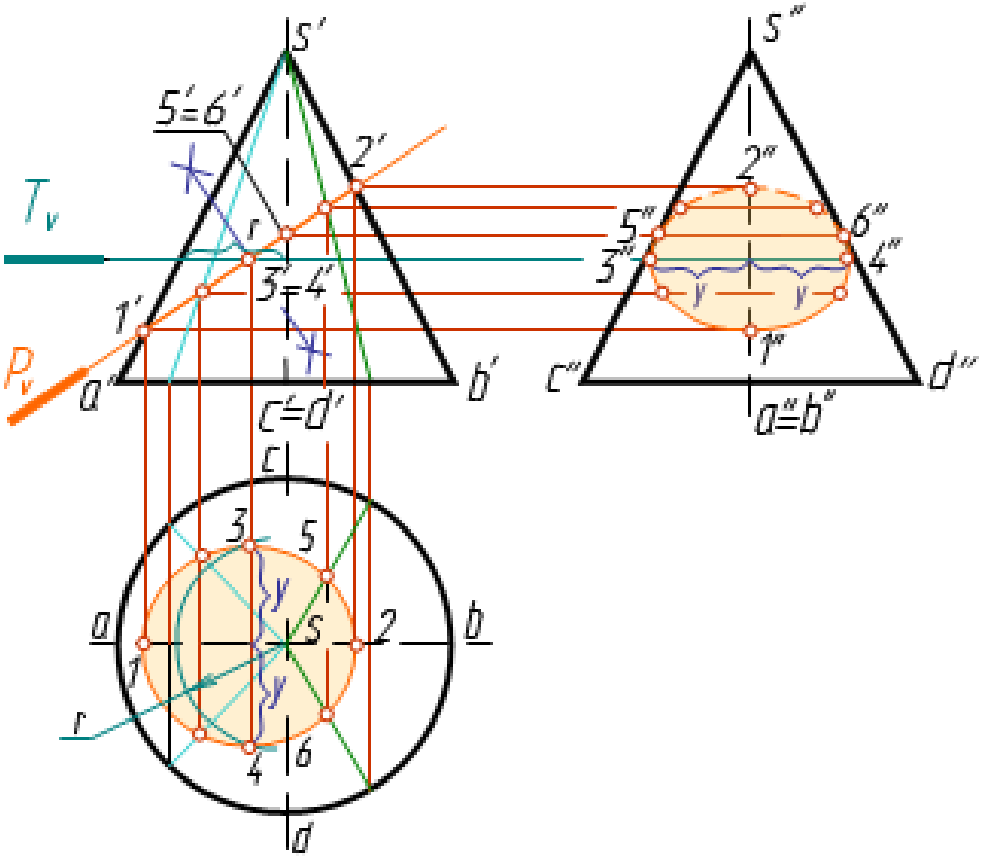
S.P. Burkova, G.F. Vinokurova, R.G. Dolotova

DESCRIPTIVE GEOMETRY



«NATIONAL RESEARCH TOMSK POLYTECHNIC UNIVERSITY»

DESCRIPTIVE GEOMETRY

Exercise-book of a practical course

TOMSK 2013

УДК 514.18(075.8)
ББК 22.151.3я73
Б914

Б914 Descriptive geometry: Exercise-book S.P. Burkova, G.F. Vinokurova, R.G. Dolotova; Tomsk: TPU Press. 2013. – 66 c.

The working book on descriptive geometry and the engineering drawing is developed for first-year students. The writing-book is used for work on lecture employment under the direction of the teacher.

This work book is intended for distance leaning Engineering Graphics for the Certificate of Higher Technical Education.

УДК 514.18(075.8)
ББК 22.151.3я73

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PREFACE

This writing-book is intended for studying the course "Engineering Graphics" by students of technical specializations of TPU who go through the Bachelor Degree Program. The working writing-book contains drawings of tasks, text conditions of problems, control questions on the basic sections of a course; in it the place for the geometrical constructions which are carried out by students in audience is provided. The following designations are accepted in the present book:

1. Points of space are usually denoted by Latin capital letters (*A,B,C*) or figures (*1,2,3*);
2. Sequence of points (and other elements) - by interlinear indexes (*A1,A2,A3,B1,B2,B3,*);
3. Lines in space - by the points specifying the given line (*AB, CD,*);
4. Angles - by Greek small letters (α, β, γ)
5. Planes - by Latin capital letters (*P*, *R*, *Q*)
6. Surfaces - by Greek capital letters (Ψ, Φ, Ω,)
7. Projection centre – *S*

8. Projection planes: horizontal – *H*; frontal – *V*; profile – *W*

9. Coordinate axes system - *xyzO*, where:
   - abscissa axis – *x*; axis of ordinates – *y*; applicate axis – *z*;
   - origin of coordinates – *O* (capital letter);
   - new projection axes obtained at planes replacing – x_1,y_2;
10. Point projections – by the corresponding lower-case letters (*a,b*):
    - for horizontal projection plane – *a*;
    - for frontal projection plane – *a′*;
    - for profile projection plane – *a″*;

11.Line projections - by projection of the points specifying the line – *ab, a′b′, a″b″.*

12. Coincidence, identity – ≡;
13. Coincidence, equality – =;
14. Parallelism – ||;
15. Perpendicularity – ⊥;
16. Representation – →;
17. Belonging of an element (a point) to a set (line, plane, etc.) – ∈;
18. Belonging of a subset (a line) to a set (plane, surface) – ⊂;
19. Intersection of sets – ∩.

