing.

My name is Luke. I have a little workshop where I produce furniture ordered by individual customers. We don't use machinery, the furniture is hand-made. Producing furniture like this is a craft industry. It's very labor-intensive: it takes a lot of work to produce each piece. Many people dislike the furniture that big companies churn out in large numbers on their production lines, so we have a lot of customers.

VOCABULARY

5. Learn the words.

manufacture – produce, assembly line – mounting line, produce – operate, cost-effective – cost-beneficial, workshop – manufactory, hand-made – manual, craft industry – home-made industry, intensive labor – serious labor, churn out – to produce a great amount.

6. Complete the chart below by inserting the missing form.

Verb	Noun: Person/organization	Noun: process	Noun: thing
		manufacturing	
	worker		
produce			
make			

7. Rearrange these lines to make a text containing the words from the text.

1. work, Of course, we still have a lot of assembly
2. plants producing TVs in Singapore, We have two production
3. My name is George Chen, and I'm a director of a manufacturing, company
4. lines working 24 hours a day, We use CAD
5. CAM, and robots, do some assembly, assisted design and automation, productivity is increasing.

SPEAKING

8. Continue in pairs or in working teams the advantage and disadvantage of craft – industry and automated industry. Pay attention to the availability of the products.

LANGUAGE BOX

As far as I know; I beg you pardon; Is it really so; never mind; in general; I share the opinion of.
E.g. – I think the availability of these products is obviously seen.
– I beg you pardon?
– It seems to me…

READING

Text B

9. Discuss the information before reading the text.

1. What is the heat exchanger?
2. Where are they used in everyday life?
3. What types of heat exchangers do you know?

10. Skim the text [19] and do exercises after it.

PLATE HEAT EXCHANGER

Plate heat exchanger is a type of heat exchanger that uses metal plates to transfer heat between two fluids. This has a major advantage over a conventional heat exchanger in that the fluids are exposed to a much larger surface area because the fluids spread out over the plates. This facilitates the transfer of heat and greatly increases the speed of the temperature change. It is not as common to see plate heat exchangers due to the fact that they need well-sealed gaskets to prevent the fluids from escaping, although modern manufacturing processes have made them increase. The concept behind a heat exchanger is the use of pipes or other vessels to heat or cool one fluid by transferring heat between it and another fluid. In most cases, the exchanger consists of a coiled pipe containing one fluid that passes through a chamber containing another fluid. The walls of the pipe are usually made of metal or another substance with a high thermal conductivity, to facilitate the interchange, whereas the outer casing of the larger chamber is made of a plastic or coated with thermal insulation, to discourage heat from escaping from the exchanger. The plate heat exchanger (PHE) was invented by Dr. Richard Seligman in 1923 and revolutionized methods of indirect heating and cooling of fluids.

VOCABULARY

11. Match the synonyms (1-7) from the left column to the words (A-G) from the right column. E.g. 1-G.

1. Transfer	A. Curved
2. Conventional	B. Thanks to, owing to
3. Expose	C. Extend, stretch, expand
4. Spread out	D. Description

5. Increase — E. Enlarge, rise
6. Due to — F. Traditional, typical
7. Coiled — G. Move, convey, shift

Language development

12. Form the words with the suffixes –ment, –ion.

expose –
increase –
describe –
extend –
move –

13. Complete the chart below by inserting the missing form.

Verb	Noun	Adjective
	transformation	
		heating
convey		
	increment	
use		
		conducting
insulate		
	escape	
		exchanging
invent		
	facilitate	
		prevent
manufacture		

14. Rearrange these lines to make a text containing the words from the text B.

1. is a type, of heat exchanger, to transfer heat, between two, Plate heat exchanger fluids, that uses metal plates
2. to a much larger surface area, Conventional heat exchangers, are exposed
3. the speed, facilitates the transfer, of heat, and greatly increases, The process, of the temperature change
4. escaping, need well-sealed gaskets, to prevent, The heat exchangers, the fluids, from
5. consists of pipes, to heat or cool, one fluid. by transferring heat, between it and another fluid, The heat exchanger, or other vessels
6. are usually made of, metal or another, substance, The walls of the pipe, with a high thermal conductivity
7. is made of, the larger chamber, of a plastic or coated, The outer casing, with thermal insulation

8. was invented, by Dr. Richard Seligman, in 1923, The plate heat exchanger.

WRITING

15. Write a short technical description of a plate heat exchanger. Follow the plan:

1. construction features (components)
2. application
3. environmental behavior

SPEAKING

16. Combine a working team and discuss design, application of plate heat exchanger.

LANGUAGE BOX

Metal plates, well-sealed gasket, manufacturing process, pipes, vessels, chamber, plastic, thermal conductivity, transfer heat, substance

GRAMMAR BOX

Passive Voice is formed "TO BE + V_3"
*E.g. The advantage of this technique over others **is recognized** by many scientists.*
It is translated from Russian into English according to the structure of the English sentence.
Prepositions "By" and "With" are used in the Passive Voice.
E.g. The task was understood with the help of the designing project.

17. Translate the sentences paying attention to the bold words.

1. The heat exchanger in that the fluids **are exposed** to a much larger surface area because the fluids spread out over the plates.
2. The walls of the pipe **are usually made** of metal or another substance with a high thermal conductivity.
3. The outer casing of the larger chamber **is made** of a plastic or coated with thermal insulation.
4. The plate heat exchanger (PHE) **was invented** by Dr. Richard Seligman in 1923.
5. Heating and cooling methods of fluids **were revolutionized and used** by engineers.

18. Match the words from the language box.

1. The method in use is ___.

2. The program under development was ___.
3. The steam turbine now in service was ___.
4. The types of power plant in existence are ___.

LANGUAGE BOX
Strongly recommended to power thermal industry Required installation of new equipment Manufactured by Sibkotek Created by the engineers of the power thermal plant

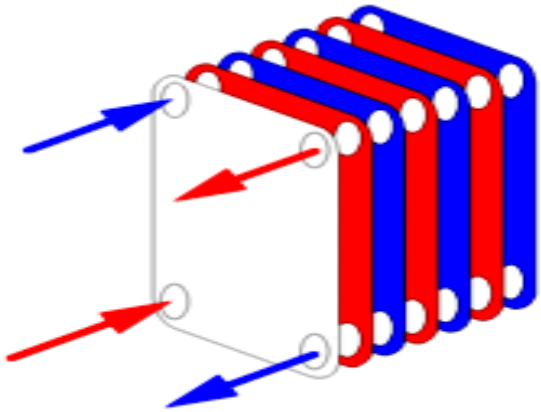
19. Give Russian equivalents to the following sentences. Determine the Passive voice in them.

1. Steam-turbine-driven direct-current generators are often used as spare exciters in steam power plants.
2. There are several components common to most turbine engines.
3. The combustion chamber pressure in the engine is very high.
4. Steam pressure measuring instruments are displayed in the hall.
5. Steam-and water circulating tubes were used in the thermal power engineering industry.

SPEAKING

20. Discuss in groups or in pairs the engineering design of the heat exchanger (picture 1).Try to describe the design process. The following plan will help you to do it. Pay attention to the language box.

1. Need recognition of the heat exchanger
2. Definition of a problem
3. Gathering information about the heat exchanger
4. Evaluation of this design
5. Communication of the design



Picture 1. *Heat exchanger*

LANGUAGE BOX

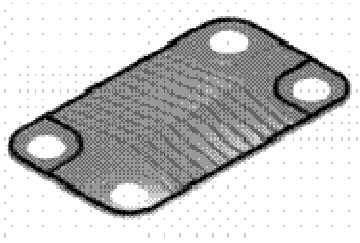
An alloy, a thermoplastic, mild steel, brass, aluminum, thermosetting plastic, high carbon steel
Conductor, copper, polyester resin, stainless steel, braze, weld, rust
Which…
-for example,…-
Such as…-

READING

Text C

21. Skim the text [16] and do exercises after it.

A SINGLE PLATE HEAT EXCHANGER



The plate heat exchanger is a specialized design well suited to transferring heat between medium- and low-pressure liquids. Welded, semi-welded and brazed heat exchangers are used for heat exchange between high-pressure fluids or where a more compact product is required. In place of a pipe passing through a chamber, there are instead two alternating chambers, usually thin in depth, separated at their largest surface by a corrugated metal plate.

The plates used in a plate and frame heat exchanger are obtained by one piece pressing of metal plates. Stainless steel is commonly used metal for the plates because it is able to withstand high temperatures, resistance to rusting while also being a strong material. The plates are often spaced by rubber sealing gaskets which are cemented into a section around the edge of the plates. The plates are pressed to form troughs at right angles to the direction of flow of the liquid which runs through the channels in the heat exchanger. These troughs are arranged so that they interlink with the other plates which forms the channel with gaps of 1.3-1.5 mm between the plates.

The plates produce an extremely large surface area, which allows for the fastest possible transfer. Making each chamber thin ensures that the majority of the volume of the liquid contacts the plate again aiding exchange. The troughs also create and maintain a turbulent flow in the liquid to maximize heat transfer in the exchanger. A high degree of turbulence can be obtained at low flow rates and high heat transfer coefficient can then be achieved.

A plate heat exchanger consists of a series of thin, corrugated plates which are mentioned above. These plates are gasketed, welded or brazed together depending on the application of the heat exchanger. The plates are compressed together in a rigid frame to form an arrangement of parallel flow channels with alternating hot and cold fluids.

As compared to shell and tube heat exchangers, the temperature approach in a plate heat exchangers may be as low as 1 ℃ whereas shell and tube heat exchangers require an approach of gives 5℃ or more. For the same amount of heat exchanged, the size of the plate heat exchanger is smaller; because of the large heat transfer area afforded by the plates (the large area through which heat can travel). Expansion and reduction of the heat transfer area is possible in a plate heat exchanger.

Another advantage of the heat exchanger is that it is easily dismantled for inspection and cleaning. The plates are also easily replaceable due to the fact that plates can be removed and replaced individually. The main weakness of the plate and frame heat exchanger is the necessity for the long gaskets which holds the plates together. Although these gaskets are seen as a weakness towards this type of heat exchanger, it has been successfully run at high temperatures and pressures.

Trough – canal

VOCABULARY

22. Match the synonyms (1-7) from the left column to the words (A-G) from the right column.

1. design	a. examine, check
2. transfer	b. plan, sketch
3. exchange	c. transmit, convey
4. obtain	d. get, achieve
5. run	e. go, flow
6. form	f. develop, figure
7. inspect	g. replace

23. Give Russian equivalents to the following pairs of words.

to heat – to reheat
to place – to replace
to use – to reuse
to link – to interlink
to make – to remake
to change – to exchange
to form – to reform

24. Tick the sentences true (T) or false (F).

1. The plate heat exchanger is a specialized design well suited to transferring heat between two surfaces.
2. Welded, semi-welded and brazed heat exchangers are used for heat exchange between high-pressure fluids.
3. The plates used in a plate and frame heat exchanger are obtained by one

piece pressing of metal plates.

4. Stainless steel is commonly used metal for the plates because it is not able to withstand high temperatures, resistance to rusting while also being a strong material.
5. The plates are seldom spaced by rubber sealing gaskets which are cemented into a section around the edge of the plates.
6. The plates produce an extremely large surface area, which allows for the fastest possible transfer.
7. The troughs also create and maintain a quite flow in the liquid to maximize heat transfer in the exchanger.
8. Expansion and reduction of the heat transfer area is possible in a plate heat exchanger.
9. Another advantage of the heat exchanger is that it is easily dismantled for inspection and cleaning.
10. The main superiority of the plate and frame heat exchanger is the necessity for the long gaskets which holds the plates together.

25. Complete the phrases (A-F) with a suitable preposition form the box and then match their meanings (1-6).

To, through, of, on

1. Suit	A. Owing to
2. Pass	B. As a result of
3. To be able	C. Comprise, contain
4. To consist	D. Can
5. Because	E. Match, fit
6. Due	F. Distribute

SPEAKING

26. Read the sentences paying attention to the Passives and give Russian equivalents.

1. Welded, semi-welded and brazed heat exchangers are used for heat exchange between high-pressure fluids or where a more compact product is required.
2. The plates used in a plate and frame heat exchanger are obtained by one piece pressing of metal plates.
3. Stainless steel is commonly used metal for the plates because it is able to withstand high temperatures, resistance to rusting while also being a strong material.
4. The plates are often spaced by rubber sealing gaskets which are cemented into a section around the edge of the plates.
5. A high degree of turbulence can be obtained at low flow rates and high heat transfer coefficient can then be achieved.
6. These plates are gasketed, welded or brazed together depending on the application of the heat exchanger.
7. The plates are compressed together in a rigid frame to form an arrange-

ment of parallel flow channels with alternating hot and cold fluids.
8. The plates are also easily replaceable due the fact that plates can be removed and replaced individually.

27. Make a plan of the text in the form of questions; speak on heat exchangers according to the plan.

E.g. What is the gist of the text from your point of view?

WRITING

28. Write the annotation of the text and entitle it.

Annotation – is a compressed logically connected description of the literary source. What is it?

All plate heat exchangers look similar on the outside. The difference lies on the inside, in the details of the plate design and the sealing technologies used. Hence, when evaluating a plate heat exchanger, it is very important not only to explore the details of the product being supplied, but also to analyze the level of research and development carried out by the manufacturer and the post-commissioning service and spare parts availability. For the above reasons, plate heat exchangers are used for better and more controlled heat transfer.

LISTENING

29. Listen to the text "A turbine" and make up a dialogue on the following topics.

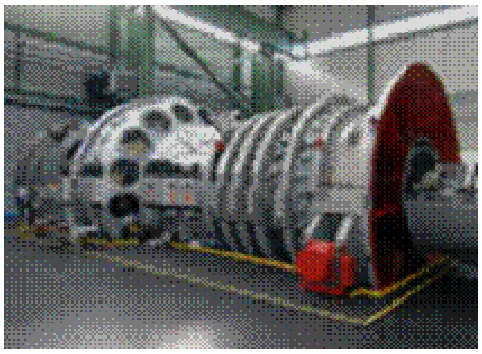
1. Two students are discussing the lecture they've just heard.
2. Two partners are discussing the turbine operation.
3. Two engineers are discussing the turbine's construction.

SPEAKING

30. Organize a team and work out the engineering project: "Turbine and its application in the thermal power industry" (picture 2). Pay attention to the language box.

LANGUAGE BOX

Technical specification, gas turbine, water turbine, design, dimensions, capacity, operation, application, environmental behavior, energy efficiency, production quality, spare parts, produce qualitative work, engineering design, economic efficiency, the correctness of operational process, analytical research of the different types of turbines.



Picture 2. *Turbine*

READING

Text D

31. Skim the text [20]; entitle it and every paragraph of the text.

1. Wind power is the fastest-growing energy source in the world. Siemens is rapidly expanding its manufacturing capacities in this exciting new business with powerful offshore wind parks, growing much faster than the market. With more than 6300 wind turbines around the world. Siemens helps to save up to 10 million tons of CO_2 emissions per year. As the market leader in offshore wind energy, Siemens offers the largest serially produced, offshore wind turbines with rotor blades sweeping an area bigger than a football field.
2. The world's largest gas turbine the Siemens SGT5-8000H is also the most powerful. Its capacity of 340 megawatts roughly equals that of 13 jumbo jet engines. In combined cycle operation, plants powered with this new gas turbine will generate 530 MW - enough to supply three million people with energy. A higher than 60 percent efficiency rate in combined-cycle applications (an increase of two percentage points) sets a new benchmark for efficient power generation and results in a reduction of CO_2 emissions by up to 40000 tons per year.
3. Superior technology for long-distance power transmission is key to generating the thousands of gigawatts of electricity required by our growing planet. But how can we efficiently transport it from remote power plants to populated areas, where it is needed? To overcome the limitations and energy losses of conventional alternating current (AC) transmission, Siemens built high-voltage direct-current (HVDC) transmission links, which are a more economical and ecological means of transporting electric power over distances of 600 km or more.
4. Buildings account for nearly 40 percent of global energy consumption. To address this massive challenge, Siemens offers measures that help reduce energy costs by 20 - 40 percent on average. Through energy Siemens plans and installs new intelligent building systems that guarantee savings in cost, energy consumption and CO_2 emissions. Under such a contract, Siemens identifies the potential for saving energy in a building through modernization and energy services. The investment pays for itself through the energy savings with no added costs incurred.

32. Read the text and fill in the gaps with suitable word from the box.

Wind power, energy, expand, capacity, wind turbine, market leader, blade, wind parks

___1 is the fastest-growing ___2 source in the world. Siemens is rapidly ___3 its manufacturing ___4 in this exciting new business with powerful offshore, ___5 growing much faster than the market. With more than 6300 ___6 around the world, Siemens helps to save up to 10 million tons of CO_2 emissions per year. As the ___7 in offshore wind energy, Siemens offers the largest serially produced, offshore wind turbines with rotor ___8 sweeping an area bigger than a football field.

33. Discuss with the partners the problem of energy efficiency.

The tough questions are: How will we cover the rising global demand for energy in the future? And at the same time: How will we supply energy in a way that is compatible with the climate and environment, reliable and also affordable? Energy efficiency will play a key role in meeting these challenges.

Role –play:

A. You are the representative of Siemens presenting on the operational meeting in the thermal engineering power company in Russia. You have to explain the colleagues of the turbine's specification and persuade them to conclude the contract.
B. Russian partners have to choose a type of the turbine and prepare a list of the questions, concerning this topic.

Case studies

34. Research the situation and prepare a presentation to give to the rest of the group.

READING

Text E

35. As a production manager of an electronics company, you must launch your new range of telephone answer machines to the trade. The following extract [12] from a sales brochure will give you some product ideas, but you may invent any information you wish about the company and its products.

Complete sophistication made simple

Giving a good first impression is vital in business. So in creating the combined telephone and answering machine for you, we've given you the means to record your welcome message digitally so it maintains consistent quality no matter

how many times it's played. Easy to use yet with a wide range of advanced facilities, the telephone is hands-free, meaning you can hold a conversation and work without having to juggle with the handset. On the other hand, if you want to keep things totally confidential, you can listen to the messages left for you using the handset, so that no-one else can overhear. The useful LCD panel shows you the number as you dial it. You can also use it to time calls if you need to bill call costs to customers.

Answering machine features include:

1. Call screening
2. Call intercept
3. Volume control
4. Message counter
5. Message save
6. Message erase
7. Memo message with indicator
8. Conversation recording
9. Ring time selector
10. Answer only capability
11. Tape full alert
12. Single micro-cassette
13. Play, pause, fast forward and rewind
14. Digitally recorded announcement
15. Private record/playback via handset
16. Color Ice Grey.

Telephone features include:

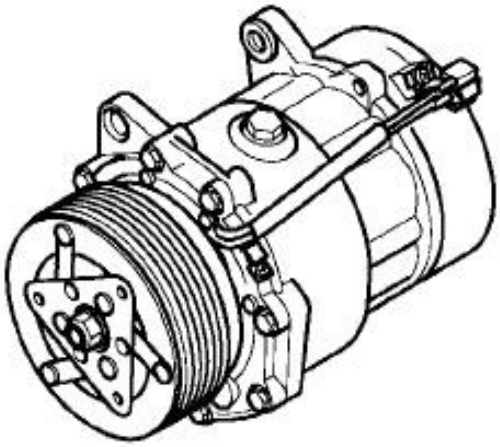
1. 20-number memory, last number redials
2. Ringer volume control, inductive coupler
3. Secrecy button, touchtone, dialing
4. Wall-mountable, hands-free operation
5. Call counter in answer-only mode

36. Work with a partner or in a group. Your company produces a range of equipment for power thermal industry (picture 3 - compressor, picture 4 - heat exchanger, picture 5 - drying unit and picture 6 - rectifier unit). They are an industrial profile of your company. Design your own new product. Think of a good brand name. The product will be succeeding in foreign and domestic markets. Pay attention to the language box.

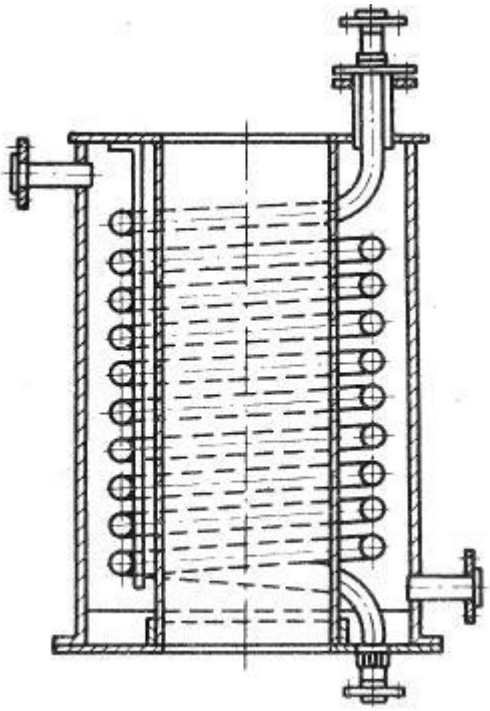
LANGUAGE BOX

Read the report on ideas for launching a new type of the product**.** Report from the meeting of the marketing department about launching possibilities new thermal engineering product. The marketing department offers one of the following ideas, you can share this opinion or not. Invite our major customers to a special conference and organize a treasure hunt.