20.Crossing – ÷.

CHAPTER 1. THE PRINCIPAL RULES OF A DRAWING PRESENTATION

The unified rules on presentation of drawings and other technical papers are regulated by Unified System of Engineering Papers (USEP).

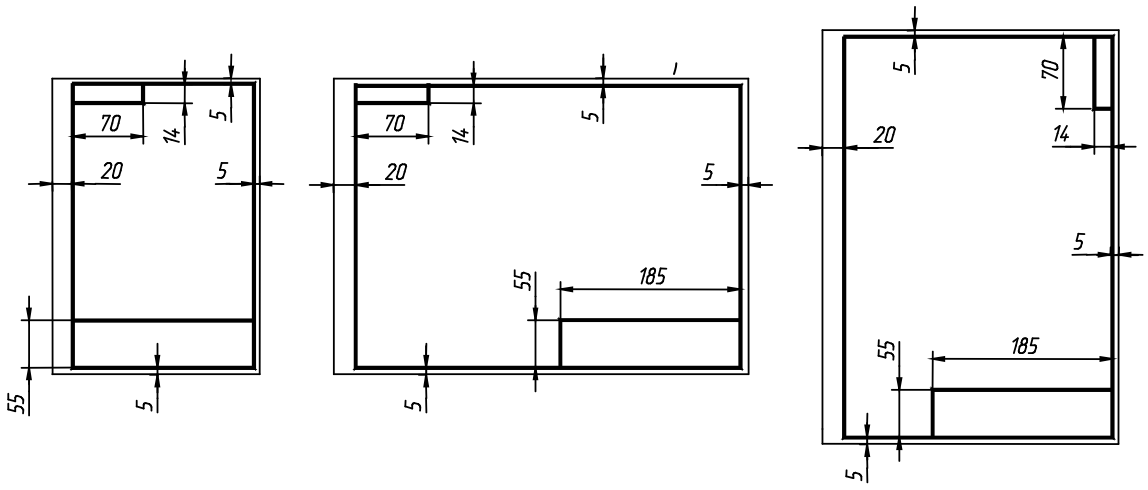
Engineering papers are the graphical and text documents specifying (separately or as a set) the construction of a product, and including all necessary data for its manufacture, control, operation and repair.

1.1 FORMATS AND TITLE BLOCKS

Format (from Latin "*forma*" - looks, appearance) - the size of drawing sheets and other engineering papers. The regulations establish the following formats and their designations:

Format designation	A0	A1	A2	A3	A4
Dimensions of a format, mm	841x1189	594x 841	420x 594	297x 420	210x 297

The format of paper sheets corresponds to the dimensions of the drawing external frame passed with a thin line (the line of clipping a drawing after its completion). The frame of drawing is produced with the base-line. The distance between the edge of paper and the frame is 5 mm and more space is on the left side (20 mm). A specimen lay out (with title blocks, 185 x 55, and an additional box, 70 x 14) is shown in Fig. 1.



Size A4 Sizes A0…A3

Fig. 1

The title blocks are drawn in base and thin lines (Fig. 2). The information in the title blocks is arranged in the following way:

Box 1 – Name of item (of your task) Lettering №7,

Box 2 – Drawing Designation (Lettering №7)

DGG I. XXXXXX. 001

a b c d

a – Department of Descriptive Geometry and Graphics;

b – Test number;

c – Classification characteristics of the item (for a detail or an assembly unit drawing) or XXXXXX (for other drawings);

d – The last figure of the student's card number;

Box 3 – Material of the item;

Box 4 – "T" (training drawing);

Box 6 – Scale (is not denoted on a sketch)

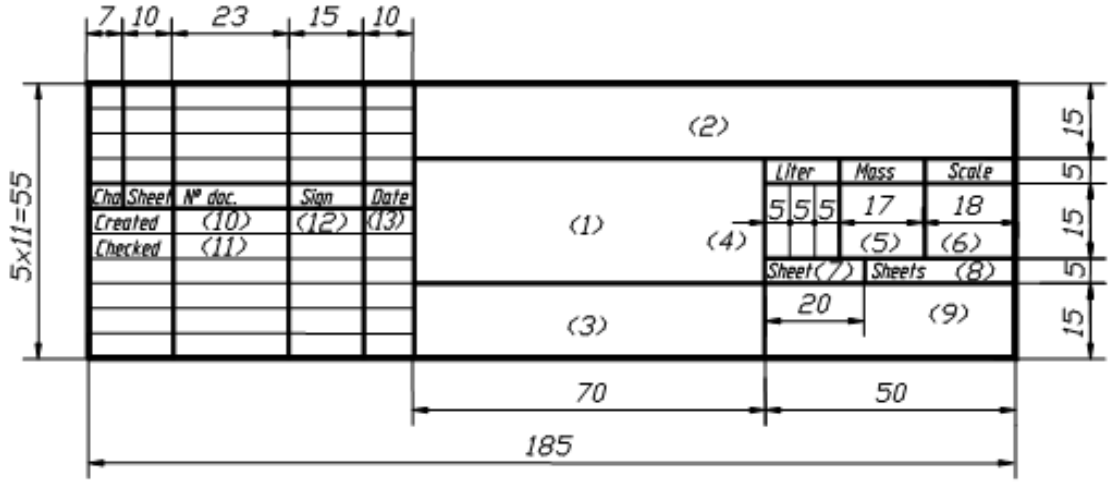


Fig. 2 Title Blocks (Form 1)

Box 7 – Sheet number (if the task consists of one sheet, the box is not filled in)

Box 8 – Total number of sheets in the test (is filled in only on the first sheet of the test)

Box 9 – TPU (Tomsk Polytechnic University), CDL (Center of Distance Learning), Group number

Box 10 – Student's Name

Box 12 – Student's Signature

Box 13 – Date

Other boxes are not filled in for training drawings.

1.2 SCALES

Scale is a ratio of a representation's dimensions to the natural dimensions of a product.

According to the drawing's complexity and the dimensions of the items being represented, select the scales from the following table:

Reduction scales	1:2; 1:2.5; 1:4; 1:5; 1:10; 1:15; 1:20; 1:25; 1:40; 1:50; 1:75; 1:100, etc.
Nominal scale	1:1
Increase scales	2:1; 2.5:1; 4:1; 5:1; 10:1; 20:1; 40:1; 50:1; 100:1; etc.

Choose a scale to make working with a drawing easier.

The Scale is inserted in the box "Scale" of the title blocks. When dimensioning a drawing, the scale different from that printed in the title blocks, is placed just above the representation near the representation sign.

Example: for extension elements, auxiliary and detail views - A(2:1)

for sectional views and sections - A-A(2:1)

1.3 LINES

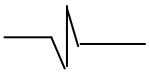
The Regulations establish design and principle applications of lines on drawings for all production and construction industries.

Thickness *s* of a continuous base-line must be 0.5 - 1.4 mm, depending on the size and complexity of the representation and on the drawing size (format). The lines of one drawing must be of equal thickness on all elevations drawn to one scale. You are recommended to draw continuous base-lines 0.8 - 1 mm thick.

The standard establishes the minimal thickness of lines and the minimal distance between adjacent lines depending on a drawing size; it also specifies the outlining of representations:

- the length of dashes of dashed and dash-and-dot lines depends on the dimensions of representations;
- dashes should be approximately equal in length;
- spaces between dashes of each line must be approximately equal;
- dash-and-dot lines must intersect and end in dashes;
- dash-and-dot lines applied as centre lines should be replaced by continuous thin lines, if a circle diameter or dimensions of other geometric figures on representation is less than 12 mm;
- for complex sectional views and sections it is permitted to connect the ends of a broken line by a thin chain line.

The Lines and Their Applications

Item	Outline	Thickness	Principal Applications
1. Continuous thick base-line		s	Visible outlines; visible transition lines; outline of section (removed and detail)
2. Continuous thin		From s/3to s/2	Outlines of covering (revolved) section; dimension and extension lines and their shelves; hatching; outlines of adjacent parts; limit lines; imaginary, fictitious lines; traces of planes
3. Continuous irregular (wavy)		From s/3 to s/2	Break lines; separating lines between a view and a sectional view
4. Short dashes (dashed line)		From s/3 to s/2	Hidden outlines, invisible transition lines
5. Chain (dash-and-dot line)		From s/3 to s/2	Axis and centre lines; section lines being symmetry axes for removed and covering sections
6. Chain thick		From s/2 to 2/3s	Indication of surfaces which have to meet special requirements; lines of elements located in front of a cutting plane (“covering projection”)
7. Broken		From s to 1.5s	Section lines
8. Continuous polygonal thin		From s/3 to s/2	Long lines of a break
9. Double-dotted chain		From s/3 to s/2	Bend lines of developments; lines of parts of products in utmost or intermediate positions; lines representing a development coincided with a view

1.4 LETTERING

All notes on drawings and other technical papers are completed by the drawing lettering. The lettering for technical papers of all production and construction fields is regulated by a standard.

The principal lettering parameters:

lettering size ***h –*** height of capital letters in mm, measured along a line perpendicular to the basis of line;

height of small letters ***c*** (without branches - *k*);

width of a letter ***g*** – maximal width of a letter;

thickness of a lettering line ***d*** depends on type and height of lettering.

There are the following *lettering types*:

type A without sloping (*d=1/14h*); type *A* with sloping of about 75° (*d=1/14h*); type *A* with sloping of about 75° (*d=1/10h*);

type *B* without sloping (*d=1/10h*);

type *B* with sloping of about 75° (*d=1/10h*), with the parameters shown in the table.

The following lettering sizes are specified by the standard:

(1.8); 2.5; 3.5; 5; 7; 10; 14; 20; 28; 40

Lettering of Type B

Parameter	Des-n	Relative size		Dimensions, mm				
Lettering size	*h*	(10/10)*h*	0*d*	2.5	3.5	5.0	7.0	10
Height of capital letters	*c*	(7/10)*h*	*d*	1.8	2.5	3.5	5.0	7.0
Distance between letters	*a*	(2/10)*h*	*d*	0.5	0.7	1.0	1.4	2.0
Minimal pace of lines	*b*	(17/10)*h*	7*d*	4.3	6.0	8.5	12	17
Minimal space between words	*e*	(6/10)*h*	*d*	1.5	2.1	3.0	4.2	6.0
Thickness of lettering lines	*d*	(1/10)*h*		0.3	0.4	0.5	0.7	1.0

Notes:

1. Distance ***a*** between the letters the neighbouring lines of which are not parallel to each other (e.g. *TA*, *AT*), may be reduced by a half, i.e. by the thickness ***d*** of the lettering lines.