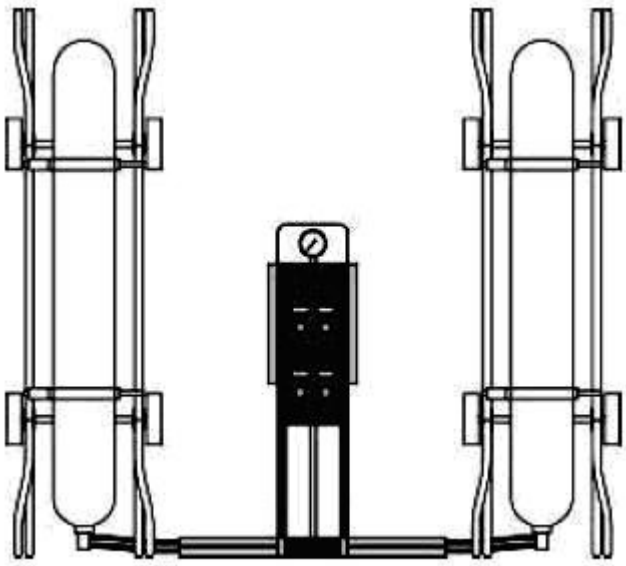
“The treasure” is the product which should be advertized. The technology displays with some effects, lightning. Invitations to some technical and engineering companies. A launch for the press. It is important to define the image of the product. The final decision should take into consideration both image of the product and the budget.



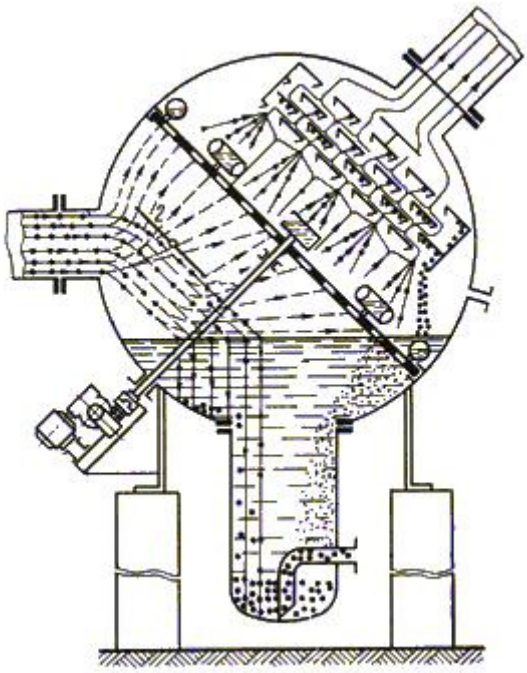
Picture 3. *Compressor*



Picture 4. *Heat exchanger*



Picture 5. *Drying unit*



Picture 6. *Rectifier unit*

37. Discuss in groups with your colleagues what problems lead to poor heat transfer and reduce the efficiency of the boiler. Find some positive solutions of the problem. Try to solve the problem, pay attention to the Language Box.

Boiler corrosion is it a sufficient problem for power thermal engineering industry?

Language Box
From the engineering point of view…
To attract new researches and technologies…
The idea has captured me…
To change the equipment…
To find a new supplier…
To attract investments…

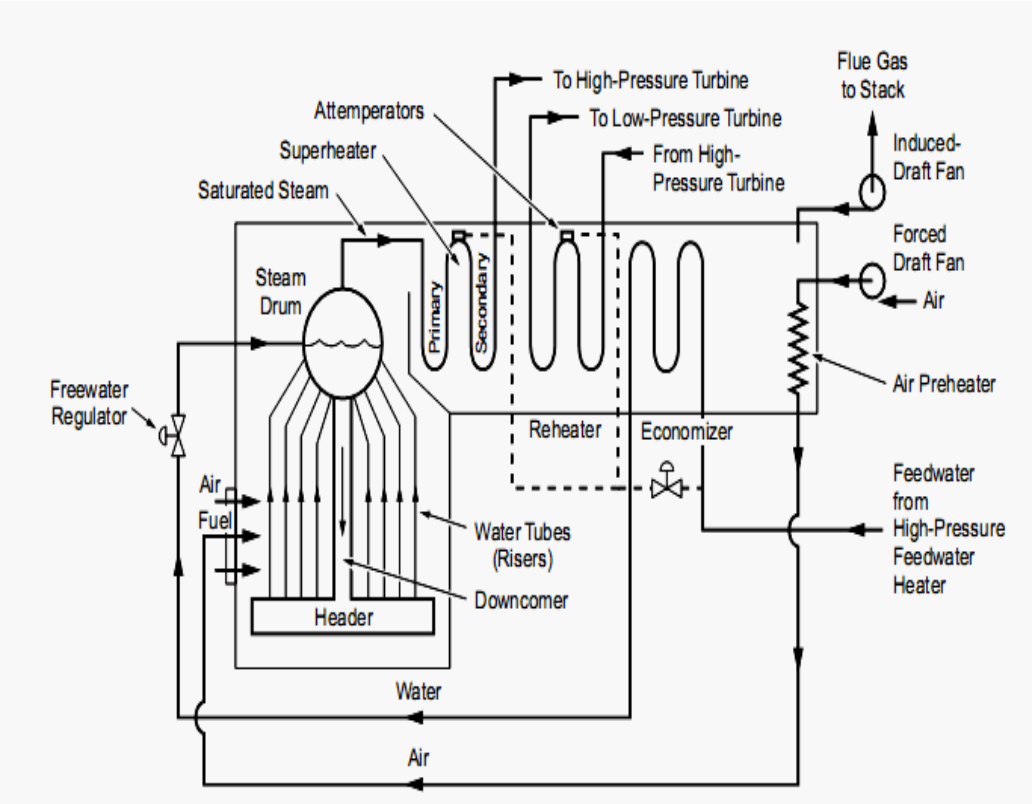
Skim the text [21] and discuss in groups extracted information from it. Discribe the operational principle of the boiler (picture 7) and name the main components of it.

Boiler

Two types of boilers are used in modern power plants: subcritical water-tube drum-type and supercritical once-through type. The former operates around 2500 psi, which is under the water critical pressure of 3208.2 psi. The latter operates

above that pressure, at around 3500 psi. The superheated steam temperature is about 1000°F (540°C) because of turbine temperature limitations. A typical sub-critical water-tube drum-type boiler has an inverted-U shape. On the bottom of the rising parties the furnace where the fuel is burned. The walls of the furnace are covered by water pipes. The drum and the super heater are at the top of the boiler. The falling part of the U houses the repeaters, economizer (water heater) and air preheater, which is supplied by the forced-draft fan. The induced-draft fan forces the flue gaseous of the system and sends them up the stack, which is located behind the boiler. A flow diagram of the drum-type boiler is shown in Fig. The steam generator has three major systems: fuel, air-flue gas and water-steam.

Fuel is mixed with air and injected into the furnace through burners. The burners are equipped with nozzles, which are supplied by preheated air and carefully designed to assure the optimum air-fuel mix. The fuel mix is ignited by oil or gas torches. The furnace temperature is around 3000°F. Ambient air is driven by the forced-draft fan through the air preheater, which is heated by the high temperature (600°F) flue gases. The air is mixed with fuel in the burners and enters into the furnace, where it supports the fuel burning. The hot combustion flue gas generates steam and flows through the boiler to heat the super heater, reheaters, economizer etc. Induced-draft fans, located between the boiler and the stack, increase the flow and send the 300°F flue gases to the atmosphere through the stack.



Picture 7. *Boiler*

UNIT 6. PROJECT AS A PRODUCT OF PROFESSIONAL ACTIVITY

Grammar: infinitive, word-combination "a number of", "the number of", phrasal verb "turn"
Speech strategy: opinion

1. Warming up activity:

- What types of projects do you know?
- Did you participate in any kind of a project?
- Is it necessary to posses some professional knowledge, education, experience in order to participate in some projects?

SPEAKING

2. Discuss the topic about the project. Pay attention to the chart below.

Project name		Project subject
1. Building 2. Thermal power engineering 3. Renewable 4. Mechanical engineering 5. Nuclear engineering 6. Energy saving	*Deals with* *Covers* *Considers* *Treats of* *Is concerned with*	A. Producing heat energy B. Creating new nuclear stations, reactors C. Constructing new buildings and objects D. Electric motors, generators, transformers E. Solar energy, wind energy, tide energy F. Energy calculations

3. Tick the sentences true (T) or false (F).

1. Building project considers creating new architectural forms and buildings.
2. Mechanical engineering is closely connected with electricity, designing electric motors, generators and transformers.
3. Energy saving isn't up-to-date issue.
4. Nuclear engineering project is going to be developed in Tomsk.
5. Thermal power engineering project in Tomsk is of interest.
6. Renewable project in Russia is under investigation.

LISTENING

4. Listen to the text "The Role of Technology in National Development" and discuss the question "Technology plays an important role in the professional activity".

LANGUAGE BOX

a fundamental role, in wealth creation, improvement of the quality of life, real economic growth, transformation in any society, industrial leaders in manufacturing and information technology, invest quite heavily in people and factories, designed plans and strategies, technology is viewed as a consumable item, technology is the primary engine of economic growth, provides the key to unlocking any country's potential, invest significantly in science and technology, the use and application of knowledge, skills, tools, materials.

READING

Text A

5. Scan the text in order to continue the nuclear engineering project. Before reading the text discuss some points with your partners, colleagues.

1. Nuclear energy is the future of our society.
2. Pros and cons of creating nuclear reactor in Tomsk.
3. Energy power will have been increased by 2015 in Tomsk.

Some useful facts about nuclear stations:

1. Approximately 440 nuclear stations in the world
2. Nuclear stations are located in 30 countries of the world
3. USA – 103; France – 59; Japan – 55; Russia – 31
4. 30 new nuclear reactors under construction.

NUCLEAR ENERGY

This is another important source of energy that is obtained from the energy that is stored in the nucleus of an atom [22]. This stored energy can be obtained by carrying out two types of nuclear reactions called nuclear fission reaction and nuclear fusion reaction. Nuclear Fission Reaction the process of splitting of a heavy nucleus into a number of light nucleus with the liberation of tremendous amount of energy and two or three neutrons is called nuclear fission.

In the fissioning of the Uranium-235 isotope, some mass of Uranium disappears (or is lost) and this small mass gets converted into tremendous amount of energy governed by Einstein's famous mass-energy equation

$$E=\Delta mc^2$$

Where E - energy released, Δm - difference in mass of the original nucleus and product nucleus, c - velocity of light . This energy is expressed in terms of electron volt. The fission of an atom of Uranium produces 10 million times the energy produced by the combustion of an atom of carbon from coal.

Nuclear energy is produced in a nuclear reactor which is a device to generate electricity and used Uranium-235 as its fuel. In this reactor the energy released is controlled or sustained which is called as sustained fission reaction. Otherwise the energy goes out of control which becomes an explosive fission re-

action. The energy is controlled by retaining just enough neutrons to undergo fission and the excess neutrons are absorbed by the control rods in the reactor.

Principle of nuclear power production

Nuclear fission which takes place inside the reactor produces tremendous heat. This heat energy is used to boil water to form super-heated steam, which in turn rotates the turbines to generate electricity.

Advantages of Nuclear Power

- Nuclear power is a viable option where fossil fuels like coal are not available.
- If operated properly, nuclear power plants produce less atmospheric pollution than thermal power plants.
- It consumes very little fuel. It can operate for more than a year without needing new fuel elements.
- A sizeable amount of fuel (uranium and plutonium) can be reclaimed by processing the spent fuel material in contrast to fuels like coal which cannot be reclaimed.
- Some radioactive byproducts in the process are used in medicine and industry.

Disadvantages

- In case of accidents or explosion, the radioactive materials can contaminate vast areas of land, crops, water, people etc.
- The number of safety measures that has to be considered before setting up a plant makes the construction of the plant expensive.
- The disposal of radioactive wastes in the fission process is a major problem. Expensive long-term storage areas have to be built.
- They also pose security problems, as the fuel and the by-products can be used to build nuclear weapons.

Conclusion

Currently all commercial reactors are based on nuclear fission. But there is another possibility of nuclear energy generation by a safer process called nuclear fusion. Nuclear fusion is the combining of two lighter nuclear to form a heavier nucleus, most commonly used are the hydrogen isotopes to create helium. It is the source of energy in the sun. It happens continuously in the atmosphere of the sun and takes place at extremely high temperature.

VOCABULARY

6. Match the synonyms (A-H) from the left column to the words (1-8) from the right column. E.g. B-4.

A. Source	1. Pollute
B. Store	2. Machine
C. Carry	3. Quantity
D. Tremendous	4. Keep

E. Amount	5. Bear
F. Convert	6. Resource
G. Device	7. Magnificent
H. Contaminate	8. Transmit

Phrasal verb

turn – to move or cause to move around an axis
to turn + adjective – to become
E.g. to turn old
to turn on – switch on
to turn off – switch off
to turn out – to dismiss, discharge, or expel
to turn into – change into
to turn to – invert, apply to
to turn out to be – prove to be

7. Make up your own sentences with the phrasal verb.

E.g. Water turns into steam very slowly.

WRITING

8. Read the text given below and render it in Russian.

Nuclear energy is produced in a nuclear reactor, which is a device to generate electricity and used Uranium-235 as its fuel [22]. In this reactor the energy released is controlled or sustained which is called as sustained fission reaction. Otherwise the energy goes out of control which becomes an explosive fission reaction. The energy is controlled by retaining just enough neutrons to undergo fission and the excess neutrons are absorbed by the control rods in the reactor.

SPEAKING

Topics for discussion

Nuclear fission which takes place inside the reactor produces tremendous heat. This heat energy is used to boil water to form super-heated steam, which in turn rotates the turbines to generate electricity.

1. What problem may occur during nuclear fission?
2. In what way can you solve the problem as an engineer?
3. Appreciate the effectiveness of the process from the economic and engineering point of view.

GRAMMAR BOX

A number of – (целый) ряд, некоторое количество
The number of – количество раз которое случается

9. Give Russian equivalents to the bold words.

1. This property was demonstrated by a **number of** experiments.
2. The problem will be described in a **number of** articles.
3. **The number of** scientists taking part in the scientific conference at our university is increased from year to year.
4. A great **number of** scientists have arrived in our country last week.
5. **The number of** nuclear stations is increased in our country from year to year.
6. **The number of** electrons in atom depends on the kind of atom.
7. **The number of** tourists visiting our country has been increased.

GRAMMAR BOX

The Infinitive is non finite form of the verb, denoting state.
E.g. to sleep, to work, to read.
The Infinitive has some constructions:
Подлежащее+сказуемое+дополнение+Infinitive
E.g. We know them to study the proposal thoroughly.(complex object)
(Мы знаем, что они изучают предложение тщательно)
Подлежащее+сказуемое+Infinitive
E.g. The method is reported to give good results.(complex subject)
(Сообщается, что этот метод дает хорошие результаты)

10. Give Russian equivalents, paying attention to the Infinitives and Infinitive Constructions.

E.g. We have a number of problems to be solved.
(Существует ряд проблем, которые нужно решить.)

1. New types of reactors were reported to have been developed.
2. Several atomic power stations are supposed to be built in our country within the next few years.
3. The power station to be built on this river will supply the town with electric energy.
4. The mechanism is believed to be the best for converting heat into work.
5. The new plant is reported to have gone into operation in our town.
6. We consider this instrument to be useful for different purposes.
7. Industrial economic equipment is known to play a very important role today.
8. To carry heat for a special area there must be heat exchangers which convey heat easily.
9. One inch is known to equal 2.54 centimeters.
10. Our country was the first to use atomic energy for peaceful purposes.

SPEAKING

PRESENTATION

11. Discuss the following questions.

1. What is a presentation?
2. For what purpose are presentations made in business?

3. What makes a presentation effective?
4. What is the worst presentation you have ever experienced?
5. Even experienced presenters can make mistakes during a presentation. Can you give any example from first-hand knowledge?

Hints for a successful presentation

- **Planning.** Plan your presentation carefully. Thorough preparation will make you more confident and help to overcome your nervousness.

- **Objectives.** What do you want to achieve. Are you aiming to inform, to persuade, to train your audience.

- **Content.** Brainstorm your ideas first. Try to carry out your objectives and researches properly. Be selective! Don't try to cram too much into your presentation.

- **Approach.** Try to develop your key points in an interesting and varied way, drawing on relevant examples, figures.

- **Organization.** Your presentation should have a clear, coherent structure and cover the points you wish to make in a logical order. The presentation starts with a brief introduction and end with a brief conclusion. Use the introduction to welcome the audience, introduce your topic/subject, outline the structure of your talk and provide guidelines on questions. Use the conclusion to summarize the main points of your presentation, thank the audience for their attention and invite questions.

- **Visuals.** Visual aids can make a presentation more interesting and easier to understand but make sure they are appropriate and clear – don't try to put too much information on each one.

- **Rehearsal.** Allow time to practice your presentation – this will give you a chance to identify any weak points or gaps. You will also be able to check the timing and make sure you can pronounce some figures and proper names correctly and confidently.

- **Delivery.** Try not to speak too fast during the first couple of minutes. Try to be enthusiastic – your interest in the subject matter will carry your audience along. Use short words and sentences that you are comfortable with. There is no benefit in using difficult language.

12. Presenting water turbines using slides.

13. Referring to the information in the slides below give a presentation in front of the group about any kind of water turbine. Prepare what you will say about each of the slides. Consult Box Language, Model Answer.

Slide 1. The Francis turbine:

- Used when the head is 30-3000m.
- 24 curved blades
- Vertical axle
- Operates underwater
- Reaction turbine.

Slide 2. The Pelton wheel impulse turbine:

- Used with heads of more than 300m.
- Single wheel mounted in horizontal axe
- Water handing with help of penstock.
- Penstock-long pipe, through it water drops on the turbine.

Slide 3. The Kaplan turbine:

- Used for head of less than 30 meters
- Rotor resembles a ship propeller
- 3-8 blades on vertical axle
- Reaction turbine.

LANGUGE BOX

1. I'd like to present some information about…
2. I'd like to start with…
3. My presentation will consist of three parts. First, I'd like to look at… finally I'd like to give the outlook of…
4. My first point is to define what is the turbine
5. Let me turn to…
6. Let me start with some data about the cost of…
7. What are the advantages/disadvantages of…
8. So, that completes my overview of the current question

Model answer

Slide 1. The Francis turbine is used when the head is between 30 and 300 meters. The Francis turbine is enclosed in a casing. The wheel has 24 curved blades. The axial is vertical. The wheel of the turbine operates under water. The rotor is turned by the weight of the flowing water pressure.
Slide 2. The Pelton wheel impulse turbine is used with heads of more than 300 meters. A Pelton`s rotor consists of a single wheel mounted on horizontal axle. Water from a lake or reservoir drops toward the turbine through a long pipe called a penstock.
Slide 3. The Kaplan turbine is used for heads less than 30 meters. The Kaplan rotor resembles a ship's propeller. Kaplan turbine is the reaction turbine.

READING

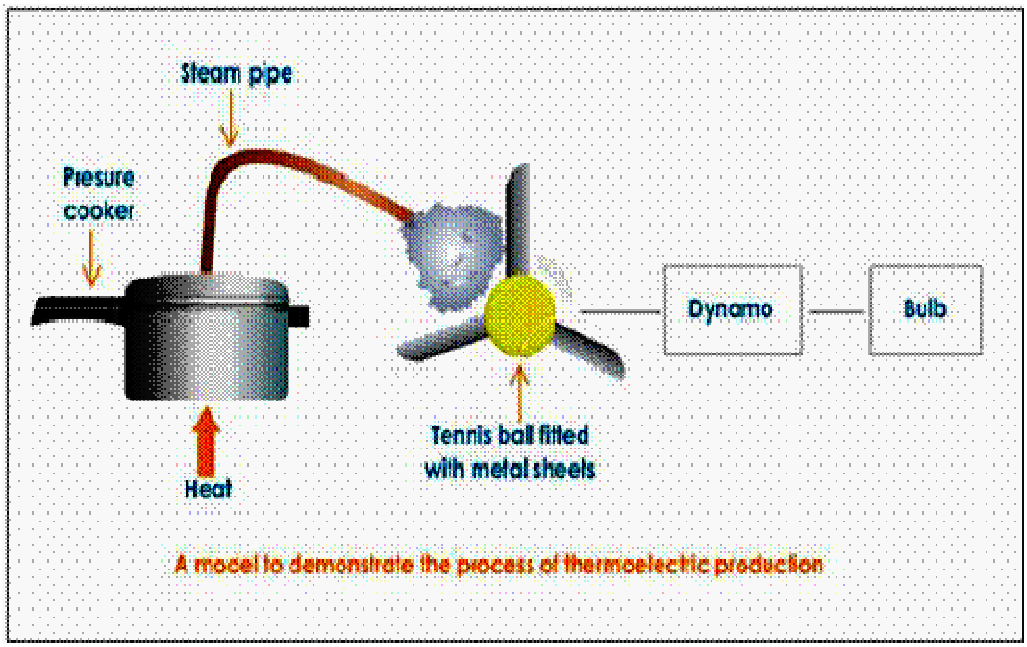
Text B

14. Scan the text [10].

THERMAL POWER PLANT (THERMAL ENERGY)

Large amount of fossil fuels are burnt everyday in power stations to heat up water, to produce steam which further runs the turbines to generate electricity. The transmission of electricity is more efficient than transporting coal or petroleum over the same distance. Therefore, many thermal power plants are set up near coal or oil fields. In a thermal power plant, heat energy is converted into electrical energy (**picture 1**).

A simple example to demonstrate the working of a thermal power plant.



Picture 1. *A model to demonstrate the process of thermoelectric production*

VOCABULARY

15. Match the synonyms (1-4) from the left column to the words (A-D) from the right column. E.g. 1-B.

1. amount	A. to warm
2. to heat	B. quantity
3. to produce	C. to convey
4. to transmit	D. to generate

16. Make up collocations using the words from the text 14.

17. Make up sentences with the collocations.

E.g. Large amount of fossil fuels are concentrated in the north of Tomsk region.

Many thermal power plants in Tomsk are feed up by the coal.

SPEAKING

18. In pairs discuss the operational process illustrated on the picture 1. Pay attention to the Language Box.

LANGUAGE BOX
-Oh, I find it is essential for me! -I beg your pardon? -The operational process…

19. Prepare a small talk about the picture 2 below. Pay attention to the words below. *"Water is a great way to conduct heat, out of your body quickly".*

Picture 2. *"Water is a great way to conduct heat, out of your body quickly"*

20. What is the thermal process illustrated in the picture?

LANGUAGE BOX
Heat transfer conditions, evaporation process, environmental state, heat conduction, conductivity heat

READING

Text C

21. Read the text [23] and do some exercises.

MY BIGGEST MISTAKE

David Arnold, 36 is director of studies at Ashridge Management College and a marketing consultant for such multinationals as Merck, Alfa-Laval and Boots. After a degree in English Literature at University College London and in modern drama at London University, he began a career in publishing in 1979 as an editor

for Mitchel Beasly. He moved to Ashridge in 1984 as a marketing manager and later after taking an MBA at City University, became a tutor on Ashridge MBA course. His book, The Handbook of Brand Management, is published by Century Business.

My biggest mistake was failing to find out who was going to be in the audience before I gave a speech. It was two years ago, when I had been invited to be guest speaker at the annual management conference of a major clothing supplier, a company that relied on Marks &Spencer for more than 75% of its sales.

My brief as a guest speaker was to get the audience to think strategically about changing market. The conference was held at Cleneagles. I had to speak for an hour and a half to 70 managers and when I began they were very subdued.

I decided to raise the level of challenge in order to get some reaction. When my first attempts proved unsuccessful, I turned to my last resort: I suggested that Marks & Spencer, their lifeline wasn't the paragon of business success they thought it was.

Now this did spark some reaction, but the audience was still more subdued than most groups – so I actually started being rude about their beloved Marks & Spencer. I justify these insults by saying I needed to make them ask a difference perspective and even commented that I suspected the reason they were being quiet was because they were very loyal to their major customer.

I could see they were all thinking hard – they weren't asleep or anything – and I assumed they were thinking about company issues. But at the end of the session, when we took a break for coffee, a senior director sidled up and said he had something to tell me. He took me aside and informed me that the reason they had been so quite was because sitting next to him in the front row was their chief customer in person, one of the head buyers of M&S. At that point my heart hit my boots and I realized I had made the most awful error of judgment. When I spotted the buyer, I remember going to enormous efforts to avoid him.

I managed to escape, but only at the expense of leaving my coat behind in the conference room, where everyone had assembled after coffee. I couldn't face going back in. The other thing I couldn't face was sending the company an invoice for the agreed speaker's fee or for my expenses in travelling to Scotland.

Looking back, I remember a lot of fidgeting going on during my speech. I thought it was because I was talking about their most valued customer. It was the squirming of the senior director in the front row that I remember most. Clearly, he was trying to make a judgment about whether he should speak up and halt me in the mid flow.

I think it would have been better if he had. The night before, I had joined them for dinner and had become quite chummy with a lot of them, which is probably why I thought I was safe in taking the risk of winding them up. But it was a mistake to assume I understood why people were reacting the way they were. It was a fatal assumption, because it was wrong. As a result, I was more critical about Marks& Spencer that I normally would have been and certainly more than was necessary.

I still can't believe that doing the job I do. I didn't find out who was there beforehand. I've had no communication with the company since but the lesson to be learned is quite simple. In meetings, conferences or presentations of any sort always make sure you find out exactly who you are speaking to.

VOCABULARY

22. Learn the words.

brief – short
paragon – example, model
subdue – conquer
resort – to sort again
insult – speak to rudely; offend
assume – undertake
sidle – to move along sideways
spot – fault
fidget – to move about restlessly
squirm – to feel deep mental discomfort
halt – stop
chummy – sociable
wind up – bringing to or reaching a conclusion

23. Match the words (A-E) with their definitions (1-5). E.g. B-1.

A. To find out	1. To trust
B. To rely on	2. To address oneself to
C. To turn to	3. To address to a person
D. To speak to	4. To speak more loudly
E. To speak up	5. To gain knowledge of smth.

SPEAKING

24. Make up your own sentences with the word-combinations above.

E.g. I found out the correct conclusion of the existing problem at the power thermal plant.

25. Rearrange the sentence. Try to comment on the sentence below. Pay attention to the Language box.

In meetings, of any sort, always you find out exactly, make sure, who you are speaking to, conferences or presentations

LANGUAGE BOX
In my opinion/view…
To my mind…
I think/suppose/believe/consider…
It seems to me that…
As far as I'm concerned…

Discussion points

1. Why did David Arnold start making critical comments about Mark and Spencer in his talk?

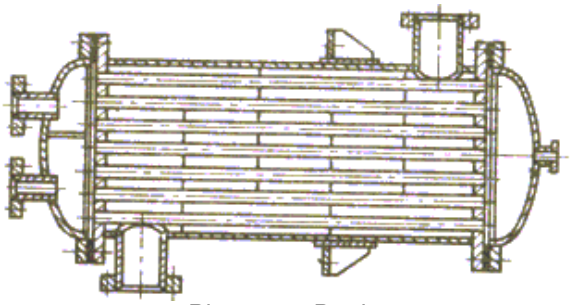
2. How did the audience react?
3. How did he interpret the audience's reaction and respond?
4. What awful error of judgment did the senior director bring to his attention in the coffee break?
5. How did David Arnold respond to this piece of news?
6. With hindsight, what was the true significance of the audience's body language?
7. What was David Arnold's biggest mistake?
8. What did Arnold learn from the experience?

LISTENING

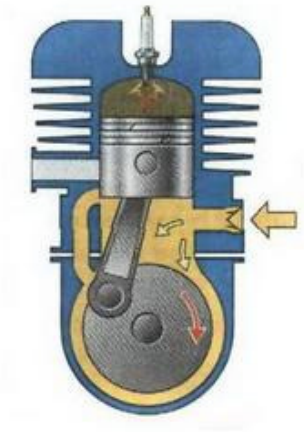
26. Listen information about the product and define what does the abbreviation "USPs" mean? (Unique selling products).

SPEAKING

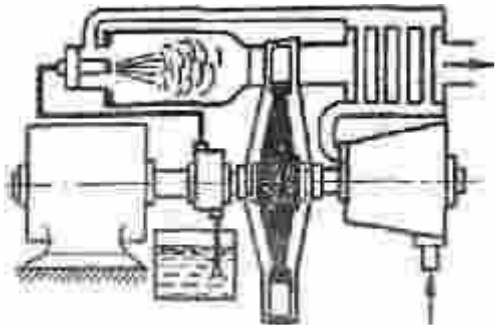
27. Look at the pictures below and find what products are shown?



Picture 3. *Device*



Picture 4. *Engine*



Picture 5. *Unit*

28. Work in pairs. For each product discuss the following.

1. What are the features of the product?
2. What are the products benefits to the customer? What are USPs?

3. What type of customer probably buys this product?

LANGUAGE BOX

shell-and-tube heat exchanger, efficient and comfortable heating and cooling technologies, plate heat exchanger, currently available, water heaters, products meet strict energy efficiency, to boost tank fed supplies, performance, products that make a difference, application, unit dimensions, in my opinion, I think, consider, operational performance, mass carrier, heat exchange surface, internal combustion engine, heat exchanger kinds, internal combustion engine types, pipes quantity, geometric characteristics of pipes, mass carrier flow, temperature range, used materials, fuel waste products, gas turbine unit, types of gas turbine unit, environmental behaviour

WRITING

29. For each of the products, complete the table with words from the Language Box.

Product name	**Dimensions(Length) (approximately)**	**Shape (width) (approximately)**	**Where is it from?**	**What it is made of?**
Plate heat exchanger	460 mm	160 mm	Germany	Special alloys

30. Which of the products do you like to own and why?

Product presentation

READING

Text D

31. Read the text "Air-to-Water Heat Pump"[2] and choose the correct answer.

AIR – TO – WATER HEAT PUMP

In heating applications, heat is removed from ambient air. A heat pump works by driving a working fluid around a refrigerator circuit containing four elements: evaporator, condenser, expansion valve. The working fluid to gas (evaporates) as a heat is absorbed from the heat source. Later in the cycle, the working fluid condenses to liquid as heat is released to where it is needed. A heat pump can be used for cooling with the addition of a reversing valve that reverses the direction of the working fluid and so the direction of the heat transfer. The central

component of the heat pump is the compressor. This is usually driven by an electric motor, although gas engine driven compressors are also available.

1. What is the name of the product?
    a. gas turbine unit
    b. water heat pump
    c. internal combustion engine
2. The presenter describes the product as
    d. device
    e. unit
    f. machine
3. To launch the product you need
    g. to advertise its technical characteristics
    h. pay a very careful attention to the design
    i. manufacture
4. Which special features should be mentioned at first
    j. compressor is the central part of the pump
    k. save energy
    l. heat source is the central part of the pump
5. In order to see a person you are offering the product on the market
    m. you need to have the product
    n. the buyer needs the product
    o. both parties need the product

32. Present the product as a project of professional activity. Make up the presentation and be ready to answer the questions according your topic. Speak on the following topics:

1. Multistage compressor
2. Steam-power unit
3. Boiler
4. Gas turbine unit
5. Internal combustion engines
6. Heat pumps
7. Heat exchanger
8. Air refrigeration engine
9. Drying unit
10. Rectifier unit

READING

Text E

33. Read the text and answer the questions after it.

Modern heat insulating materials

A strong tendency of the increase requirements to modern heat insulating materials is being obviously seen nowadays. It is arisen by the resource-saving principle of the world industry development. Thus, the production of high efficient

insulating materials is one of the most important task at present. The main function of insulating materials is the reduction of heat loss. Heat insulating materials must have a small factor of the thermal conductivity, a small volume mass, humidity resistance, mechanical strength, hard combustibility, frost resistance, homogeneous finely porous structure, bacterial and chemical resistance and environmental safety.

Qualitative heat insulating materials are very expansive products. For example, the cost of insulating materials in refrigerators is 25-40% of the whole construction site. So, the question of economic profitability of producing material is vivid nowadays. Thus, the most important item of creating resource effective production technology arises today. The most significant role in this process is belonged to raw material resources.

Existing heat insulating materials can't meet all the above mentioned requirements. That's why it is necessary to depict those materials which have the most optimal and economically effective characteristics. According to given estimated calculations and comparing analysis one of those materials is viralit (artificial foamed stone) [26]. Getting possibility of viralit is produced by the nature. Under the volcano eruption the firing clinker is contacting with the earth crust and under the high temperature the thermal processing of the loams are being produced by the natural way. This natural phenomenon was noticed long ago by many famous scientists. The natural principle of loams processing has been realized for the technological base of viralit production (picture 1). The main properties of which are given in the table 1.

The Combination of high constructional strength, heat insulating properties and economical efficiency allow to build objects without using additional insulating materials and to reduce the damage and production cost price. Being developed a new power and resource-saving technology of getting porous glass-ceramic material "Viralit" has a very wide application in such industrial branches as building, power energy, nuclear power, metallurgical, chemical and others. Having used scientific principles are being assumed the further improvement of the produced technology and creating new high efficient materials of strategic meaning. "Viralit 1000" (picture 2), for example possess unique thermal physical characteristics with high strength properties in comparison with the existing thermal safety materials. Viralit's technology allows governing by strength and heat insulating properties of being get material at the wide ranges, and modify material's properties according to the product's thickness, overlapping heat insulating and ornate finishing functions.

For example, the characteristic property of this technology will allow regulating the heat extraction out of the cooled melt. The process impacts on the shrinkage of the crystallized material and considerably influence the quality of the getting product in the technological processes of metallurgical industry [27-29]. "Viralit 1000" will be taken as the used material for casting molds. Taking into consideration the condition of the heat exchange under melting [30] of the viralit construction, one can considerably reduce the velocity destruction material in the case of the emergency situation at the nuclear station.

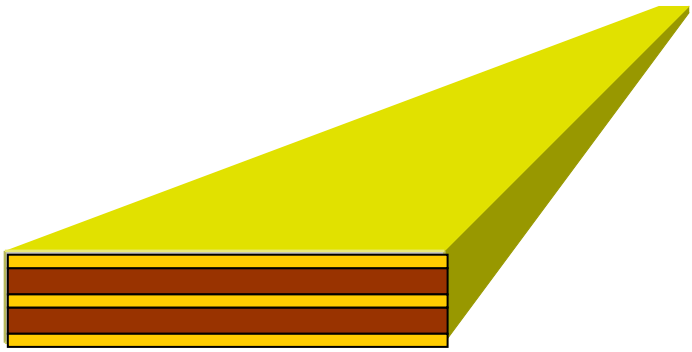
The production of sandwich large block material (picture 3) allows creating building objects which are the perfecting product's development [31].

Table 1. *Main characteristics*

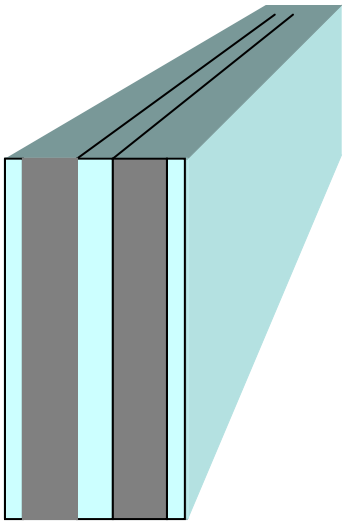
Material's application	Density, kg/m^3	Strength, bar	Heat conductivity factor, W/(m·deg)	Freeze resistance
Thermal insulation	300	25	0,09	NOT LESS 50
Loading structures	1200	450	0,25	NOT LESS 50
Low material cost				
High environmental purity				

Picture 1.*Constructional heat-insulating material "Viralit" of different types*

Picture 2. *“Viralit 1000”*



a)



b)

Picture 3. *Sandwich large block materials: a) panel, length 6m and more; b) heat insulating block “sandwich”. Sidewall and medium wall from high-strength reflector ceramics, inner lay is porous*

What materials are called heat insulating?

What properties must heat insulating materials possess?
What material's properties of heat insulating material are the most significant?
In what way do you understand the resource-saving principle?
What heat insulating materials are being regarded high-performance?
What technical areas are these materials being used?
What heat insulating materials do you know?
What is the economic efficiency of produced material?
What is the economic facet of raw material resource?
What is treating principle of raw materials being laid in the technological base of "Viralit"?
What characteristics of material does the technology "Viralit" allow to govern?
What main functions does the material possess?
What structure does the glass ceramic material "Viralit" possess?
What industrial spheres can be the material used?
What do you mean by high performance material of strategic trend?
What the benefits does "Viralit 1000" possess in comparison?
What are the perspectives of enhancement "Viralit 1000" existing?
In what way the use of "Viralit 1000" can influence the product's quality in the technological process of metallurgical industry?
What properties of "Viralit 1000" do allow reducing the destruction velocity of technological construction in the case of emergency situation at the objects of nuclear industry?

Attachment 1

АНГЛО-РУССКИЙ СЛОВАРЬ ТЕРМИНОВ И СПЕЦИАЛЬНЫХ СЛОВОСОЧЕТАНИЙ

adiabatic process	адиабатный процесс
abstracted heat	отведенная теплота
absorption	поглощение, абсорбция, впитывание
area of heating surface	величина поверхности нагрева
aspirator	эжектор, вытяжное устройство
air casing	воздушная рубашка
ash catcher	золоуловитель
air mixing chamber	смесительная камера
air channel	воздухопровод, вентиляционная труба
air chimney	вентиляционная труба
air cleaner	воздушный фильтр
ash collection	золоулавливание
air-cooled condenser	конденсатор с воздушным охлаждением
air cooler	воздухоохладитель
annular tunnel dryer	сушилка кольцевая туннельная
air heater	воздухоподогреватель
behavior of flow (stream)	режим течения
behavior of individual molecules	поведение отдельных молекул
boiler arrangement	схема котлоагрегата
baffler	дроссельный клапан
balance of heat	тепловой баланс
bleed	отбор пара, сопло
boil	кипение, кипеть
(to) boil down	выпаривать
breeching	газоход
bubbling	кипение, барботаж
boiler capacity	производительность котла
boiler circuit	контур циркуляции котла
boiler circulation	циркуляция (воды) в котле
boiler construction code	правила по устройству изготовлению котлов
boiling coefficient	коэффициент теплоотдачи при кипении
boiler component	элемент котлоагрегата
boiler plant	котельная установка
balanced condition	состояние равновесия
basic operating conditions	основные рабочие параметры
brine cooler	охладитель рассола
batch dryer	сушилка периодического действия
blower	вентилятор

calandria	выпарной аппарат
calorific parameter	калорический параметр
calorific capacity	теплота сгорания
capacity	объем, емкость, производительность, мощность
casing	корпус, кожух, рубашка, оболочка
cast-iron pipe	чугунная труба
Carnot cycle	цикл Карно
Carnot refrigeration cycle	обратный цикл
Carnot vapour cycle	паровой цикл Карно
cavity	полость, каверна
cell	ячейка, элемент, камера, датчик
channel	канал, трубопровод
chamber	камера
chamber dryer	сушилка камерная
chart	диаграмма, схема, график, номограмма
chemical composition	химический состав
chimney	дымовая труба
circulation	циркуляция
circuit	цикл, контур, циркуляция, схема
circuit of installation	схема установки
cinder catcher	золоуловитель
classical approach	классический подход
closed system	закрытая система
cock	клапан
code	технические условия, правила эксплуатации
coefficient of conductivity	коэффициент теплопроводности
coefficient of cubical expansion	коэффициент объемного расширения
coefficient of discharge	коэффициент расхода
coefficient of efficiency	коэффициент полезного действия
coefficient of expansion	коэффициент расширения
coefficient of heat passage	коэффициент теплопроводности
coefficient of heat transfer	коэффициент теплопередачи
coefficient of performance	производительность
coefficient of safety	коэффициент надежности
coil	змеевик
colorimetric analysis	колориметрический анализ
combustion chamber	камера сгорания
combustible constituent	горючий компонент
composition	состав, компоновка
compressor	компрессор
compression	сжатие, компрессия
compression work	работа сжатия

condenser	конденсатор, холодильник
condensing coefficient	коэффициент теплоотдачи при конденсации
conditioning	кондиционирование воздуха для жилых помещений
conditions of constant mass flow	условия постоянства массового расхода
congeal	замораживать
consumption	потребление, расход
contact heat exchanger	смесительный теплообменник
contracted channel	суживающийся канал
content	содержание, объем
contraflow	противоток
controlled consumption	регулируемый расход
convergent-divergent channel	сопло Лаваля
conversion	преобразование, превращение
constant-pressure process	процесс изобарический
constant-volume process	процесс изохорический
constituent	составная часть, компонент
continuous dryer	сушилка непрерывного действия
continuous through dryer	сушилка конвейерная
control circuit	схема управления
control surface	контрольная поверхность
control volume	контрольный объем
conjugate/ nonconjugate	сопряжённый/ не сопряжённый
cooling agent	холодильный агент
coolant	охлаждающая среда, хладоагент
coolant conditions	условия охлаждения
cooler	холодильник
coolant circuit	контур теплоносителя (охладителя)
cooling circuit	контур охлаждения
cooling coil	змеевик холодильника
cooling-tower condenser	градирня-конденсатор
cooling apparatus	холодильник, охладитель
copious cooler	глубокое охлаждение
daily steam consumption	суточный расход
damp air	влажный воздух
deaerator	деаэратор
deep cold	глубокий холод
depends on	зависеть от
diffusion coefficient	коэффициент диффузии
dimension of parameter	размерность параметра
displacement chamber	рабочий объем цилиндра
draw-in air	всасываемый (засасываемый) воздух
drying apparatus	сушильный аппарат
drying cell, drying chamber, drying	сушильная камера