2. Minimal distance ***e*** between the words, separated by punctuation marks, is the distance between a punctuation mark and a word following it.

Width of Letters and Figures

Letters and Figures		Relative size		Lettering dimensions, mm				
				2.5	3.5	5.0	7.0	10
Width of figures and №	*1*	(3/10)h	3d	0.8	1.1	1.5	2.1	3
	4	(4.5/10)h	4.5d	1.1	1.6	2.3	3.2	4.5
	2,3,5,6,7,8,9,0	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	№	(10/10)h	10d	2.5	3.5	5	7	10
Width ofcapital letters	*Г,Е,З,С*	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	Б,В,И,Й,К,Л,Н,О,П	(6/10)h	6d	1.5	2.1	3	4.2	6
	Р,Т,У,Ц,Ч,Ъ,Ь,Э,Я	(6/10)h	6d	1.5	2.1	3	4.2	6
	А,Д,М,Х,Ы,Ю	(7/10)h	7d	1.8	2.5	3.5	4.9	7
	Ж,Ф,Ш,Щ	(8/10)h	8d	2	2.8	4	5.6	8
Width of small letters	*с*	(4/10)h	4d	1	1.4	2	2.8	4
	з	(4.5/10)h	4.5d	1.1	1.6	2.3	3.2	4.5
	а,б,в,г,д,е,и,к,л,н	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	о,п,р,у,х,ц,ч,ъ,ь,э,я	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	м,ы,ю	(6/10)h	6d	1.5	2.1	3	4.2	6
	ж,т,ф,ш,щ	(7/10)h	7d	1.8	2.5	3.5	4.9	7
Width of capital letters	*I*	(1/10)h	d	0.3	0.4	0.5	0.7	1.0
	J	(4/10)h	4d	1	1.4	2	2.8	4
	C,E,F,L	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	B,D,G,H,K,N,O	(6/10)h	6d	1.5	2.1	3	4.2	6
	P,Q,R,S,T,U,Z	(6/10)h	6d	1.5	2.1	3	4.2	6
	A,M,V,X,Y	(7/10)h	7d	1.8	2.5	3.5	4.9	7
	W	(9/10)h	9d	2.2	3.1	4.5	6.3	9
Width of small letters	*i*	(1/10)h	d	0.3	0.4	0.5	0.7	1.0
	l	(2/10)h	2d	0.5	0.7	1.0	1.4	2.0
	j	(3/10)h	3d	0.8	1.1	1.5	2.1	3.0
	c,f,r,t	(4/10)h	4d	1	1.4	2	2.8	4
	a,b,d,e,g,h,k,n	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	o,p,q,s,u,v,x,y,z	(5/10)h	5d	1.3	1.8	2.5	3.5	5
	m,w	(7/10)h	7d	1.8	2.5	3.5	4.9	7

Standard drawing lettering consists of the Russian, Latin and Greek alphabets, and the Arabian and Roman figures and symbols. A specimen of the Russian and Latin lettering is presented in Fig.3, 4.