compartment	
drying drum	сушилка барабанная
dual circulation	двухступенчатое испарение (в котле)
dust catcher	пылеуловитель
dust collection	пылеулавливание
dynamic behavior	динамические характеристики
dynamic coefficient of viscosity	динамическая вязкость
effective tool for engineering analysis and design	эффективный инструмент для инженерного проектирования и компоновки
energy conversion	преобразование энергии
enthalpy	энтальпия
enthalpy-entropy diagram	h-s диаграмма
entropy	энтропия
entropy-temperature diagram	s-T диаграмма
equilibrium	равновесие
essence	сущность
evaporated condensate	конденсат испарителя
evaporation capacity	паропроизводительность, испарительная способность
evaporating circuit	испарительный контур
evaporative cooling	испарительное охлаждение
evaporator	испаритель
expansion cock	дроссельный клапан
expansion work	работа расширения
explosion chamber	камера сгорания
extensive properties	экстенсивные свойства
extent	размер, степень
external work	внешняя работа
extraction cycle	регенеративный цикл
fan	вентилятор
feed circuit	контур питания
feed pump	насос питательный
feedwater conditioning	подготовка питательной воды
feed-water economizer	водяной экономайзер
feedwater-heater arrangement	схема подогрева питательной воды (устройство)
flash chamber	испаритель
flow chart	технологическая схема
flow control	регулирование расхода (потока)
flowdryer	сушилка поточная
final parameter	конечный параметр
fixed	неподвижный, стационарный
force convection	вынужденная конвекция
force feed circulation	принудительная циркуляция
fraction composition	фракционный состав

free air	атмосферный воздух
free-convection cooling	естественное охлаждение
fuel cock	топливный кран
fuel control assembly	регулятор подачи топлива
functional dependence	функциональная зависимость
furnace chamber	топочная камера
gas analyzer	газоанализатор
gas checker chamber	газовый генератор
gas cleaner	скруббер
gas constant	газовая постоянная
heat capacity	теплоемкость
heat carrier	теплоноситель, проводник тепла
heat content	теплосодержание
heating body	нагревательный прибор, радиатор
heat booster	подогреватель
heating control	регулирование нагрева
heating controller	терморегулятор
heating chamber	нагревательная камера
heat conversion	преобразование тепла
heat exchange	теплообмен
heat-exchanger circuit	контур теплообменника
heat-exchange coil	змеевиковый теплообменник
heat-producing capability	теплопроизводительность
heat-to-work conversion	превращение тепла в работу
heat-transfer area	поверхность теплообмена
heat-transfer behavior	режим теплопередачи
heat-transfer coefficient	коэффициент теплопередачи
heavy air	сжатый воздух
humidity controller	регулятор влажности
incompressible nonisothermal fluid	несжимаемая неизотермическая жидкость
initial condition	начальное условие
isolated system	изолированная система
isothermal process	процесс изотермический
inflowing air	поступающий воздух
infrared dryer	сушилка радиационная
injection cock	форсунка, сопло
intensive properties	интенсивные свойства
internal energy	внутренняя энергия
internal work	внутренняя работа
intervening cooling	промежуточное охлаждение
isenthalpic temperature-pressure coefficient	коэффициент Джоуля-Томсона
jet cooling	струйное охлаждение
kinematic coefficient of viscosity	кинематическая вязкость
kinetic theory	кинетическая теория

laminar (streamline) flow	ламинарное течение
liquid cooling	жидкостное охлаждение
liquefaction of gases	сжижение газов
low-temperature area	низкотемпературная зона
macrostructure of matter	макроструктура вещества
mass carrier	рабочее тело
mix composition	состав смеси
mixed flow	смешанное течение
mixture control	регулирование состава смеси
moisture capacity	влажность, влагосодержание
molar heat capacity	мольная теплоемкость
molecular mass of substance (matter)	молекулярная масса вещества
molecular weight	молекулярный вес
movable	подвижный
multicircuit control	многоконтурная схема
multistage compression	многоступенчатое сжатие
numerical simulation	численное исследование
numerical value	численное значение
opened system	отрытая система
operating characteristic	рабочая характеристика
operating conditions	рабочие параметры, условия работы
oxygen carrier, oxidizing constituent	окислитель
parameter	параметр
perfect gas (ideal gas)	идеальный газ
performance capability	работоспособность (системы, агрегата)
pipe branch	патрубок
pit drying stove	сушило ямное
plant capacity	мощность установки
plate exchanger	пластинчатый теплообменник
pneumatic dryer	сушилка пневматическая
poor-grade coal	низкосортный уголь
phase transition	фазовый переход
physical sense	физический смысл
pressure	давление
pressure-volume diagram	p-v диаграмма
principles of thermodynamics	основные положения термодинамики
process control	управление технологическим процессом
polytrope index	показатель политропы
polytropic process	политропный процесс
power consumption	потребление энергии
process of perfect gas	процесс идеального газа
pulverized coal	угольная пыль

pump capacity	производительность насоса
quantity	количество, величина
radiant heat-transfer coefficient	коэффициент теплоотдачи излучением
Rankine cycle	цикл Ренкина
rated steam conditions	номинальные параметры пара
received heat (added heat)	подведенная теплота
reciprocating compressor	поршневой компрессор
rectification column	ректификационная колонна
recuperator, regeneration	рекуператор
regenerator, reclaimer	регенератор
regenerative cooling	регенеративное охлаждение
refrigerant circuit	контур циркуляции хладоагента
refrigerating capacity	холодопроизводительность
reheat control	регулирование температуры промежуточного перегрева (пара)
reversible adiabatic compression	обратимое адиабатическое сжатие
ring dryer	сушилка циркуляционная
rotary compressor	ротационный компрессор
saturation condition	состояние насыщения
second law of thermodynamics	2-ой закон термодинамики
shaft dryer	сушилка шахтная
shut-down condition	нерабочее состояние
single-stage compression	одноступенчатое сжатие
slag catcher	шлакоуловитель
specific/non-specific value	удельная/не удельная величина
spent (expended) work	затраченная работа
spontaneous combustion	самопроизвольное воспламенение
state equation (equation of state)	уравнение состояния
state parameter	параметр состояния
steam circulation	движение пара
steam condensate	конденсат пара
steaming conditions	условия парообразования
steam content	паросодержание
steam flow condition, steam consumption	расход пара
steam-generator block (boiler)	парогенератор
steam-generating circuit	контур циркуляции котла
steam-jet compressor	пароструйный компрессор
steam-relieving capacity	паропроизводительность
steam-turbine condenser	конденсатор паровой турбины
steel pipe	стальная труба
structural diagram	диаграмма состояния
surface heat-transfer coefficient	коэффициент теплоотдачи
superheater	пароперегреватель
superheated area	область перегретого пара

surroundings	окружающая среда
sweat cooling	охлаждение за счет испарения
system boundary	граница системы
tapered chimney	коническая дымовая труба
technical atmosphere	техническая атмосфера
temperature balance	температурное равновесие
temperature contrast	неравномерное распределение температуры, разность температур
thermal parameter	термический параметр
thermodynamic analysis	термодинамический анализ
thermodynamic process	термодинамический процесс
thermodynamic system	термодинамическая система
thermodynamical properties gas	термодинамические свойства газа
throttling cock	дроссельный клапан
transport phenomena	явление перемещения
tube bundle	трубный пучок
tubular heat exchanger	трубчатый теплообменник
turbine steam-flow capacity	расход пара через турбину
turbulent (eddying) flow	турбулентный поток
type of distribution	характер распределения (тип)
(to) undergo a process	подвергать влиянию
unit mass	единичная масса
universal gas constant	универсальная газовая постоянная
unsteady-state conditions	нестационарные условия
vapor conditions	параметры пара
vapor cooler	пароохладитель
vaporizer	испаритель
vaporization cooler	испарительный охладитель
ventilator	вентилятор
ventilation chimney	вентиляционная труба
viscous	вязкость
volume	объем
water capacity of cooling system	емкость системы водяного охлаждения
water conditioning	водоподготовка
water constitution	состав воды
water consumption	расход воды
water cooling	водяное охлаждение
wind catcher	воздухозаборник
work of cycle	работа цикла

Attachment 2

РУССКО-АНГЛИЙСКИЙ СЛОВАРЬ ТЕРМИНОВ И СПЕЦИАЛЬНЫХ СЛОВОСОЧЕТАНИЙ

абсорбция	absorption
адиабатный процесс	adiabatic process
атмосферный воздух	free air
барботаж	bubbling
величина (количество)	quantity
величина поверхности нагрева	area of heating surface
вентилятор	blower, ventilator
вентиляционная труба	air chimney, ventilation chimney
влагосодержание (влажность)	moisture capacity
влажный воздух	damp air
внешняя работа	external work
внутренняя работа	internal work
внутренняя энергия	internal energy
водяное охлаждение	water cooling
водяной экономайзер	feed-water economizer
воздухозаборник	wind catcher
воздухоохладитель	air cooler
воздушная рубашка	air casing
воздушный фильтр	air cleaner
воздухоподогреватель	air heater
воздухопровод, вентиляционная труба	air channel
водоподготовка	water conditioning
всасываемый воздух	draw-in air
выпаривать	(to) boil down
выпарной аппарат	calandria
вытяжное устройство	aspirator
газоанализатор	gas analyzer
газовая постоянная	gas constant
газовый генератор	gas checker chamber
газоход	breeching
горючий компонент	combustible constituent
градирня-конденсатор	cooling-tower condenser
граница системы	system boundary
график	chart
глубокий холод	deep cold
глубокое охлаждение	copious cooler
движение пара	steam circulation
двухступенчатое испарение	dual circulation
деаэратор	deaerator
диаграмма	chart, diagram
диаграмма h-s	enthalpy-entropy diagram

диаграмма s-T	entropy-temperature diagram
диаграмма p-v	pressure-volume diagram
диаграмма состояния	structural diagram
динамическая вязкость	dynamic coefficient of viscosity
динамические характеристики	dynamic behavior
дроссельный клапан	baffler, expansion cock, throttling cock
дымовая труба	chimney
единичная масса	unit mass
естественное охлаждение	free-convection cooling
емкость	capacity
емкость системы водяного охлаждения	water capacity of cooling system
жидкостное охлаждение	liquid cooling
зависеть от	depends on
закрытая система	closed system
замораживать	congeal
затраченная работа	spent (expended) work
золоулавливание	ash collection
золоуловитель	ash catcher, cinder catcher
змеевик	coil
змеевик холодильника	cooling coil
змеевиковый теплообменник	heat-exchange coil
идеальный газ	perfect gas (ideal gas)
изолированная система	isolated system
интенсивные свойства	intensive properties
испаритель	evaporator, flash chamber, vaporizer
испарительная способность	evaporation capacity
испарительный охладитель	vaporization cooler
испарительное охлаждение	evaporative cooling
испарительный контур	evaporating circuit
калорический параметр	calorific parameter
камера	chamber, cell
камера сгорания	combustion chamber, explosion chamber
канал	channel
кинематическая вязкость	kinematic coefficient of viscosity
кинетическая теория	kinetic theory
кипение, кипеть	boil, bubbling
клапан	cock
классический подход	classical approach
кожух (корпус)	casing
колориметрический анализ	colorimetric analysis
компонент (составная часть)	constituent
компоновка	composition
компрессор	compressor
конденсат испарителя	evaporated condensate

конденсат пара	steam condensate
конденсатор (холодильник)	condenser
конденсатор с воздушным охлаждением	air-cooled condenser
конденсатор паровой турбины	steam-turbine condenser
конечный параметр	final parameter
коническая дымовая труба	tapered chimney
кондиционирование воздуха для жилых помещений	conditioning
контрольная поверхность	control surface
контрольный объем	control volume
контур	circuit
контур охлаждения	cooling circuit
контур питания	feed circuit
контур теплообменника	heat-exchanger circuit
контур теплоносителя (охладителя)	coolant circuit
контур циркуляции котла	boiler circuit, steam-generating circuit
контур циркуляции хладоагента	refrigerant circuit
котельная установка	boiler plant
коэффициент Джоуля-Томсона	isenthalpic temperature-pressure coefficient
коэффициент диффузии	diffusion coefficient
коэффициент надежности	coefficient of safety
коэффициент теплопередачи	heat-transfer coefficient
коэффициент теплоотдачи	surface heat-transfer coefficient
коэффициент теплоотдачи излучением	radiant heat-transfer coefficient
коэффициент теплоотдачи при кипении	boiling coefficient
коэффициент теплоотдачи при конденсации	condensing coefficient
коэффициент теплопроводности	coefficient of conductivity
коэффициент объемного расширения	coefficient of cubical expansion
коэффициент расхода	coefficient of discharge
коэффициент полезного действия	coefficient of efficiency
коэффициент расширения	coefficient of expansion
коэффициент теплопроводности	coefficient of heat passage
коэффициент теплопередачи	coefficient of heat transfer
ламинарное течение	laminar (streamline) flow
макроструктура вещества	macrostructure of matter
молекулярная масса вещества	molecular mass of substance (matter)
молекулярный вес	molecular weight
мольная теплоемкость	molar heat capacity

мощность	capacity
мощность установки	plant capacity
многоконтурная схема	multicircuit control
многоступенчатое сжатие	multistage compression
нагревательная камера	heating chamber
нагревательный прибор (радиатор)	heating body
насос питательный	feed pump
начальное условие	initial condition
неподвижный (стационарный)	fixed
нерабочее состояние	shut-down condition
неравномерное распределение температуры	temperature contrast
нестационарные условия	unsteady-state conditions
низкотемпературная зона	low-temperature area
низкосортный уголь	poor-grade coal
номинальные параметры пара	rated steam conditions
номограмма	chart
область перегретого пара	superheated area
обратимое адиабатическое сжатие	reversible adiabatic compression
обратный цикл	Carnot refrigeration cycle
объем	capacity, volume, content
одноступенчатое сжатие	single-stage compression
окислитель	oxygen carrier, oxidizing constituent
окружающая среда	surroundings
основные положения термодинамики	principles of thermodynamics
основные рабочие параметры	basic operating conditions
отбор пара	bleed
отрытая система	opened system
отведенная теплота	abstracted heat
охладитель	cooling apparatus
охладитель рассола	brine cooler
охлаждающая среда	coolant
охлаждение за счет испарения	sweat cooling
параметр	parameter
параметр состояния	state parameter
параметры пара	vapor conditions
паровой цикл Карно	Carnot vapor cycle
парогенератор	steam-generator block (boiler)
пароперегреватель	superheater
паропроизводительность	evaporation capacity, steam-relieving capacity
паросодержание	steam content
пароструйный компрессор	steam-jet compressor

пароохладитель	vapor cooler
патрубок	pipe branch
пластинчатый теплообменник	plate exchanger
поведение отдельных молекул	behavior of individual molecules
поверхность теплообмена	heat-transfer area
поглощение	absorption
подведенная теплота	received heat (added heat)
подвергать влиянию	(to) undergo a process
подготовка питательной воды	feedwater conditioning
подогреватель	heat booster
показатель политропы	polytrope index
политропный процесс	polytropic process
поршневой компрессор	reciprocating compressor
поступающий воздух	inflowing air
потребление	consumption
потребление энергии	power consumption
правила по устройству и изготовлению котлов	boiler construction code
правила эксплуатации	code
превращение тепла в работу	heat-to-work conversion
преобразование (превращение)	conversion
преобразование тепла	heat conversion
преобразование энергии	energy conversion
принудительная циркуляция	force feed circulation
производительность	capacity, coefficient of performance
производительность котла	boiler capacity
производительность насоса	pump capacity
промежуточное охлаждение	intervening cooling
противоток	contraflow
процесс идеального газа	process of perfect gas
процесс изобарический	constant-pressure process
процесс изотермический	isothermal process
процесс изохорический	constant-volume process
пылеулавливание	dust collection
пылеуловитель	dust catcher
работа сжатия	compression work
работа расширения	expansion work
работа цикла	work of cycle
работоспособность (системы, агрегата)	performance capability
рабочая характеристика	operating characteristic
рабочие параметры	operating conditions
рабочий объем цилиндра	displacement chamber
рабочее тело	mass carrier
равновесие	equilibrium
размер	extent

размерность параметра	dimension of parameter
разность температур	temperature contrast
расход	consumption
расход воды	water consumption
расход пара	steam flow condition, steam consumption
расход пара через турбину	turbine steam-flow capacity
регенератор	regenerator, reclaimer
регенеративное охлаждение	regenerative cooling
регенеративный цикл	extraction cycle
регулирование нагрева	heating control
регулирование расхода (потока)	flow control
регулирование состава смеси	mixture control
регулирование температуры промежуточного перегрева (пара)	reheat control
регулируемый расход	controlled consumption
регулятор влажности	humidity controller
регулятор подачи топлива	fuel control assembly
режим теплопередачи	heat-transfer behavior
режим течения	behavior of flow (stream)
ректификационная колонна	rectification column
рекуператор	recuperator, regeneration
ротационный компрессор	rotary compressor
рубашка, оболочка	casing
самопроизвольное воспламенение	spontaneous combustion
сжатие	compression
сжатый воздух	heavy air
сжижение газов	liquefaction of gases
скруббер	gas cleaner
смесительная камера	air mixing chamber
смесительный теплообменник	contact heat exchanger
смешанное течение	mixed flow
содержание	content
сопло	injection cock, bleed
сопло Лаваля	convergent-divergent channel
состав	composition
состав воды	water constitution
состав смеси	mix composition
состояние равновесия	balanced condition
состояние насыщения	saturation condition
степень	extent
стальная труба	steel pipe
струйное охлаждение	jet cooling
суживающийся канал	contracted channel

суточный расход	daily steam consumption
сушилка барабанная	drying drum
сушилка камерная	chamber dryer
сушилка кольцевая туннельная	annular tunnel dryer
сушилка конвейерная	continuous through dryer
сушилка непрерывного действия	continuous dryer
сушилка периодического дейст-вия	batch dryer
сушилка пневматическая	pneumatic dryer
сушилка поточная	flowdryer
сушилка радиационная	infrared dryer
сушилка циркуляционная	ring dryer
сушилка шахтная	shaft dryer
сушило ямное	pit drying stove
сушильный аппарат	drying apparatus
сушильная камера	drying cell, drying chamber, drying compartment
сущность	essence
схема	chart, circuit
схема котлоагрегата	boiler arrangement
схема подогрева питательной воды (устройство)	feedwater-heater arrangement
схема управления	control circuit
схема установки	circuit of installation
температурное равновесие	temperature balance
тепловой баланс	balance of heat
теплоемкость	heat capacity
теплоноситель	heat carrier
теплопроизводительность	heat-producing capability
теплосодержание	heat content
теплота сгорания	calorific capacity
термический параметр	thermal parameter
термодинамический анализ	thermodynamic analysis
термодинамический процесс	thermodynamic process
термодинамическая система	thermodynamic system
термодинамические свойства газа	thermodynamical properties gas
терморегулятор	heating controller
техническая атмосфера	technical atmosphere
технические условия	code
технологическая схема	flow chart
топливный кран	fuel cock
топочная камера	furnace chamber
трубный пучок	tube bundle
трубопровод	channel
трубчатый теплообменник	tubular heat exchanger

турбулентный поток	turbulent (eddying) flow
угольная пыль	pulverized coal
удельная/ не удельная величина	specific/ non-specific value
управление технологическим процессом	process control
универсальная газовая постоянная	universal gas constant
уравнение состояния	state equation (equation of state)
условия охлаждения	coolant conditions
условия парообразования	steaming conditions
условия постоянства массового расхода	conditions of constant mass flow
условия работы	operating conditions
фазовый переход	phase transition
физический смысл	physical sense
форсунка	injection cock
фракционный состав	fraction composition
функциональная зависимость	functional dependence
характер распределения (тип)	type of distribution
химический состав	chemical composition
хладоагент	coolant
холодильник	cooler, cooling apparatus
холодильный агент	cooling agent
холодопроизводительность	refrigerating capacity
цикл	circuit, cycle
цикл Карно	Carnot cycle
цикл Ренкина	Rankine cycle
циркуляция	circulation, circuit
циркуляция (воды) в котле	boiler circulation
численное значение	numerical value
чугунная труба	cast-iron pipe
шлакоуловитель	slag catcher
эжектор	aspirator
экстенсивные свойства	extensive properties
элемент котлоагрегата	boiler component
энтропия	entropy
энтальпия	enthalpy
эффективный инструмент для инженерного проектирования и компоновки	effective tool for engineering analysis and design
явление перемещения	transport phenomena

Attachment 3

CONJUGATE HEAT EXCHANGE AND HYDRODYNAMICS FOR A VISCOUS INCOMPRESSIBLE FLUID MOVING IN A RECTANGULAR CAVITY

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Numerical simulation was performed of the motion of a viscous incompressible nonisothermal fluid (heat carrier) in an open rectangular cavity under conditions of forced convection and conjugate heat exchange. The effect of the jet dynamic parameter (Reynolds number) and fluid flow conditions on the character of motion and heat exchange of viscous incompressible nonisothermal fluids in rectangular cavities is studied. A hydrodynamic pattern of viscous flow in an open cavity under forced convection conditions (in the conjugate and nonconjugate formulations of the problem) is obtained. The effect of parameters of the model on the character of motion is studied. Temperature profiles for the solid and fluid phases are obtained. The effect of parameters of the model on the character of temperature distribution in both phases is studied.

Introduction. Over the past forty years there has been steady interest in convective flows in cavities of various types, which is explained by the practical importance of the problem: cavities are used as heat-transferring, heat-insulating and structural elements in power and process installations of various purposes, electronics and heat exchangers [1, 2].