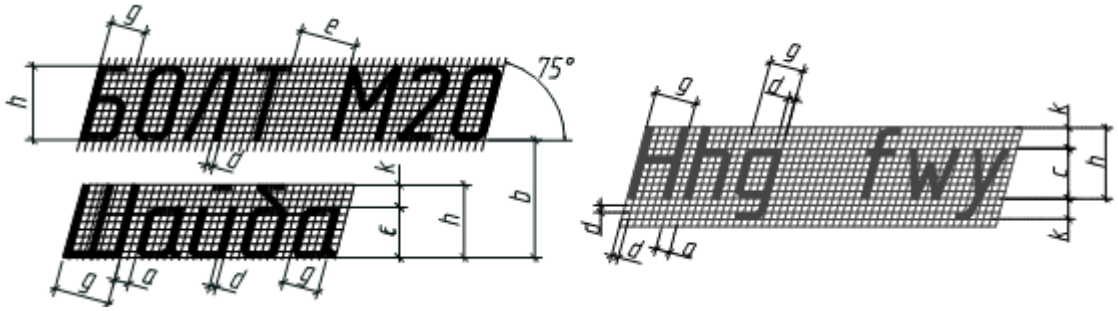
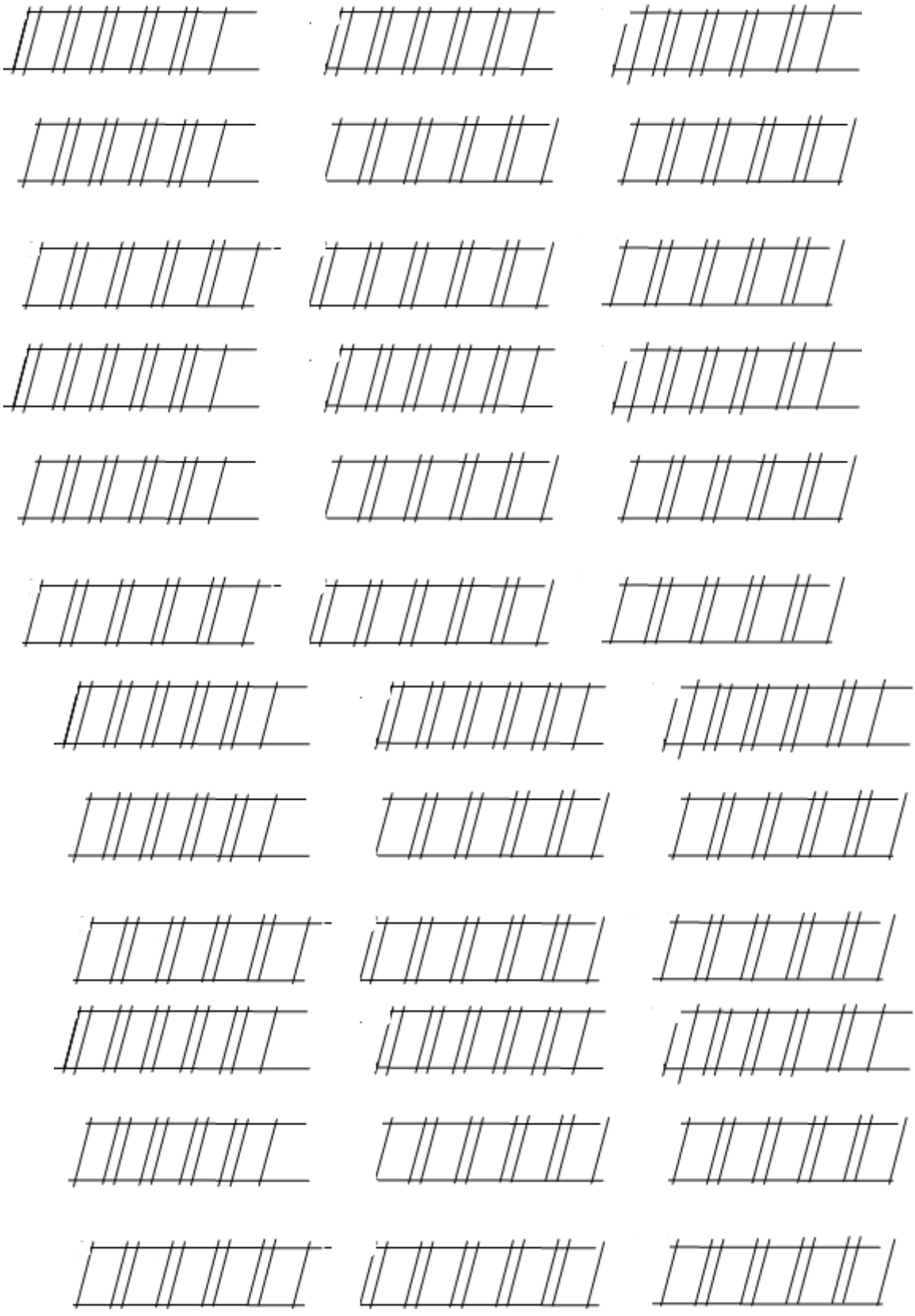

БОЛТ М20
75°
Hhg fwy

Fig. 3


АБВГДЕЖЗИЙКЛМНОПРСТУ
ФХЦЧШЩЪЫЬЭЮЯ
абвгдежзиклмнопрсту
фхцчшщъыьэюя
ABCDEFGHIJKLMNOPQRST
UVWXYZ
abcdefghijklmnopqrst
uvwxyz
1234567890 Э №

Fig. 4

Font 7 to write capital and lower case letters of the latin alphabet, figures from 1 up to 0.



THE TITLE PAGE

According to a sample resulted on fig. 6 to perform work "Title page".

Work is carried out on a sheet of format A3. In a right bottom corner of a sheet the basic inscription under the form 1 (see fig. 1) is carried out. In the left top corner the additional column is carried out.

Words « Graphic works » are carried out by a font 10.