Studies of the frontal interaction of a viscous incompressible nonisothermal jet with a variously shaped bounded volume is of great scientific and practical significance because such flows are widely used in engineering processes of various complexity levels in metallurgical, power, etc., industries [2-5].

Simulation of heat exchange for a viscous flow in a rectangular cavity involves solution of complex problems of forced convection of an incompressible fluid. Since the complexity of viscous incompressible nonisothermal flows in bounded volumes makes it impossible to develop reliable analytical methods to calculate such flows, numerical simulation is required.

Formulation of the Problem. We consider the unsteady interaction of a subsonic laminar viscous jet of an incompressible nonisothermal fluid with an open rectangular cavity (Fig. 1). Numerical solution of the hydrodynamic problem was implemented in region 2, bounded by the inflow region 1, the line of symmetry 3, the side wall 6, the bottom of the cavity 4 and the region of exit 7 from the rectangular cavity.

We use a mathematical model based on the Navier-Stokes equations in the variables "vortex-stream function" at moderate Reynolds numbers ($100 \le Re \le 800$), the energy equation, and the heat-conduction equation for the material of the rectangular cavity with corresponding initial and boundary conditions:

$$\frac{\partial \omega}{\partial \tau} + u\frac{\partial \omega}{\partial x} + v\frac{\partial \omega}{\partial y} = \frac{1}{\mathrm{Re}}\left(\frac{\partial^2 \omega}{\partial x^2} + \frac{\partial^2 \omega}{\partial y^2}\right) \quad (1)$$

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} = \omega \quad (2)$$

$$\frac{\partial \theta}{\partial \tau} + u\frac{\partial \theta}{\partial x} + v\frac{\partial \theta}{\partial y} = \frac{1}{\mathrm{Re}\cdot \mathrm{Pr}}\left(\frac{\partial^2 \theta}{\partial x^2} + \frac{\partial^2 \theta}{\partial y^2}\right) \quad (3)$$

$$\frac{\partial^2 \theta_1}{\partial x^2} + \frac{\partial^2 \theta_1}{\partial y^2} = \frac{\partial \theta_1}{\partial \mathrm{Fo}} \quad (4)$$

Here Pr and Fo are the Prandtl and Fourier numbers, respectively.

At the bottom of the cavity *(y = S* and *D < x <* L), we specify nonpenetration and attachment conditions and the boundary condition of the fourth kind for the energy equation:

$$\psi = 0; \quad \omega = 2\cdot\psi(x, y+\Delta y)/(\Delta y)^2; \; \theta_1 = \theta, \quad \lambda_1 \frac{\partial \theta_1}{\partial y} = \lambda \frac{\partial \theta}{\partial y}. \quad (5)$$

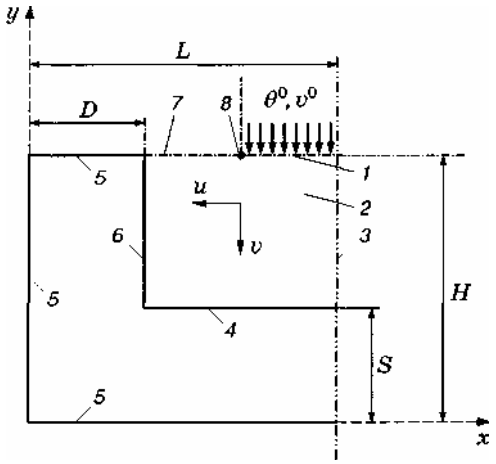


Fig. 1. Diagram of the flow in a rectangular cavity and geometry of the computation domain: 1) entrance to the cavity; 2) hydrodynamic region; 3) symmetry axis; 4) bottom of the cavity; 5) outer walls of the cavity; 6) side wall of the cavity; 7) region of exit from the cavity; 8) boundary between the exit and entrance regions

On the side wall of the cavity *(x = D* and *S < y < H)* the same conditions are imposed:

$$\psi = 0; \omega = 2\cdot\psi(x+\Delta x, y)/(\Delta x)^2; \; \theta_1 = \theta, \quad \lambda_1 \frac{\partial \theta_1}{\partial x} = \lambda \frac{\partial \theta}{\partial x}. \quad (6)$$

On the symmetry axis of the jet *(x = L* and *S < y < H),* we specify the conditions of heat-flux continuity and nonpenetration

$$\frac{\partial \psi}{\partial x} = 0;\ \omega = 0;\ \lambda \frac{\partial \theta}{\partial x} = 0. \tag{7}$$

At the exit from the rectangular cavity, we use the "drift" conditions *du/dy* = 0 and *dv/dx* = 0 for the velocity components and a "soft" boundary condition for the temperature (zero second derivative of temperature with respect to *y)* [6, 7]. On the outer boundaries of the cavity, heat insulation conditions are specified:

$$y = \mathrm{H},\ 0 < x < \mathrm{D}: \quad \lambda_1 \frac{\partial \theta_1}{\partial y} = 0; \tag{8}$$

$$y = 0\ ,\ 0 < x < \mathrm{L}: \quad \lambda_1 \frac{\partial \theta_1}{\partial y} = 0; \tag{9}$$

$$x = 0\ ,\ 0 < y < \mathrm{H}: \quad \lambda_1 \frac{\partial \theta_1}{\partial x} = 0; \tag{10}$$

$$x = \mathrm{L},\ 0 < y < \mathrm{S}: \quad \lambda_1 \frac{\partial \theta_1}{\partial x} = 0. \tag{11}$$

In the fluid flow in the cavity, two regions are distinguished: the entrance to the cavity 1 and the exit from the cavity 7 (Fig. 1). The position of the point of separation of the entrance and exit regions is found from the following integral relation, which defines the flow rate as the main integral characteristic of the flow:

$$\int_{x_2}^{x_0} \mathrm{v}_+(x, y)dx = \int_{x_0}^{x_1} \mathrm{v}_-(x, y)dx \tag{12}$$

Here x_1 is the fixed extreme point of the entrance region that lies on the symmetry axis, x_0 is the coordinate of the point of separation of the regions with different fluid flow directions in the cavity $(x_2 < x_0 < x_1)$, x_2 is the coordinate of the fixed extreme point of the exit region that lies on the side wall of the cavity, $\mathrm{v}_-(x, y)$ is the transverse component of the fluid velocity in the direction from the entrance to the bottom of the cavity, $\mathrm{v}_+(x, y)$ is the transverse velocity component of the fluid flow in the direction from the bottom of the cavity to the exit region.

TABLE 1

Grid	[7,8]			Present work		
	x	*Y*	Ψ*	*x*	*y*	Ψ*
Re = 300						
20 x 17	0.342	0.375	0.043	0.352	0.386	0.044
39 x 33	0.316	0.359	0.051	0.325	0.369	0.052
Re = 500						
20 x 17	0.342	0.375	0.036	0.352	0.386	0.037
39 x 33	0.302	0.328	0.050	0.311	0.337	0.051

The initial conditions are written as

$$\psi(x, y,0) = \psi^0(x, y); \quad \theta(x, y,0) = \theta^0(x, y). \tag{13}$$

The Navier-Stokes equations in the variables "stream function-vortex", the energy equation and the heat-conduction equation [Eqs. (l)-(4)] are solved by the finite-difference method. The difference analogs of the Navier-Stokes equations are solved by the explicit iterative method of [8]. The difference analogs of the energy equations and thermal-conduction equations are solved by the sweep method [7-9]. A difference scheme of second-order accuracy was used. The calculations were performed on a uniform difference grid.

In the formulation of the problem for the Navier-Stokes equations in the variables "vortex-stream function", the boundary conditions for the solid fixed surface have the form [7, 8]

$$\psi = 0, \quad \frac{\partial \psi}{\partial n} = 0. \tag{14}$$

where *n* is the normal line to the solid surface.

In the numerical solution of the difference equation for vortex, boundary conditions for it need to be determined because boundary conditions (7) relating to the Navier-Stokes equations are specified only for the stream function and not for the vortex.

In the present study, we used a method in which the stream function near the boundary is written as a Taylor series. This gives the expression for the vortex on the boundary [6].

Test Problems. To test the approximation and convergence of the numerical solution, we used the problem of a two-dimensional flow in a rectangular cavity with the upper wall moving in its plane with constant velocity [6-9].

Profiles of the longitudinal [$u(y)$] and transverse [$v(y)$] velocity components are determined. Stream functions are calculated for various values of the Reynolds number 300 ≤ Re ≤ 1000 and various numbers of nodes of the difference grid 20 ≤ m_1 ≤ 60 and 17 ≤ m_2 ≤ 60 (m_1 and m_2 are the numbers of grid nodes along the *x* and *y* coordinates, respectively). The results obtained differ from the results of [6-8] by not more than 7%. Table 1 gives maximum values of the stream function Ψ_* and the *x* and *y* coordinates of the points at which these values are reached for Re = 300 and 500 on grids 20 x 17 and 39 x 33.

As a second test problem, we solved the problem of shear circulation flow at small Reynolds numbers 10 ≤ Re ≤ 50, which reduces to solving a biharmonic equation for the stream function [10-12]. The stream function profiles obtained differ from the results of [10] by not more than 5%.

Results and Discussion. Flows of various fluids, in particular, water, molten lead and fluid steel were studied over a wide range of Reynolds numbers and other parameters of the model. Figures 2-4 show numerical results for fluid steel at a temperature of 1500°C.

As follows from analysis of the steady-state flow field for various values of the geometrical characteristics of the cavity (in particular, *L/H* = 1/2, 2/3 and 1) over a rather wide range 100 ≤ Re ≤ 500, the fluid reaches the bottom of the cavity, rotates and flows out through the entire region 7 (sec Fig. 1). Thus, in the viscous incompressible nonisothermal flow in the cavity, we can distinguish two stages.

The first stage includes the passage of the fluid from the entrance region to the bottom of the cavity and interaction with the bottom. The interaction of the jet with the bottom of the cavity is accompanied by deceleration of the flow and occurrence of a region of elevated pressure, which leads to spread of the fluid along the bottom of the cavity.

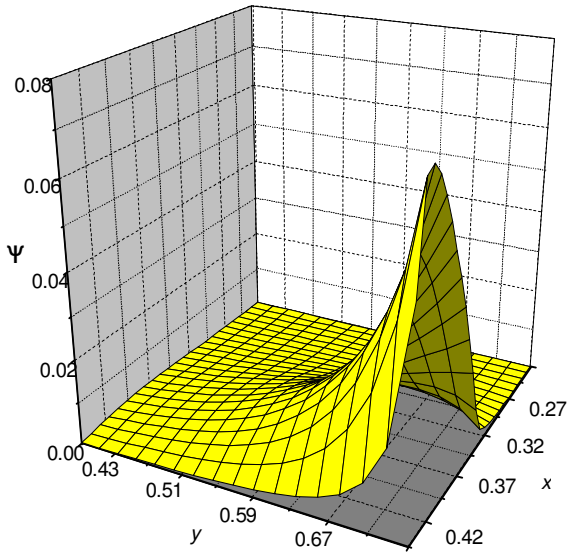
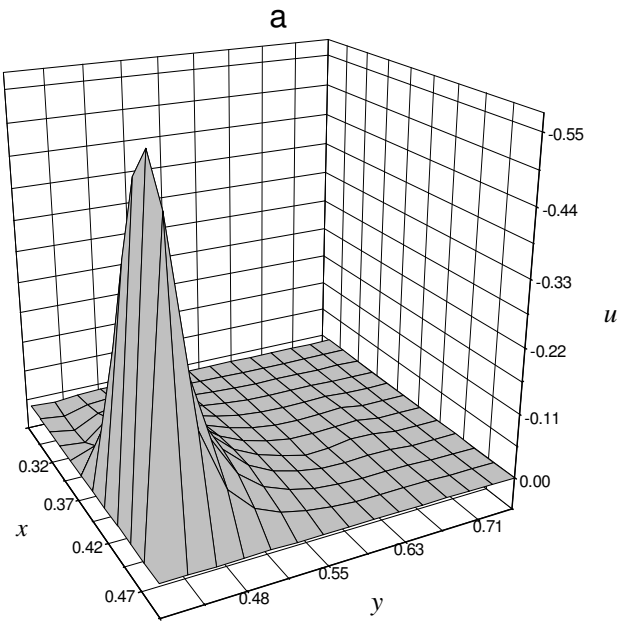


Fig. 2. Distribution of the stream function for steady flow (Re = 200 and L/H = 2/3)



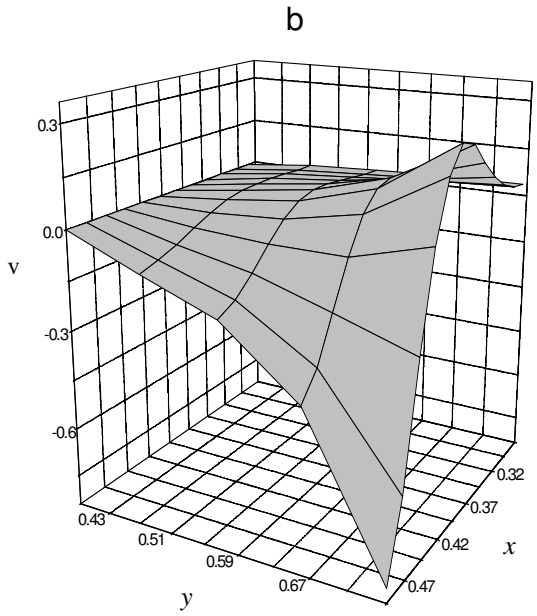


Fig. 3. Distribution of the longitudinal (a) and transverse (b) velocity components for steady flow (Re = 200)

At the second stage, the fluid moves from the bottom of the cavity to the exit with formation of a region of reverse flow. At this stage, deceleration of the fluid continues, which also leads to which a region of elevated pressure arises.

The direct and reverse regions flow corresponding to the above stages of fluid flow in the cavity are evident in Fig. 3b.

Figure 2 shows the distribution of the stream function $\psi(x,y)$ for the time t^* corresponding to the steady-state flow field for Re = 200 and a geometrical ratio of the sides of the cavity $L/H = 2/3$. The maximum value of the stream function is in the region of $0.35 < x < 0.39$, $0.67 < y < 0.75$, in which the most intense formation of vortex structures is observed. We note that the analysis performed revealed the rather strong effect of the geometrical characteristics on the formation of the stream-function field.

Figure 3a gives the distribution of the longitudinal velocity component $u(x,y)$ at the time t^* for Re = 200. The maximum velocity is in the region of $0.40 < x < 0.44$ near the bottom of the cavity. With increase in Reynolds number, the behavior of the longitudinal velocity component remains unchanged.

Figure 3b shows the distribution of the transverse velocity component $v(x,y)$ at time t^* for Re = 200. We note that with increase in Reynolds number, the profile of $v(x,y)$ at the initial sections of the cavity becomes close to a constant value, while at Re = 100 and 200, the profiles of the transverse velocity component are almost parabolic at the same sections. An analysis of the distribution of the transverse velocity component shows that in the flow field, two maxima are formed, which correspond to the direct and reverse flows.

From Fig. 3, it is evident that at the first stage, as the incompressible fluid jet moves to the bottom of the cavity, the transverse velocity component decreases

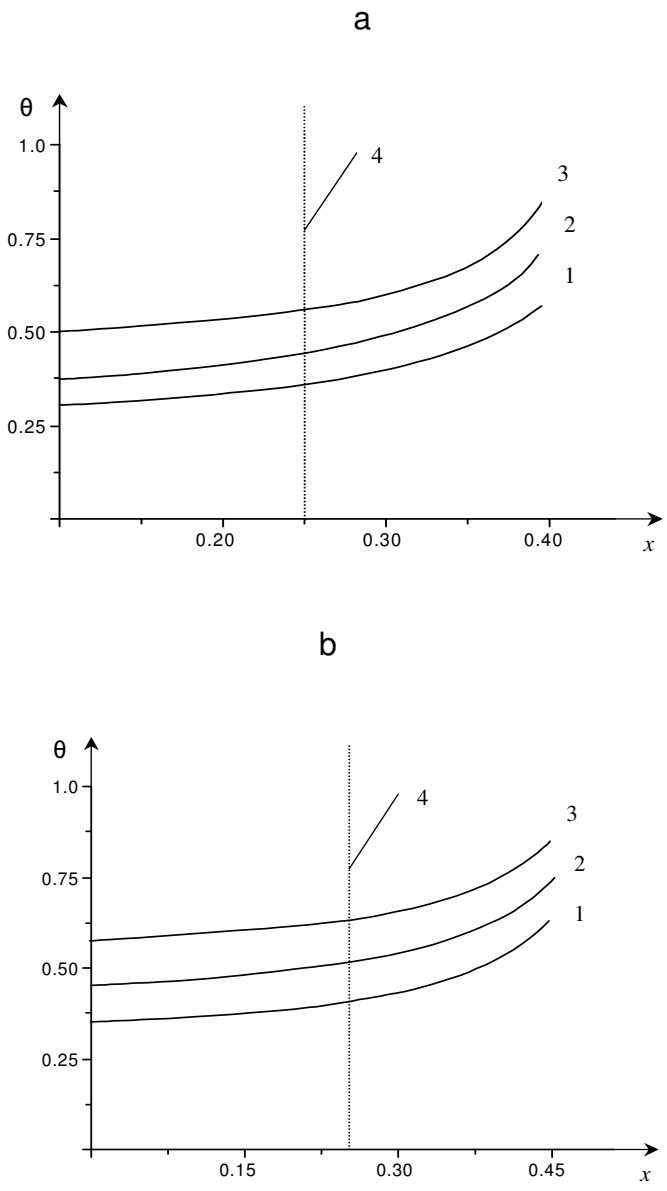


Fig. 4. Solid- and liquid-phase temperature distributions along the x coordinate for steady flow: (a) Re = 300, Pr = 0.979, $\alpha=0.3\alpha_*$, L/H = 1/2, and y = 0.40 (1), 0.52 (2), and 0.68 (3); (b) Re = 500, Pr = 0.979, $\alpha=0.32\alpha_*$, L/H = 1/2, and y = 0.40 (1), 0.56 (2), and 0.64 (3); curves 4 are interfaces between the liquid and solid phases

with increase in the longitudinal component, which is clearly seen in the region of $0.41 < y < 0.55$. At the second stage, as the jet moves to the exit section, the longitudinal velocity component decreases, which is clearly seen in the region of $0.32 < x < 0.41$, $0.41 < y < 0.55$. At the same time, the transverse velocity component begins to increase and its most intense increase is observed in the region of $0.59 < y < 0.75$, $0.30 < x < 0.40$. According to Fig. 3b, the maximum value of the outflow velocity is $v_{max} = 0.24$.

The motion of the viscous incompressible fluid in the rectangular cavity was studied under conditions of conjugate heat exchange. The temperature dependencies in the solid and liquid phases were obtained for various dynamic parameters and variation of the parameter α (α is the length of the entrance region).

Figure 4a shows solid- and liquid-phase temperature profiles at various sections of y at the time t^* for Re = 300, Pr = 0.979, $\alpha=0.3\alpha_*$ (α_* is the length of the penetrable region of the cavity $y = H$, $D < x < L$) and $L/H = 1/2$. It should be noted that with increase in α and decrease in geometrical parameters, the behavior of temperature fields along the height of the cavity changes insignificantly.

Figure 4b shows solid- and liquid-phase temperature distributions at various sections of y at the time t^* for Re = 500, Pr = 0.979, $\alpha=0.32\alpha_*$ and $L/H = 1/2$. As can be seen from Fig. 4b, the temperature profile decreases rather rapidly up to the interface $x = 0.25$, whereas the solid-phase temperature varies much more slowly.

From the results obtained it follows that the behavior of the temperature profiles at various sections of the cavity remains unchanged with variation of the parameter Re.

In the present work, we also solved the nonconjugate problem. On the walls of the cavity, we imposed heat insulation conditions (no heat transfer to the cavity walls).

The difference in the temperatures obtained in the conjugate and nonconjugate formulations of the problem is ±23%, which confirms that solving the problem in the conjugate formulation is reasonable.

Conclusions. The results of numerical analysis given here suggest that the range of application of the mathematical apparatus of [7, 8] can be further extended to solve problems of convective flows in open cavities under conditions of jet inflow and conjugate heat exchange. The present work is a continuation of the studies of [8, 9], in which it was first shown that the mathematical tool of [7] can be used to solve problems in the conjugate formulation for regions having more complex geometry than a channel or a streamlined body [13]. Optimization of grid parameters gives stable solutions of problems in regions of more complex geometry than those considered in [7-9].

The present study showed that stable solutions of the problem considered can be obtained over a rather wide range of Reynolds numbers ($100 \le Re \le 1000$).

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Attachment 4

Mathematical and Physical Magnitudes

Fractional Numerals

1/2 a half, one half

1/3 a third, one third

1/4 a quarter, one quarter
a fourth, one fourth

1/10 a tenth, one tenth

1/100 a (one) hundredth

1/1000 a (one) thousandth

Decimal Fractions

0 o, naught, zero

0.1 o point one
naught point one
zero point one

0.25 naught point two five

2.35 two point three five

45.23 forty five point two three

Separate signs, equations and expressions.