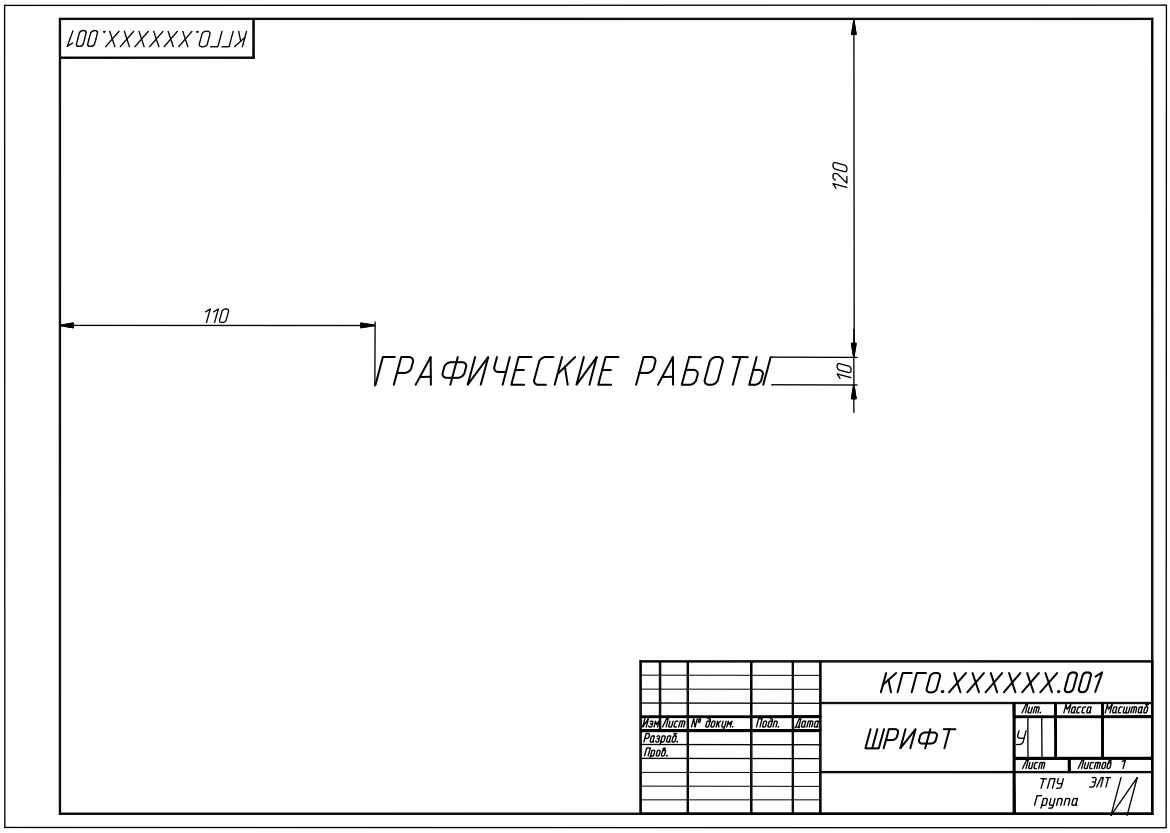


Fig. 5

1. What are the dimensions of size A4 of a drawing sheet?
2. What format has the side of 594 mm?
3. What is the application of dash-and-dot line?
4. What is the recommended thickness of section lines?
5. How thick should the broken line be?
6. What are the lettering dimensions according to standards?
7. What value determines the lettering size?
8. How to determine the height of small letters?
9. What are the drawing conventions for the materials of your ball-pen, if it is made of plastics, its rod - of polyethylene and the ball of metal?

CHAPTER 2. THE METHOD OF ORTHOGONAL PROJECTIONS

2.1 DRAWING OF POINT

How many coordinates determine position of a point in space?

_____

_____

Any projection of a point is determined by _____coordinates:

Horizontal _____;

Frontal _____;

Profile _____;

What refers to as an axis of projections?

_____

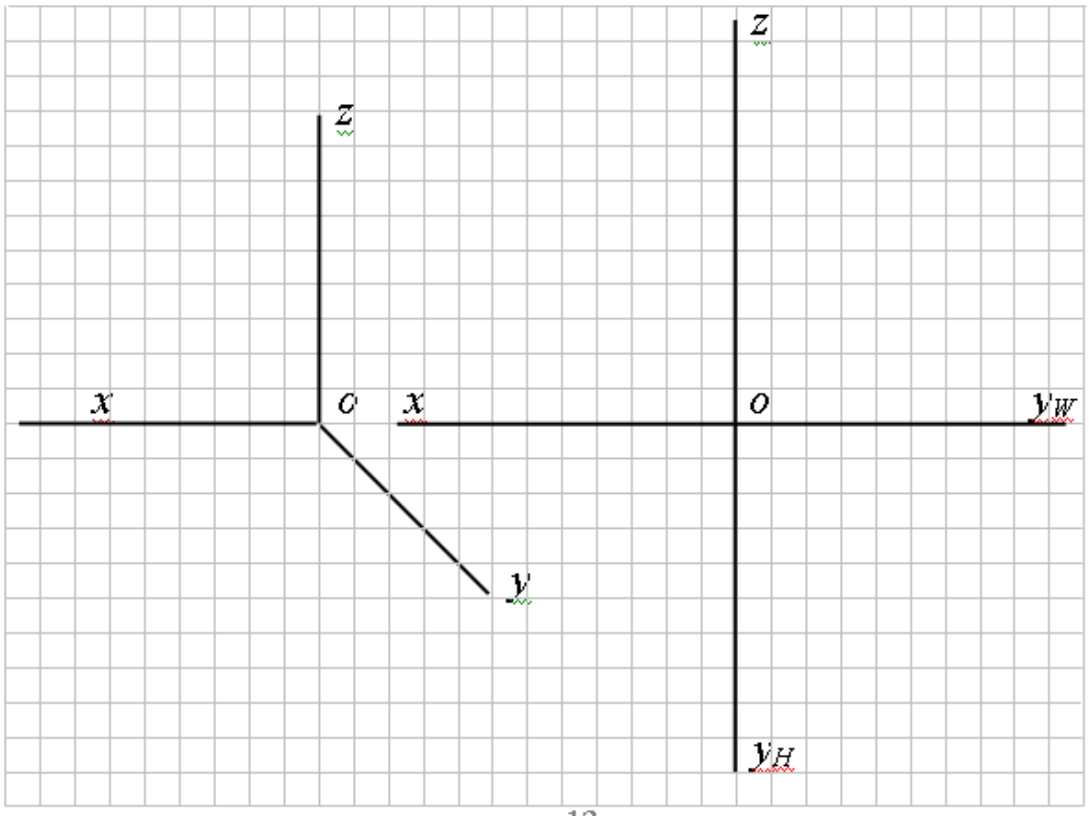
How many projections of a point determine its position in space?