\+ Plus (sign of addition) positive

\- Minus(sign of subtraction) negative

X times by (multiplication sign), multiplied by

: sign of division, colon, ratios sign, divided by

= sign of equality

() round brackets, parentheses

{ } braces

[ ] square brackets

∑ sigma, sum of

a=b a equals b, a is equal to b, a is b

a≠b a is not equal to b, a isn't b

a< b a is less than b

a>b a is greater than b

2x2=4 twice two is four

6x5=30 six times five or 6 multiplied by 5 is thirty

12:3=4 12 divided by three is four

20:5=16:4 the ratio of 20 to 5 equals the ratio of 16 to 4

X^2 x square, x squared

X^3 x cubed

x^{-2} x to the minus two

√4=+2 the square root of 4 is (equals) plus 2

a' a prime

a_1 a first

y= f(x) y is a function of x

Percentages

% per cent

0.3 % Point three per cent

Denominate numbers

31 m.p.h. 31miles per hour

40 HP forty horse power

20^0 twenty degrees

5′ 5 minutes

5″ 5 seconds

0^0 C zero degrees Centigrade (Celsius)

100^0 C one hundred degrees Centigrade (Celsius)

32^0 F thirty-two degrees Fahrenheit

300^0 K three hundred degrees Kelvin

Density (Плотность)

1lb/in^3 = 27.7g/cm^3 1lb/ft^3 = 16.02kg/m^3	1 kg/m^3 = 0.06lb/ft^3

Acceleration (Ускорение)

1 ft/s^3 = 0.3m/s^2	1 m/s^2 = 3.3ft/s^2

Torque (Крутящий момент)

1lb ft =1/36 Newton meters	1 Nm = 0,74 lb ft

Pressure and Stress (Давление и напряжение)

1 p.s.i. (1b/m$^{2)}$ = 6900 N/m^2	1 N/m^2 = 1458*10^6 p.s.i.

Power (мощность)

1 horse power (hp) = 746 watts(W)
1metric horsepower = 736 W

Energy (энергия)

1Brutish thermal unit (B.t.u.) =1.05 kilojoules (kJ)
1therm =105.5 megajoules (Mj)
1kilowatt hour (kWh) = 3.6MJ
calorie = 4.2J

Attachment 5

SUPPLEMENTARY GRAMMAR

INFINITIVE

Infinitive is a non finite form of the verb.

e.g. to read, to write, to hear.

The Infinitive has some constructions:

Subject+predicate+object+Infinitive

E.g. We know them to study the proposal thoroughly.(complex object)

(Мы знаем, что они изучают предложение тщательно)

Subject+predicate+Infinitive

E.g. The method is reported to give good results.(complex subject)

(Сообщается, что этот метод дает хорошие результаты)

Examples

To weld metals is possible by means of heat produced by a current.

You **must learn** these rules.

I will be pleased **to help** you.

I'm sorry; I'm the last **to come.**

Give Russian equivalents of the sentences paying attention to the Infinitives.

1. Compression heat pumps always operate on mechanical energy through electricity.
2. Absorption heat pumps may also run on heat as an energy source.
3. Steam generators are used to convert water into steam.
4. An ideal steam turbine is considered to be a constant entropy process, in which the entropy of the steam entering the turbine is equal to the entropy of the steam leaving the turbine.
5. The idea of using boiling water to produce mechanical motion has a long history.
6. The heat cycle is known as the Rankin cycle.
7. Steam engines can be said to have been the moving force behind the Industrial Revolution.
8. The piston is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod or connecting rod.
9. To study heat mass exchange one has to study physics.
10. I.K. Butakov is known to be the founder of heat power engineering in Tomsk Polytechnic University.

Give Russian equivalents, paying attention to the Infinitives and Infinitive Constructions.

E.g. We have a number of problems to be solved.

(Существует ряд проблем, которые нужно решить.)

11. New types of reactors were reported to have been developed.
12. Several atomic power stations are supposed to be built in our country within the next few years.
13. The power station to be built on this river will supply the town with electric energy.
14. The mechanism is believed to be the best for converting heat into work.
15. The new plant is reported to have gone into operation in our town.
16. We consider this instrument to be useful for different purposes.
17. Industrial economic equipment is known to play a very important role today.
18. To carry heat for a special area there must be heat exchangers which convey heat easily.
19. One inch is known to equal 2.54 centimeters.
20. Our country was the first to use atomic energy for peaceful purposes.

PARTICIPLE

A participle is a non finite from of the verb. It has the properties of the verb and an adjective in the sentence. It has 2 forms (Part.I, part.II)

e.g. *to work-work<u>ing</u>- work<u>ed</u>*

Participle I (Simple) *writing being written.*
Participle I (Perfect) *having written having been written*
Participle II - *written*

NO PREPOSITIONS ARE USED WITH PARTICIPLES

Examples

I see a **writing** student.
Reading the text he stopped.
He is **writing** the text.

Read and find the Participle in the sentence. Give Russian equivalents of the Participle.

1. A heat pump is a machine or device that moves heat from one location (the 'source') to another location (the 'sink' or 'heat sink') using mechanical work.
2. Evaporating and condensing fluid known as a refrigerant.
3. According to the second law of thermodynamics heat cannot spontaneously flow from a colder location to a hotter area; work is required to achieve this.
4. Heat pump normally refers to a vapor compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of heat flow may be reversed.
5. One common example of a heat exchanger is the radiator in a car, in which the heat source, being a hot engine-cooling fluid, water, transfers heat to air flowing through the radiator (i.e. the heat transfer medium).

6. The type and size of heat exchanger used can be tailored to suit a process depending on the type of fluid, its phase, temperature, density, viscosity, pressures, chemical composition and various other thermodynamic properties.
7. In many industrial processes there is waste of energy or a heat steam that is being exhausted.
8. The heat supplied to other steams from the heat exchangers would otherwise come from an external source which is more expensive and more harmful to the environment.
9. Using the energy of the atom we produce electric energy at atomic power plant.
10. Russian scientists and inventors always try to find a practical application for thermodynamic laws discovered.

Find the participle and give Russian equivalents.

1. Heating a substance, we cause a more rapid motion of its molecules.
2. The results obtained during the last experiment are very important.
3. When living in Moscow, Yablochkov often met with well-known scientists and inventors of that time.
4. The experiment described attracted everybody's attention.
5. We saw many electrical installations, some of the devices being connected to the ground.
6. Two small metal balls are hung from the copper rod, one being supported by a silk string and the other one being supported by a thin copper wire.
7. When following along the conductor, the current heats it.
8. The technology having reached a high stage of development, new methods of work became possible.
9. Electrons forming an atom are in motion.
10. When finishing his experiment, he carefully noted the results.
11. Silver being very expensive, we only rarely use it as a conductor.
12. Using the energy of the atom we produce electric energy at atomic power station.
13. While explaining the results of the experiment the professor wrote many formulas on the blackboard.
14. They continued testing until the sample was destroyed.
15. Scientific experiments have been finished for three days.

GERUND

A gerund is the –**ing** form of the verb used as a noun. A gerund is used in the same way as a noun, as a subject or an object.

Examples

Studying English is fun.

We enjoy **studying** in TPU.

H's excited about **studying** in TPU.

Common verbs followed by gerund.

Enjoy	quit (give up)	keep(keep on)	
Avoid	discuss	postpone	
Suggest	consider	finish (get through)	stop

Complete the sentences with the given verbs: get, make, read, steal, look for, try, write, meet, and drive.

E.g. Do you fancy *getting* a diploma this year?

1. I considered _____the job but in the end I decided against it. (try)
2. Mary gave up_____ a job in Britain and decided to emigrate. (look for)
3. Students don't like_____in English. (read, write)
4. Have you finished_____a report of the laboratory work. (make)
5. Does your job involve_____a lot of people. (meet)
6. He admitted_____the car but denyed_____it. (steal, drive)

Make your own sentences. Complete each sentence using – ing.

E.g. I think people should stop polluting the atmosphere.

1. I often regret_____
2. This year fancy_____
3. At weekends I suggest_____
4. Learning English involves_____

Read the sentences paying attention to the Gerund. Give Russian equivalents of the Gerund.

1. The coolant (treated water), which is maintained at high pressure to prevent boiling, is pumped through the nuclear reactor core.
2. Heat transfer takes place between the reactor core and the circulating water and the coolant is then pumped through the primary tube side of the steam generator by coolant pumps before returning to the reactor core.
3. Heat transfer takes place between the reactor core and the circulating water and the coolant is then pumped through the primary tube side of the steam generator by coolant pumps before returning to the reactor core.
4. Watt proceeded to develop his engine further, modifying it to provide a rotary motion suitable for driving factory machinery.
5. A gas turbine is a rotary machine similar in principle to a steam turbine and it consists of three main components: a compressor, a combustion chamber, and a

turbine. The air after being compressed in the compressor is heated by burning fuel in it.
6. Heat exchangers are widely used in spacing, refrigerating, air conditioning, natural gas processing.
7. Heat pump works by exploiting the physical properties of an evaporating and condensing fluid known as a refrigerant.
8. No change can be used in thermal power engineering industry without introducing new technology.
9. He went on studying the structure of the internal combustion engine.
10. On receiving successful results he carried out various experiments of this kind.

PASSIVE VOICE

Passive Voice is formed "TO BE + V_3"
*E.g. The advantage of this technique over others **is recognized** by many scientists.*
It is translated from Russian into English according to the structure of the English sentence.
Prepositions "By" and "With" are used in the Passive Voice.
E.g. The task was understood with the help of the designing project.

Give Russian equivalents of the sentences paying attention to the words underlined.

1. The heat exchanger in that the fluids are exposed to a much larger surface area because the fluids spread out over the plates.
2. The walls of the pipe are usually made of metal or another substance with a high thermal conductivity.
3. The outer casing of the larger chamber is made of a plastic or coated with thermal insulation.
4. The plate heat exchanger (PHE) was invented by Dr Richard Seligman in 1923.
5. Heating and cooling methods of fluids were revolutionized and used by engineers.

Give Russian equivalents to the following sentences. Determine the Passive voice in them.

1. The direct-current generators are often used as spare exciters in steam power plants.
2. There are several components common to most turbine engines.
3. The combustion chamber pressure in the engine is very high.
4. Steam pressure measuring instruments are displayed in the hall.
5. Steam and water circulating tubes were used in the thermal power engineering industry.

MODALS

Must, can, could, be able to, may, might, will, shall, should, to have (to) are modal verbs.
They express meanings such as obligation, necessity, certainty, ability and possibility, lack of necessity, offers, suggestions, requests, logical assumption, permission, prohibition, advice and criticism.
E.g. Modern engineers can produce technical and engineering products.
You should follow the advice of the manager coming to the conference.
All operators in the boiler room must follow safety regulations instructions

Fill in the gaps, paying attention to the box, give Russian equivalents of the sentences.

Should, can, might, may

1. A degree in engineering ___ go a long way, but it is also possible to become an engineer with a degree in math, physics or even computer science.
2. You ___ expect to take the following courses; algebra, geometry.
3. You ___ also need to take some computer programming or computer applications coursework.
4. With the heavy course load involved in an engineering program, you ___ come prepared.

Fill in the proper modal verb.

1. A power thermal engineer ___ go a long way, in order to become a specialist and occupy the position of the top manager.
2. The future engineer ___ take the following courses; algebra, geometry, trigonometry and calculus.
3. Depending on your specialty, you ___ to take some computer programming or computer applications coursework.
4. With the English course load involved in an engineering program, you ___ prepared.

Supplement your knowledge of grammar with additional information from other grammar books.

Attachment 6

Heat Transfer Research by Emission

1. Introduction

Engineering practice implies to provide the heat stream calculation of any technical apparatus or technological process one must know the integral factor of heat radiation for solid. If the reference book does not contain any required data on physical properties of the substance, one should start the heat engineering experiment.

Under doing this experiment the students conduct the scientific research the dependence of the integral factor radiation of the real grey surface from temperature with the calorimetric method individually. Besides it, the students will consolidate theoretical knowledge of heat exchange by radiation; acquire skills to provide scientific experiment and its processing.

2. Laboratory work Goals and Aims

The goal - to obtain skills of the experimental definition integral factor heat radiation of the solid body.

Aims:

1) The definition of integral emissivity ability of solid body under the different temperatures radiative surface;
2) The emissivity construction depends on the temperature;
3) The comparison of the obtained results with the prominent literary source;
4) The compilation of a report on the work done.

3. Basic Theoretical Information

The given laboratory work connected with such physical phenomena as heat radiation.

In view of the fact, that all heated material objects emit energy into the environment, the necessity of the accounting component of the radiation heat arises between the objects under engineering calculations. In pure form, the radiate heat exchange takes place only in high vacuum.

Heat emission as a process of spreading electromagnet waves has the following characteristics: length wave λ and oscillation frequency $\nu = c / \lambda$, where c – light velocity (in vacuum c=3·10^8 m/s). All types of electromagnetic radiation have the similar origin that's why the radiation classification according the length of waves and its effect has conventional character.

The heat stream emitted on all length of waves with the unit surface body to all directions called surface density of integral radiation E, W/m^2.

The origin of the body and its temperature define the surface density of this body. This is the natural body emission.

Stefan-Boltzmann law presents the surface density stream of integral emission completely black body E_0, W/m^2, depending on its temperature

$$E_0 = \sigma_0 T^4.$$

Here, σ_0=5,67·10^{-8} W/(m^{2}K^4) – Stefan-Boltzmann constant. Stefan-Boltzmann physical law presents the following formula for technical calculations

$$E_0 = C_0 (T/100)^4,$$

where $C_0=\sigma_0 \cdot 10^8$=5,67 W/(m^{2}K^4) –the radiation coefficient of the completely black body.

Bodies, with which we are dealing, in practice, emit less heat than a black body at the same temperature.

Held up by another substance, heat rays are partially absorbed and their energy is converted into heat again, partly reflected and pass through the body
The heat beams absorption completed in thin surface layer and doesn't depend on body's thickness. The process is appropriate for most solid and liquid bodies.

The heat radiation for these bodies is regarded to be the surface phenomena. The resultant equation of the beam stream put in the method of the work. The equation describes the heat radiation the bodies system in the transparent environment between the heated body (tungsten wire) and cooled case (glass tube):

$$Q_{12} = \varepsilon_{red} c_0 F_1 \left[\left(\frac{T_1}{100} \right)^4 - \left(\frac{T_2}{100} \right)^4 \right], \quad (1)$$

where ε_{red} – the reduced integral coefficient of heat radiation of bodies

$$\varepsilon_{red} = \frac{1}{\left[\frac{1}{\varepsilon_1} + \frac{F_1}{F_2} \left(\frac{1}{\varepsilon_2} - 1 \right) \right]};$$

ε_1, ε_2 – integral coefficient of heat radiation of the researched wire and case;
F_1, F_2 – the surfaces of wire and case. The square surface of the tungsten wire is small in comparison with the square surface of the case ($F_1 << F_2$), in the formula $\varepsilon_{red}=\varepsilon_1$.One must know the wire temperature T_1 and the temperature of the glass inner wall T_2 (scale Kelvin) and determine the density of the stream radiation from the wire surface

$$E = Q/(\pi d l),$$

where Q – power necessary for heating the wire, W; d – tungsten wire diameter, m; l – tungsten wire length, m.

The tungsten wire heated by means of DC (Direct Current), the value of which calculated to the drop voltage on the exemplary element of resistance.

$$I = U_0 / R_0, \text{ Amp.}$$

Emitted constant power is proportional to the drop voltage on the working part of the wire in the determined heat mode

$$Q = I U_1.$$

The tungsten wire temperature t_1 calculated according its resistance R_1.The resistance calculated according to the formula

$$R_1 = U_1 / I \text{ , Ohm.}$$

One must take into consideration the resistance of metal temperature when the wire heated

$$R_1 = R_{12}[1 + \alpha_R(t_1 - t_2)] \text{, Ohm,} \quad (2)$$

where α_R – temperature coefficient the resistance of metal, R_{12} – the tungsten wire resistance under the temperature of the environment t_2, °C.

Using the dependence (2), the formula for determining tungsten wire temperature is the following

$$t_1 = \frac{R_1 - R_{12}}{\alpha_R R_{12}} + t_2 \text{, °C,}$$

$T_1 = t_1 + 273{,}15$, K.

4. Student Knowledge Test

The entrance theoretical test allows assessing student's knowledge and provides access to work.

1. What is the name of the completely black body?

a) a solid black color, which at any intensity of the lighting is black;

b) body, which has the same spectral response absorption in the whole range of wavelengths;

c) body, which in the given range of wavelengths, only absorbs electromagnetic radiation, with no skips and reflects nothing.

2. Give the law formulation of Stefan-Boltzmann:

a) integrated intensity of the black-body radiation, inversely proportional to the absolute temperature of the surface at 4 degrees;

b) integrated intensity of the black-body radiation, depends only on the characteristics of the body surface;

c) integrated intensity of the black-body radiation, proportional to the absolute temperature of the surface at 4 degrees.

3. What is in the test section for the research of heat transfer by radiation?

a) heated hot wire placed in an vacuum tube, surrounded by the shell with cooling liquid inside;

b) heated wire placed in the tube (with the air inside it), surrounded by the shell with cooling liquid inside;

c) wire, placed in the vacuum tube, surrounded by the shell, with heating liquid inside.

5. Research Programme

The Description of the Experimental Setup.

Figure 1 presents the description of the experimental setup scheme. The front panel presents the two-channel temperature meter (1) mode 2TM, connected to chromel - copel thermocouple, universal voltmeter (1) mode MY-67 with automatic change measurement limits, tumbler of electric supply of setup (3), connectors (*V*) for plug-in voltmeter (1), tumbler (5) for switching voltmeter to

measure the voltage drop for exemplary resistance (U_0) and resistance on the tungsten wire (U_w).

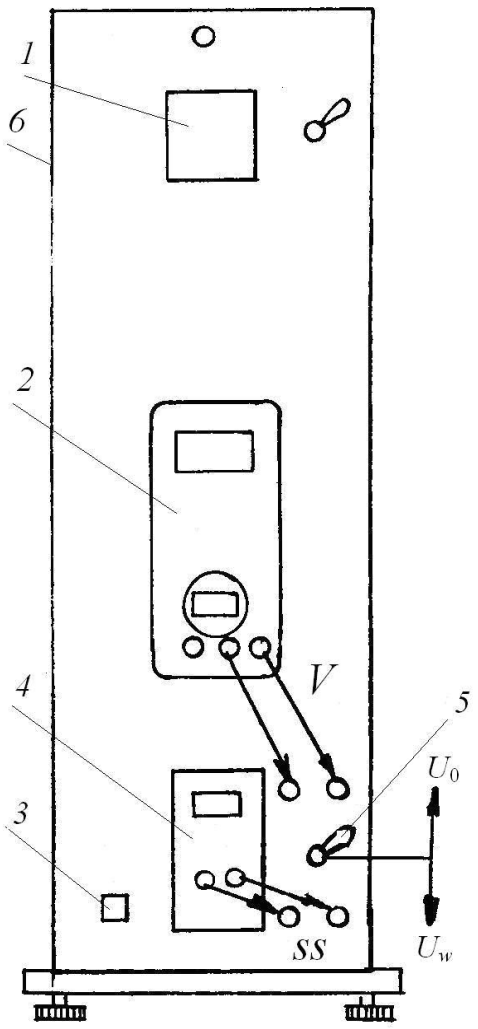


Fig.1. Setup scheme

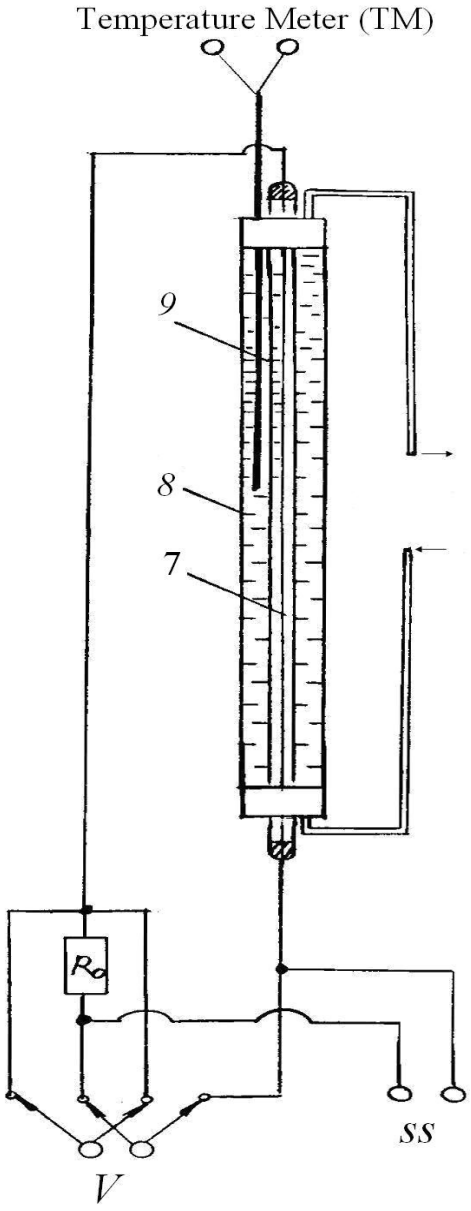


Fig.2. The working part of the scheme

Figure 2 presents the fundamental scheme of the working part, electric power scheme and measurement. Heated tungsten hot-wire (7) situated in a cylindrical glass container (8) with double walls. Between these walls there is water. The inner tube is vacuumed till 10^{-5} (express pressure in millimeters of mercury).

The wall temperature of this tube t_2 is considered to be equal of the water temperature circulating between double walls and constant within the experiment. It is determined with chromel - copel thermocouple (9) connected with the tem-

perature meter (2). The glass container with hot-wire mounted module (6), situated on the laboratory panel.

Electric Power supply to tungsten wire supplied from the electric source (4) by means of connectors (source supply).

To determine the magnitude of the electric current in a circuit on it by the measured value of the voltage drop, the exemplary resistance (R_0) connected with tungsten wire in series. To measure the voltage on the tungsten wire U_1 and the voltage on the exemplary resistance U_0 to connectors (V) the multimeter plugged in (1).

The Experiment Conducting

One must prepare writing observations in the special form of the protocol, after reading the description of the experimental setup.

To conduct the experiment one must provide according to the following scheme:

1. Writing data of the setup, experiment conditions
2. Be sure that all devices switched off. Using the multimeter (mode the resistance measurement) measure electric resistance of the tungsten wire R_{12} under the room temperature t_2.
3. Turn the power supply voltage regulator clockwise until it stops. Switch on the panel by means of tumbler (3). Switch on power supply (4), multimeter (2) and measure the temperature.
4. Determine (sets the teacher) voltage values, under which measurements conducted. Recommended voltage values set on the power supply 6; 8; 10; 12; 16 volt.
5. Switch over the tumbler (5) in mode U_w. Set the first value of voltage on the wire, following the indications of voltmeter. Perform the voltage reading on the wire U_1 by means of multimeter U_0.
6. Switch over the tumbler in the mode U_0. Perform the voltage reading on the exemplary resistance.
7. Determine the temperature the tube's wall t_2 by means of the meter temperature (1).
8. Points 5 and 6 repeat for the following voltage values set on the tungsten wire.
9. Remove the voltage on the wire. Switch off devices and the panel.

6. Processing Research Data

Setup data and the table of measurement results:

Diameter of tungsten wire $d = 0{,}15 \cdot 10^{-3}$ m;
Exemplary resistance $R_0 = 0{,}1$ Ohm;
Temperature resistance coefficient tungsten $\alpha_R = (3{,}9 - 4{,}5)10^{-3}$, 1/K;
Wire length $l = 0{,}45$ m.

Table 1

Results of measurements and calculations

№	t_1, °C	T_1, K	t_2, °C	T_2, K	U_0, V	U_1, V	I, Amp	Q, W	ε_1
1									

…									
5									

Using measurement data on the working part of the set up according to the equation (1) one must find the radiation coefficient of the researched agent. The calculation done for every temperature regime. The calculations put into the table 1. The graph of the dependence coefficient radiation of the temperature $\varepsilon_1=f(t_1)$ produced in the researched interval temperature.

7. Results analysis

The obtained dependence of radiation coefficient from temperature is necessary to compare with the data of literary sources, to conduct the evaluation of error measurement and to perform the conclusions. The maximum possible measurement error of integral coefficient of heat radiation of the researched surface determined with the equation (1) with the consideration of applied devices:

$$\frac{\Delta\varepsilon_1}{\varepsilon_1}=\frac{\Delta Q}{Q}+\frac{\Delta F}{F}+\frac{4(\Delta T_1+\Delta T_2)}{T_1^4-T_2^4},$$

where Δ – absolute errors of measurement of separate values.

8. The Report Content Requirements

The following report structure for laboratory work:

1. Title page
2. Tasks for the laboratory work
3. The scheme description of experimental setup and calculation methods
4. Calculation methods put down into the table 1
5. Results analysis and work conclusions

Attachment 7

Specific Air Thermal Capacity Definition under the Constant Pressure.

1. Lead-in

In engineering practice on doing thermal calculation of technical device or on organizing the technological process it is necessary to know the thermal capacity of liquids and gases which are being used. If the data of the necessary physical properties substance are absent in the reference book one should produce a thermal experiment.

The scientific research of isobaric heat capacity air will be produced by the students individually on doing this laboratory work.

The students will master thermal dynamic laws, acquire skills of doing and processing scientific experiment.

2. Laboratory work goals and aims

The experiment definition skills of mass specific heat air under the constant pressure on the energy balance is the aim of this work.

Research goals are

1. Master theoretical knowledge of thermodynamics basic laws;
2. Compare getting results with the reference meaning;
3. Make up a report of having produced work.

3. Basic theoretical information

One of the most important parameters defining the heat is *c* proportionality factor, specific mass heat.

The specific heat defines the heat quality, which is necessary for the temperature change of 1kg mass carrier for 1 ^{0}C. Gases heat capacity depends on the pressure and temperature. Essentially mixing methods and permanent inflow are used for isobaric heat capacity.

The Permanent inflow method has the leading place in the research of heat capacity gases because of simple construction and detailed theory development.

The experiment definition of heat capacity gaseous substance is based on the measuring rate of the researched gas, temperature before and after heating, power emitting on the heater.

The power used for heating gas

$$Q = V\rho c_p (T_2 - T_1) \text{, Watt,} \qquad (1)$$

T_1, T_2 - gas temperatures before and after heating due to the scale Kelvin, K;
c_p – specific mass isobaric gas heat capacity, J/(kg·K); ρ – gas density under the temperature T_2, kg/m^3; *V*-volume rate of the heating gas, m^3/s.

In accordance with the heat exchange equation in the stationary mode all heat quantity produced by the heater of the time unit, it is transferred to the research gas for heating and it is lost by the calorimeter into the environment.

$$Q_R = Q + Q_L . \quad (2)$$

For defining c_p from the equation (1) is necessary to define heat flow, equaled electrical power and necessary for the wire heating.

$$Q_R = IU_1 .$$

None chromic wire is heated by the direct current and its unit is defined by the calculation way of the dropping voltage on the standard resistance

$$I = U_0 / R_0 , \text{ Amp.}$$

Of the equation (1) taking into account (2), neglect the heating and its lost by the calorimeter into the environment, one should get:

$$c_p = \frac{Q_R}{V\rho(T_2 - T_1)} . \quad (3)$$

4. Student's knowledge testing

Entrance theoretical test allows evaluating student's acquired knowledge and getting permission for the work.

1. What natural basic laws are defining the operational principle of the unit and the basic principle of the experiment?
2. Explain the physical sense of heat capacity.
3. What types of heat capacity can you enumerate? What is the difference between them?
4. Explain the first beginning thermodynamics interrelation and isobaric heat capacity.
5. What is the main point of the experiment?
6. What is the reason of the relative error under the defining of the isobaric heat capacity air? What is the reason of discrepancy between the experimental values and reference book?

5. Research program

5.1. Experiment unit description

Experiment unit description scheme is given on the picture 1.

On the front panel there is 2 channel temperature gage (5) type TM or TRM 200, direct current battery (3), rotameter (4), tumbler of electricity supply unit (1), compressor switch on tumbler (2), multimeter (9) type MY-67 with automatic switch measurement limits, connectors for switching on voltmeter (9), tumbler (7) for switching over on voltmeter for measuring voltage drop on the standard resistance (U_0) and voltage on the nichrome heater (U_w).

In the picture 2 the working part scheme, electric circuit supply and measuring system are given. Stationary flow of the researched gas and air are given by

the compressor (11) through the fridge (12) and rotameter (4) into running calorimeter which consists of the inner, cylindrical, glass tube (14) placed into vacuum layer (15). The nichrome heater is in the tube (16). Air heating moving along the tube (14) is being regulated by electrical supply source with the change power heating with the tickler and voltage.

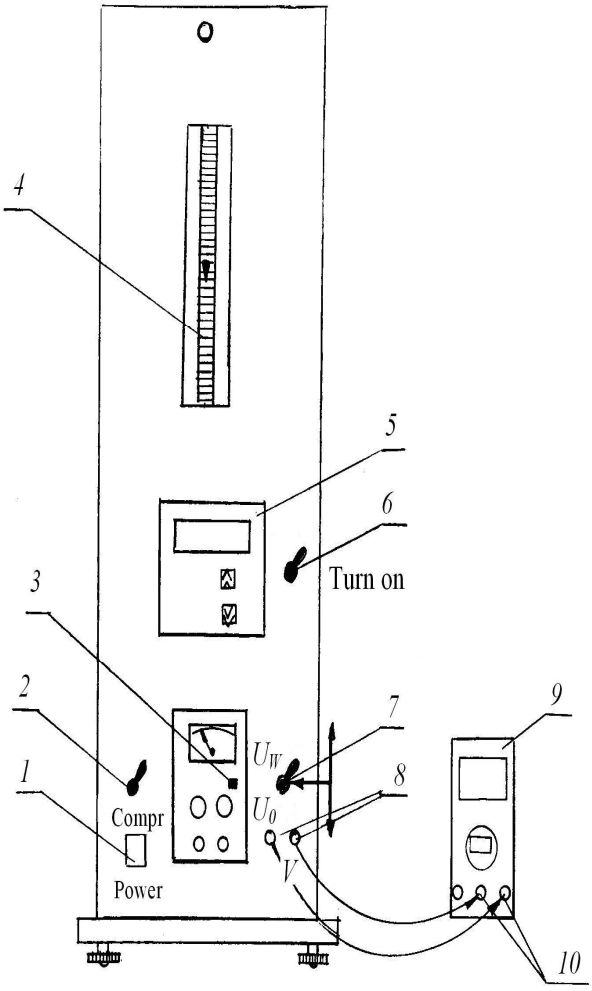
Input air temperature t_1 and output t_2 air temperature of the running calorimeter is being defined by the chrome thermocouple, connected to the first and the second measure temperature channel.

Air flow rate volume G is being measured by rotameter (4). Energy supply is being delivered to the heater of the power supply (3)**.** The standard resistance (R_0) is connected to the heater in serial. Electric current unit in the circuit for measured unit drop résistance. For measuring voltage on the heater U_1 and measuring voltage on the standard resistance U_0 the multimeter (*V*) being connected to the terminals.

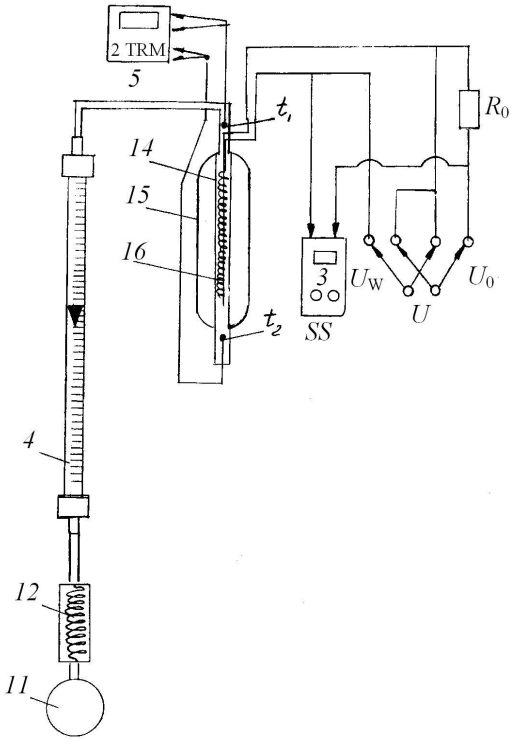
One should prepare a special form for putting down research notes, after reading the description of the experimental unit.

The experiment is being done to the following scheme:

1. Put down the units data, experiment criterion.
2. Define (gives the teacher) the voltage meanings under which the measurement is being done. Recommended voltage meanings are given on the power supply: 3,4,5,6,7 *V*. Define the air volume consumption *V*.
3. Be sure that all devices are switched out.
   Connect multimeter (9) with the help of wires to the terminals (8) on the front panel unit. Switch the multimeter from the range of the constant voltage to the voltage 20 *V*.
4. Turn the voltage power supply against the hour hand till the fixed stop. Switch on the electric supply by the reversible switch (1), compressor by the reversible switch (2), temperature measurer by the reversible switch (6).
5. Turn on the heater by the power supply button switch, pushing down the button «ON/OFF».
6. Turn on the reversible switch (7) in the position U_w. Install the recurrent voltage meaning on the heater and follow voltmeter indications. Do voltage count on the heater U_1 on the display multimeter.
7. Switch on the reversible switch (7) to the state U_0. Do voltage count on the standard resistance U_0.
8. In 4-6 minutes (on reaching state heat behavior) define gas temperature t_1, t_2 according to the display temperature tester (5) and correct air volume capacity on the rotameter (4).
9. Points 6-8 repeat for the following voltage meanings which are being installed on the heater.
10. Put off the voltage on the heater. Switch off the devices and panel.



Picture 1. Scheme unit



Picture 2. Unit working part

5.2. Data Processing Research

Unit's data and the table indication results:
standard resistance R_0 = 0,1 Ohm; air density ρ=1,293 kg/m^3.

Using indication data on the working part of the unit due to the equation (1) define the specific mass isobar air thermal capacity.

This calculation is being done for the temperature mode, results of which are put down into the table. Dependence chart $Q_R=f(\Delta T)$, $\Delta T = T_2 - T_1$ in the temperature interval is being done and the linear function parameters are being defined $Q_R = V\rho c_p \Delta T + Q_L$.

Table 1

Results measurements and calculations table

№	V, m^3/s	t_1, °C	T_1, K	t_2, °C	T_2, K	ΔT, K	U_0, V	U_w, V	I, Amp	Q_R, W	c_p, J/(kg·K)
1											
2											

3											
4											
5											

The precise meaning of mass isobar air capacity under the average temperature $\overline{T} = 0,5(T_1 + T_2)$ can be found due to the empirical formula:

$$c_p^* = 1002,7 + 0,027(\overline{T} - 273,15), \text{ J/(kg·K)}.$$

The absolute error is being defined:

$$\delta c = \frac{c_p - c_p^*}{c_p} 100, \%.$$

6. Research Analysis

Getting dependence of the specific mass isobar air thermal capacity of the researched substance of the temperature is necessary to compare with literature sources and make up conclusions.

Determine the specific mass isobar air thermal capacity under different 5 meanings of the temperature t_2 in the researched interval.

Calculate the measurement error of the specific isobar air capacity.

7. Requirements to the Work Report Content

Laboratory report:

1. Cover page;
2. Laboratory tasks;
3. Description of the experiment scheme and calculation methodology;
4. Calculations results must be filled in the table;
5. Work analysis results and conclusions.

Literature

1. Theoretical basis of heat engineering. Heat engineering experiment. Book 2: Manual / Grigoryev V.A., Zorin V.M. - M: Energoatomizdat, 1988. - 557 p.
2. Practical work of heat transfer / Under the supervision of A.P. Solodova.- M: Energoatomizdat, 1986. - 297 p.
3. Thermal physical measurements and devices / E.S. Platunov, S.E. Burovoy, V.V. Kurepin, G.S. Petrov. - L: Machine building engineering, 1986. - 255 p.

Attachment 8

Guidelines for the Technical Translation of the Texts.

For the literate translation of technical texts, remember the following:

1. Please read carefully the sentence and try to understand its meaning.
2. Find the subject.
3. Find the predicate
4. Translate the subject and the predicate.
5. Find the object.
6. Translate the subject, the predicate, and the object.
7. Select the sentence and determine the left and right adjective and give their interpretation.
8. Translate the whole sentence

Read the sentences and give Russian equivalents.

1. Steam turbine driven current generators are often used as spare exciters in steam power plants.
2. The combustion chamber pressure in the engine is very high.
3 A vapor compressed refrigeration device includes a reversing valve and optimized heat exchangers.
4. Compression heat pumps always operate on mechanical energy.
5. Heat exchangers are used in many industries, some of which include: waste water treatment, refrigeration systems, wine-brewery industry, and petroleum industry.
6. Water entering the blades steam turbine will likely result in the destruction of the thrust bearing for the turbine shaft.
7. About two-thirds of the heated air combined with the products of combustion is expanded in a turbine resulting in work output which is used to drive the compressor.

Attachment 9

ANNOTATION WRITING

(Abstract) 100-250 words.

Annotation is a shorten version of the paper written for people who may never read the full version. There are 2 types: descriptive and informative.

1. Introduction (explanation)\explanation of the title.
2. Discussing the characteristic features of the problem (the aim of the research).
3. Methods and materials describing method equipment and conditions of the experiments.
4. Results (main findings).
5. Pros and cons (recommendations).
6. Conclusion.

Descriptive annotation: present tense. Generalized vocabulary and phrases.
Informative annotation: past tense. Precise specific language including numbers.
Key words printed in the line (5).
One paragraph without red line.

Clinches for annotation writing

The object (purpose) of this paper is to present (to discuss, to describe, to show, to develop) …
The paper (article) discusses some problems relating to (deals with some aspects of, considers the problem of, presents the basic theory of, and provides information on) …
The objective of this article is …
The work is divided into … major parts.
The first part deals with …
Then follows a discussion on …
Then the author goes on to the problem of …
The next part presents (describes, discusses) …
After discussing the author turns to …
The final part states …
The conclusion is that the problem is …
According to the author …
The author concludes that …
In summing up the author …
Evaluating the situation the conclusion can be drawn that …
In my opinion (to my mind, I think) …
The paper is interesting (not interesting), of importance, valuable (invaluable), up-to-date (out-of-date), useful (useless) …
It gives (doesn't give) me more technical terms …
It enlarges (doesn't enlarge) the scope in the sphere of …

Answer the questions:

1. What do you mean the word "annotation"?

2. What does the concise annotation?
3. What types of annotation do you know?
4. What stages of annotation do you know?
5. What is the recommended volume of annotation?

I. Pre-reading task. (Speaking)
1. Have you ever read any scientific article in Russian or in English?
2. What is the general objective of these publications?
3. Why should students learn to read, understand and write such a kind of articles?

II. You are going to read the abstracts from the authentic scientific articles. As you know any scientific article consists of a certain structure and starts with an abstract. Look through the abstracts and try to identify their composition and purpose. (Reading)

Abstract example (1)

Numerical simulation was performed of the motion of a viscous incompressible no isothermal fluid (heat carrier) in an open rectangular cavity under conditions of forced convection and conjugate heat exchange. The effect of the jet dynamic parameter (Reynolds number) and fluid flow conditions on the character of motion and heat exchange of viscous incompressible no isothermal fluids in rectangular cavities is studied. A hydrodynamic pattern of viscous flow in an open cavity under forced convection conditions (in the conjugate and no conjugate formulations of the problem) is obtained. The effect of parameters of the model on the character of motion is studied. Temperature profiles for the solid and fluid phases are obtained. The effect of parameters of the model on the character of temperature distribution in both phases is studied.
Simulation, viscous, conjugate heat exchange, rectangular cavity, temperature distribution

Abstract example (2)

The scientific text is about superconductivity. The performance of wires made from yttrium, barium, copper and oxygen is getting tantalizing close to what is needed to compete with conventional conductors. A new generation of wires has been produced by the scientists of the USA (CA). This product is available on the market and the operational principle is higher than the former. The production arises on a lot of discourses in the scientific world. The performance of the wires of new generation is competitive with conventional conductors.
Superconductivity, wires, produce, scientist, conductors

III. Write out the answers to the following questions:
1. Which branches of science are these abstracts devoted to?
2. What are the subjects of these abstracts?
3. What experiments were carried out?
4. What were the results and the conclusions?

Attachment 10

SUMMARY WRITING

A summary is the information from a text or an article. The summary contains an essential information of the literary sources. Writing summary one must understand the main ideas of any reading paper. The information of the original literary sources should be compressed. Summary is written for people who have already read the whole thing.

Steps for writing a summary.

1. Identify the main idea.
2. Decide what you are going to leave out. Include the most essential details.
3. At the beginning include some sentences stating the subject matter of the summary, where the original text came from, and the original author's name.
4. State the author's opinion and not your own.
5. Make sure your verb tenses are appropriate.
6. Make the summary short, not more than 1/3 of the original text.

Guidelines for writing a summary.

1. Read the whole original text quickly to gain an impression of the content and its relevance to your work.
2. Highlight the main points in every paragraph as you read.
3. Make notes of your own on these points.
4. Put away the original and rewrite your notes in your own words in complete sentences.
5. Begin your summary with the statement of the main idea at the start.
6. Using your notes write out supporting points in well-connected sentences.
7. Reread your work to check that you have concluded all the information than you need.

Pattern for writing a summary [32, 33].

Definition
The main idea is…..(to+V); according to the writer, a_____is.
Description
According to the writer, a___has (characteristics).

Classification
(Two) types of_____were discussed in the lecture.
Chronology
The writer explained the sequence of events for_____.
Comparison
The writer compared_____with_____.
Contrast
The writer contrasted_____with_____.
Cause and effect
The writer explains why_____.
Problem and Solution
The writer presents several solutions for the problem of._____.

KEY WORDS FOR WRITING SUMMARIES.