_____

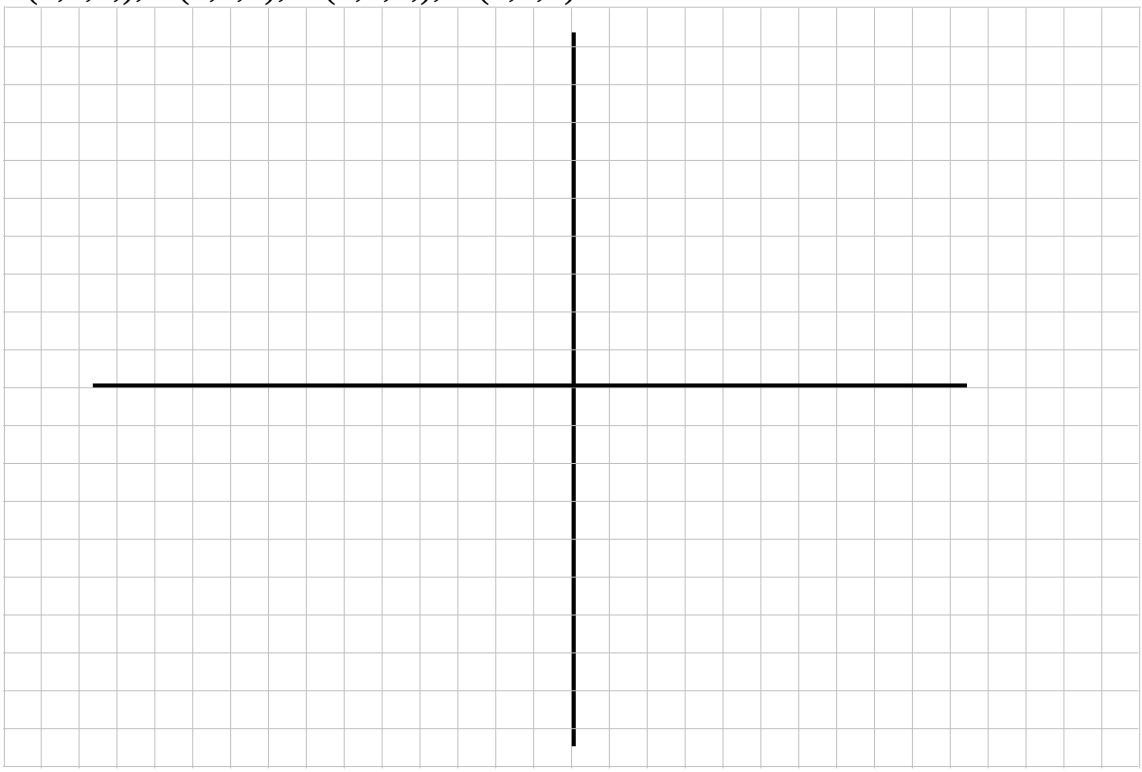
How projections of a point concerning an axis dividing them settle down?

_____

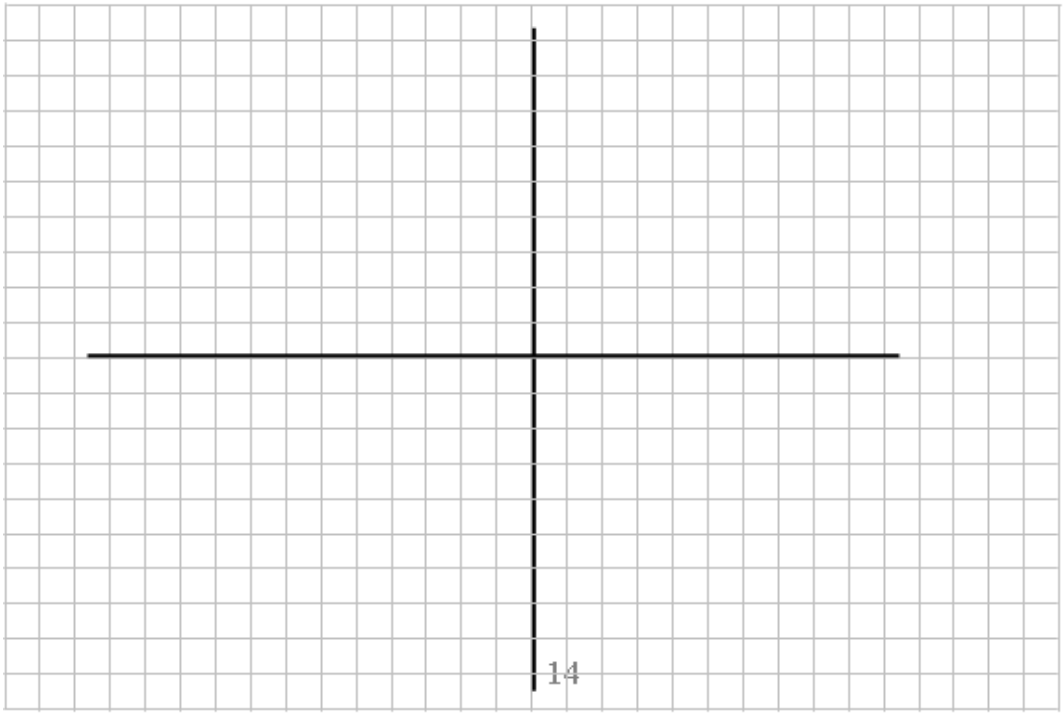
1.To construct the evident image and the orthogonal drawing of a point *A* (5,7,9).