Definition Is known Is called Is Refers to Means **Classification** Kinds of Types of classes of Groups of Parts of Properties of Characteristics of Varieties of **Comparison and contrast** Like Similar to Differ from Compared with In comparison In the same way In contrast Whereas(тогда как; несмотря на то, что (вводит придаточные уступительные и противопоставительные) Although But Conversely In spite of even though however instead	**Description** Consist of Namely Specifically That is For example For instance **Sequence-chronology or process** First, second, third Next, then, last Finally Before After At the same time Meanwhile (тем временем, между тем, пока) Now As soon as Later Subsequently Step Stage Phase **Cause and Effect** As a consequence As a result Thus Therefore Because Because of For this reason Consequently Since So **Evaluation** First, second, third Should, must, ought Therefore In conclusion, in summary

on the contrary on the other hand despite adjectives (характеристики, определения)	**Cues (реплики) for writing** Especially important is And this is important And this is the key point

Attachment 11

Heat Capacity of Gases

Average Mass Heat Capacity of Gases at Constant Pressure c_p, kJ/(kg·K)

t, °C	O_2	N_2	CO	CO_2	H_2O	SO_2	Air (absolutely dry)
0	0,9148	1,0304	1,0396	0,8148	1,8594	0,607	1,0036
100	0,9232	1,0316	1,0417	0,8658	1,8728	0,636	1,0061
200	0,9353	1,0346	1,0463	0,9102	1,8937	0,662	1,0115
300	0,9500	1,0400	1,0538	0.9487	1,9192	0,687	1,0191
400	0,9651	1,0475	1,0634	0,9826	1,9477	0,708	1,0283
500	0,9793	1,0567	1,0748	1,0128	1,9778	0,724	1,0387
600	0,9927	1,0668	1,0861	1,0396	2,0092	0,737	1,0496
700	1,0048	1,0777	1,0978	1,0639	2,0419	0,754	1,0605
800	1,0157	1,0881	1,1091	1,0852	2,0754	0,762	1,0710
900	1,0258	1,0982	1,1200	1,1045	2,1097	0,775	1,0815
1000	1,0350	1,1078	1,1304	1,1225	2,1436	0,783	1,0907
1100	1,0434	1,1170	1,1401	1,1384	2,1771	0,791	1,0999
1200	1,0509	1,1258	1,4493	1,1530	2,2106	0,795	1,1082
1300	1,0580	1,1342	1,1577	1,1660	2,2429	–	1,1166
1400	1,0647	1,1422	1,1656	1,1782	2,2743	–	1,1242
1500	1,0714	1,1497	1,1731	1,1895	2,3048	–	1,1313
1600	1,0773	1,1564	1,1798	1,1995	2,3346	–	1,1380
1700	1,0831	1,1631	1,1865	1,2091	2,3630	–	1,1443
1800	1,0886	1,1690	1,1924	1,2179	2,3907	–	1,1501
1900	1,0940	1,1748	1,1983	1,2259	2,4166	–	1,1560
2000	1,0990	1,1803	1,2033	1,2334	2,4422	–	1,1610

Average Mass Heat Capacity of Gases at Constant Volume
c_v, kJ/(kg·K)

t, °C	O_2	N_2	CO	CO_2	H_2O	SO_2	Air (absolutely dry)
0	0,6548	0,7352	0,7427	0,6259	1,3980	0,477	0,7164
100	0,6632	0,7365	0,7448	0,6770	1,4114	0,507	0,7193
200	0,6753	0,7394	0,7494	0,7214	1,4323	0,532	0,7243
300	0,6900	0,7448	0,7570	0,7599	1,4574	0,557	0,7319
400	0,7015	0,7524	0,7666	0,7938	1,4863	0,578	0,7415
500	0,7193	0,7616	0,7775	0,8240	1,5160	0,595	0,7519
600	0,7827	0,7716	0,7892	0,8508	1,5474	0,607	0,7624
700	0,7448	0,7821	0,8009	0,8746	1,5805	0,624	0,7733
800	0,7557	0,7926	0,8122	0,8964	1,6140	0,632	0,7842
900	0,7658	0,8030	0,8231	0,9157	1,6483	0,645	0,7942
1000	0,7750	0,8127	0,8336	0,9332	1,6823	0,653	0,8039
1100	0,7834	0,8219	0,8432	0,9496	1,7158	0,662	0,8127
1200	0,7913	0,8307	0,8566	0,9638	1,7488	0,666	0,8215
1300	0,7984	0,8390	0,8608	0,9772	1,7815	–	0,8294
1400	0,8051	0,8470	0,8688	0,9893	1,8129	–	0,8369
1500	0,8114	0,8541	0,8763	1,0006	1,8434	–	0,8441
1600	0,8173	0,8612	0,8830	1,0107	1,8728	–	0,8508
1700	0,8231	0,8675	0,8893	1,0203	1,9016	–	0,8570
1800	0,8286	0,8738	0,8956	1,0291	1,9293	–	0,8633
1900	0,8340	0,8792	0,9014	1,0371	1,9552	–	0,8688
2000	0,8390	0,8847	0,9064	1,0446	1,9804	–	0,8742

Average Molar Heat Capacity of Gases at Constant Pressure μc_p, kJ/(kmol·K)

t, °C	O_2	N_2	CO	CO_2	H_2O	SO_2	Air (absolutely dry)
0	29,274	29,019	29,123	35,860	33,499	38,85	29,073
100	29,538	29,048	29,178	38,112	33,741	40,65	29,152
200	29,931	29,132	29,303	40,059	34,118	42,33	29,299
300	30,400	29,287	29,517	41,755	34,575	43,88	29,521
400	30,878	29,500	29,789	43,250	35,090	45,22	29,789
500	31,334	29,764	30,099	44,573	35,630	46,39	30,095
600	31,761	30,044	30,425	45,453	36,195	47,35	30,405
700	32,150	30,341	30,752	46,813	36,789	48,23	30,723
800	32,502	30,635	31,070	47,763	37,392	48,94	31,028
900	32,825	30,924	31,376	48,617	38,008	49,61	31,321
1000	33,118	31,196	31,665	49,392	38,619	50,16	31,598
1100	33,386	31,455	31,937	50,099	39,226	50,66	31,862
1200	33,633	31,707	32,192	50,740	39,825	51,08	32,109
1300	33,863	31,941	32,427	51,322	40,407	–	32,343
1400	34,076	32,163	32,653	51,858	40,976	–	32,575
1500	34,282	32,372	32,858	52,348	41,525	–	32,774
1600	34,474	32,565	33,051	52,800	42,056	–	32,967
1700	34,658	32,749	33,231	63,218	42,576	–	33,151
1800	34,834	32,917	33,402	53,504	43,070	–	33,319
1900	35,006	33,080	33,561	53,959	43,539	–	33,482
2000	35,169	33,231	33,708	54,290	43,995	–	33,641

Attachment 12

ЛАТИНСКИЙ АЛФАВИТ

Латинские буквы	Название
A a	а
B b	бэ
C c	цэ
D d	дэ
E e	э
F f	эф
G g	гэ
H h	га
I i	и
K k	ка
L l	эль
M m	эм
N n	эн
O o	о
P p	пэ
Q q	ку
R r	эр
S s	эс
T t	тэ
U u	у
V v	вэ
X x	икс
Y y	ипсилон
Z z	зэта

Attachment 13

ГРЕЧЕСКИЙ АЛФАВИТ

Греческие буквы	Название
Α α	альфа
Β β	бета
Γ γ	гамма
Δ δ	дельта
Ε ε	эпсилон
Ζ ζ	дзета
Η η	эта
Θ ϑ	тета
Ι ι	иота
Κ κ	каппа
Λ λ	лямбда
Μ μ	мю
Ν ν	ню
Ξ ξ	кси
Ο ο	омикрон
Π π	пи
Ρ ρ	ро
Σ σ	сигма
Τ τ	тау
Υ υ	ипсилон
Φ ϕ	фи
Χ χ	хи
Ψ ψ	пси
Ω ω	омега

Attachment 14

НЕМЕЦКИЙ АЛФАВИТ

Немецкие буквы	Название
A a	[а]
B b	[бэ]
C c	[цэ]
D d	[дэ]
E e	[э]
F f	[эф]
G g	[гэ]
H h	[ха] (звук [х] похож на очень легкий выдох)
I i	[и]
J j	[йот]
K k	[ка]
L l	[эл]
M m	[эм]
N n	[эн]
O o	[о]
P p	[пэ]
Q q	[ку]
R r	[эр]
S s	[эс]
T t	[тэ]
U u	[у]
V v	[фау]
W w	[вэ]
X x	[икс]
Y y	[ипсилон]
Z z	[цэт[
Ä ä	а-умлаут: [э]
Ö ö	о-умлаут: как «ё» в слове «Лёня»
Ü ü	у-умлаут: как «ю»в слове «Люся»
ß	эсцет: как звук [с]

Attachment 15

АНГЛИЙСКИЙ АЛФАВИТ

Английские буквы	Название
A a	эй
B b	би
C c	си
D d	ди
E e	и
F f	эф
G g	джи
H h	эйч
I i	ай
J j	джей
K k	кей
L l	эл
M m	эм
N n	эн
O o	оу
P p	пи
Q q	кью
R r	а, ар
S s	эс
T t	ти
U u	ю
V v	ви
W w	дабл-ю
X x	экс
Y y	уай
Z z	зед, зи

Attachment 16

Tests

1. Choose the correct variant of the first law of thermal dynamic:

1. The heat quantity imparted to the system goes to the changing of its inner energy and for the system producing work and the volume change.
2. Heat quantity imparted to the system goes to the changing of enthalpy and for the system producing work for the pressure changing.
3. The internal system energy changing determining by the heat quantity supplying to the system.
4. The heat quantity imparted to the system goes to the changing of its inner energy and for the system producing work for the pressure changing.

2. What is the name of the mixture dryness factor?

1. The relation overheated steam mass to the general mixture mass
2. The relation dry saturated steam containing in the mixture to the general mixture mass
3. The relation fluid mass containing in the mixture to the general mixture mass.
4. The relation superheated steam mass to the mass of the humid saturated steam.

3. Under what conditions of thermal dynamical process the working substance compression is cost efficient energetically?

1. Isobaric
2. Adiabatic
3. Isothermal
4. Polytropic

4. Under what conditions of thermal dynamical process the working substance compression is cost efficient not energetically?

1. Isobaric
2. Adiabatic
3. Isothermal
4. Polytropic

5. Steam having the temperature higher than the saturation temperature under given pressure..

1. humid steam
2. dry saturated steam
3. saturated mixture
4. superheated steam

CONVERSION FACTORS

Multiply	By	To Obtain	Multiply	By	To Obtain
acre	43,560	square feet (ft^2)	joule (J)	9.478×10^{-4}	Btu
ampere-hr (A-hr)	3,600	coulomb (C)	J	0.7376	ft-lbf
ångström (Å)	1×10^{-10}	meter (m)	J	1	newton-m (N-m)
atmosphere (atm)	76.0	cm, mercury (Hg)	J/s	1	watt (W)
atm, std	29.92	in, mercury (Hg)			
atm, std	14.70	lbf/in^2 abs (psia)	kilogram (kg)	2.205	pound (lbm)
atm, std	33.90	ft, water	kgf	9.8066	newton (N)
atm, std	1.013×10^5	pascal (Pa)	kilometer (km)	3,281	feet (ft)
			km/hr	0.621	mph
bar	1×10^5	Pa	kilopascal (kPa)	0.145	lbf/in^2 (psi)
barrels–oil	42	gallons–oil	kilowatt (kW)	1.341	horsepower (hp)
Btu	1,055	joule (J)	kW	3,413	Btu/hr
Btu	2.928×10^{-4}	kilowatt-hr (kWh)	kW	737.6	(ft-lbf)/sec
Btu	778	ft-lbf	kW-hour (kWh)	3,413	Btu
Btu/hr	3.930×10^{-4}	horsepower (hp)	kWh	1.341	hp-hr
Btu/hr	0.293	watt (W)	kWh	3.6×10^6	joule (J)
Btu/hr	0.216	ft-lbf/sec	kip (K)	1,000	lbf
			K	4,448	newton (N)
calorie (g-cal)	3.968×10^{-3}	Btu			
cal	1.560×10^{-6}	hp-hr	liter (L)	61.02	in^3
cal	4.186	joule (J)	L	0.264	gal (US Liq)
cal/sec	4.186	watt (W)	L	10^{-3}	m^3
centimeter (cm)	3.281×10^{-2}	foot (ft)	L/second (L/s)	2.119	ft^3/min (cfm)
cm	0.394	inch (in)	L/s	15.85	gal (US)/min (gpm)
centipoise (cP)	0.001	pascal·sec (Pa·s)			
centistokes (cSt)	1×10^{-6}	m^2/sec (m^2/s)	meter (m)	3.281	feet (ft)
cubic feet/second (cfs)	0.646317	million gallons/day (mgd)	m	1.094	yard
cubic foot (ft^3)	7.481	gallon	m/second (m/s)	196.8	feet/min (ft/min)
cubic meters (m^3)	1,000	Liters	mile (statute)	5,280	feet (ft)
electronvolt (eV)	1.602×10^{-19}	joule (J)	mile (statute)	1.609	kilometer (km)
			mile/hour (mph)	88.0	ft/min (fpm)
foot (ft)	30.48	cm	mph	1.609	km/h
ft	0.3048	meter (m)	mm of Hg	1.316×10^{-3}	atm
ft-pound (ft-lbf)	1.285×10^{-3}	Btu	mm of H_2O	9.678×10^{-5}	atm
ft-lbf	3.766×10^{-7}	kilowatt-hr (kWh)			
ft-lbf	0.324	calorie (g-cal)	newton (N)	0.225	lbf
ft-lbf	1.356	joule (J)	N-m	0.7376	ft-lbf
ft-lbf/sec	1.818×10^{-3}	horsepower (hp)	N-m	1	joule (J)
gallon (US Liq)	3.785	liter (L)	pascal (Pa)	9.869×10^{-6}	atmosphere (atm)
gallon (US Liq)	0.134	ft^3	Pa	1	newton/m^2 (N/m^2)
gallons of water	8.3453	pounds of water	Pa·sec (Pa·s)	10	poise (P)
gamma (γ, Γ)	1×10^{-9}	tesla (T)	pound (lbm,avdp)	0.454	kilogram (kg)
gauss	1×10^{-4}	T	lbf	4.448	N
gram (g)	2.205×10^{-3}	pound (lbm)	lbf-ft	1.356	N-m
			lbf/in^2 (psi)	0.068	atm
hectare	1×10^4	square meters (m^2)	psi	2.307	ft of H_2O
hectare	2.47104	acres	psi	2.036	in of Hg
horsepower (hp)	42.4	Btu/min	psi	6,895	Pa
hp	745.7	watt (W)			
hp	33,000	(ft-lbf)/min	radian	$180/\pi$	degree
hp	550	(ft-lbf)/sec			
hp-hr	2,544	Btu	stokes	1×10^{-4}	m^2/s
hp-hr	1.98×10^6	ft-lbf			
hp-hr	2.68×10^6	joule (J)	therm	1×10^5	Btu
hp-hr	0.746	kWh			
			watt (W)	3.413	Btu/hr
inch (in)	2.540	centimeter (cm)	W	1.341×10^{-3}	horsepower (hp)
in of Hg	0.0334	atm	W	1	joule/sec (J/s)
in of Hg	13.60	in of H_2O	weber/m^2 (Wb/m^2)	10,000	gauss
in of H_2O	0.0361	lbf/in^2 (psi)			
in of H_2O	0.002458	atm			

GLOSSARY

Adiabatic process - a process taking place without heat transfer of the working fluid to the environment.
Boiling - intensive process of vaporization of liquid (transfer of a substance from a liquid to a gaseous state) with the occurrence of phase separation boundaries (the formation of bubbles or vapor film on the heating surface, their growth and movement in the volume of liquid).
Binary cycle - thermodynamic cycle, carried out by two working substances.
Carnot cycle - a reversible cyclic process (cycle), on which the most complete conversion of heat into work (or vice versa), consisting of two isothermal processes (heating and cooling) and two adiabatic processes (compression and expansion).
Compressor - a device for increasing the pressure in the working fluid.
Closed thermodynamic system - a system that does not change with the environment substance.
Circular process (or cycle) - a set of processes that result in the working fluid periodically returns to its original state.
Diffuser - a channel in which the deceleration of the flow taking place with the pressure increasing of the working fluid.
Density - the mass per unit volume.
Effect of throttling (Joule - Thomson) – the change of the working fluid temperature at adiabatic throttling.
The first law of thermodynamics - the universal application of the law of conservation and transformation of energy to the phenomena of the interconversion of heat and work.
Entropy - a thermodynamic state function of a thermodynamic system, a change in the equilibrium process which is the ratio of the amount of heat imparted to the system, or allocated to it, to the thermodynamic temperature of the system.
Enthalpy - the sum of the internal energy and potential energy of pressure.
Environment - the body that are not in thermodynamic system.
Evaporation - vaporization from the free surface of the condensed phase (in the case of solids - sublimation or distillation).
Equilibrium process - the process of transition of a thermodynamic system from one equilibrium state to another, in which the speed of the process is much less than the rate of relaxation
Exergy heat - maximum work done with the working fluid in a heat engine, if the cold source is the receiving environment.
Exergy flow of the body - the maximum work that can be obtained in a reversible transition to a state of thermodynamic equilibrium with the environment
Equation of state - an equation expressing the relationship between the parameters of all possible equilibrium states of a thermodynamic system.
Gas turbine engine (GTE) - heat engine for converting heat of combustion into kinetic energy of the jet and mechanical work around the engine.
Heat- a special form of energy transfer, which in contrast to the work is not associated with a visible movement of the body.
Heat capacity - the amount of heat required for heating a substance by 1 degree.

Heat of vaporization - the amount of heat required to convert 1 kg of liquid heated to the boiling point in the dry saturated steam at a constant pressure (temperature).
Ideal gas - gas, which lacks the force of interaction between the molecules in the distance, and the size of the latter, is negligible compared to the mean free path.
Insulated (adiabatic) system - a system that has no the ability to exchange heat with the environment.
The internal combustion engine (ICE) - a heat engine in which fuel is burned to produce mechanical work.
Internal energy - the amount of energy of all kinds of motion and interaction of particles that make up the substance.
Inversion temperature - the temperature corresponding to a state of the working fluid, under which the process of the adiabatic throttling isn't not changed.
Irreversible process - non-equilibrium process, which can take place only in one direction.
Isobaric process - thermodynamic process occurring at constant pressure.
Isothermal process - thermodynamic process that occurs at constant temperature.
Isochoric process - thermodynamic process that occurs at constant volume.
Jet engine - a device in which the chemical energy of the fuel is converted into the energy of the jet working substance.
Laval nozzle - combined nozzle for obtaining supersonic velocities of the working substance.
Magnetic hydrodynamic (MHD) generator - setting the direct conversion of heat energy into electrical energy by the passage of a plasma in a magnetic field.
Nozzle - channel, which is an increase in the speed of the working substance.
No equilibrium process - a process that the flow rate is greater than or comparable to the rate of relaxation.
Open thermodynamic system - a system that communicates with the environment and material, and work and energy.
Parameters of the state - the physical quantities that uniquely define the state of a thermodynamic system and change the values in the commission process.
Polytropic process - the process of changing the state of the working fluid, which during the process heat is constant.
Pressure - the force with which the gas (or vapor) acts on a unit area of its shell.
Regeneration - the use of exhaust gas heat (or steam) for heating the incoming air, water and fuel to the plant.
Reciprocating compressor - compressor, in which compressed gas is in the cylinder under the piston.
Reversible process - equilibrium process, which can occur in both the forward and back through all of the same intermediate states.
Refrigeration cycle - reverse circular process that is used to transfer heat from the less heated body to the bodies of more heated with the expenditure for this work.
Rankine cycle - theoretical thermodynamic cycle simple steam power plants using the same body of water (closed loop) and consisting of four basic operations:

1. evaporation of the liquid at high pressure

2. expansion of steam;
3. condensation
4. increased pressure condensate to the initial level.

Saturated steam (wet, humid) - vapor in thermodynamic equilibrium with the liquid or solid of the same composition.
Superheated steam - steam heated to a temperature above the boiling point at a given pressure.
Specific heat capacity - the amount of heat required for heating a unit of the substance by 1 degree.
Specific volume - the volume of a unit mass of material.
The second law of thermodynamics - sets the conditions of thermodynamic processes flow conversion of heat into work.
Temperature - a measure (or degree) of a heated body.
Thermodynamics - the science of the laws of the interconversion of heat and work, and properties of the body involved in these transformations.
Thermodynamic system - a set of material objects that are in interaction with others their bodies in the form of an exchange of energy, work and material.
Thermal efficiency - the ratio of the work performed in the cycle, and let down the heat to the working fluid.
Thermodynamic equilibrium - state is characterized by the equality of temperatures (thermal equilibrium) and pressures (mechanical equilibrium) at all points of the volume occupied by the working fluid.
Thermodynamic process - any change that occurs in a thermodynamic system and associated with the change at least one of its state variable.
The third law of thermodynamics (Nernst theorem) - unreachable absolute zero.
Throttling - the process of reducing the pressure of the working substance in overcoming the local hydraulic resistance no useful work.
Turbocharger - centrifugal or axial vane compressor for compressing and supplying of the working substance.
Vaporization - transition of a substance from a condensed phase (liquid or solid) into the gas phase.
Working substance - the substance through which the energy conversion done.

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