2. To construct projections of points *A*(5,5,0); *B*(5,0,5); *C*(0,5,5); *D*(7,0,0); *E*(0,7,0,); *F*(0,0,7); *G*(0,0,0,); *K*(3,4,6)



3. To construct projections of points *A* (2,3,6). To construct projections of a point *B* closer points *A* on 2 units. To construct projections of a point *C* higher points *A* on 3 units. To write down coordinates of points *B* and *C*.



2.2 DRAWING OF A LINE-SEGMENT. STRAIGHT LINES OF A PARTICULAR POSITION

The line projections

The line of general position _____

_____

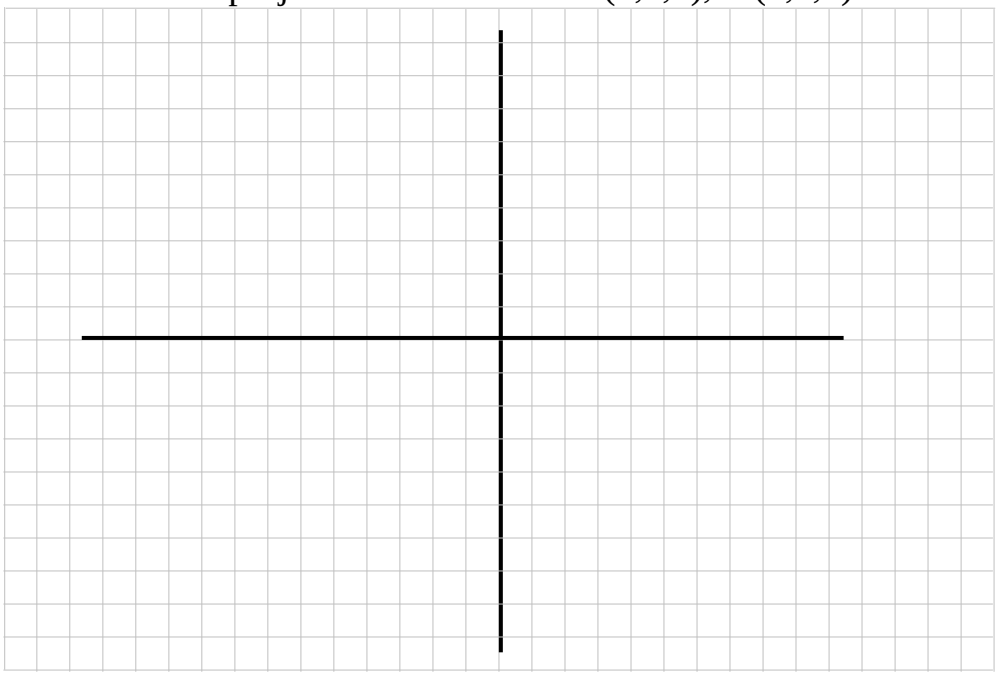
The straight line parallel to a plane of projections is_____

_____

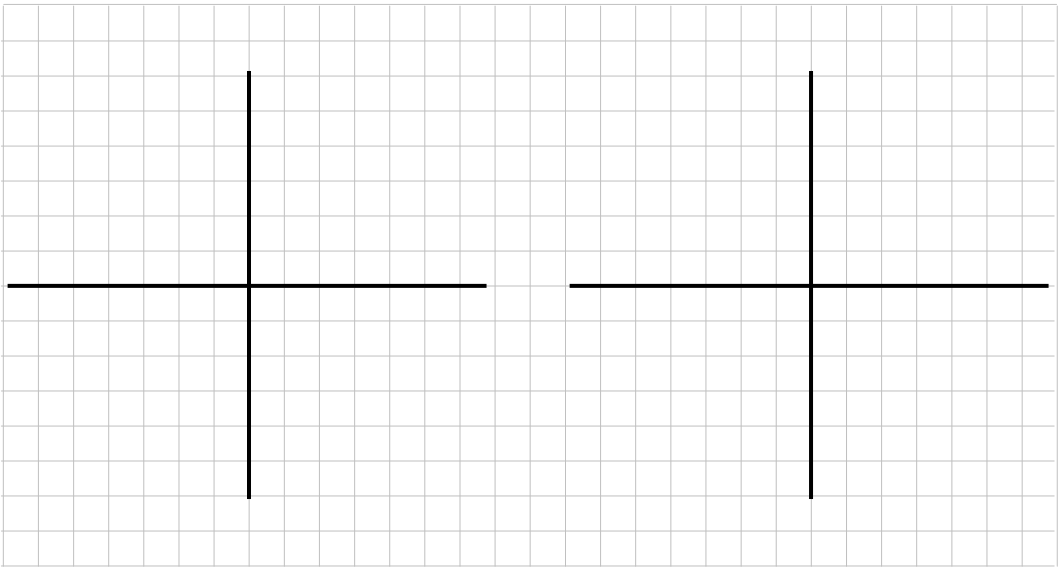
The straight line, perpendicular planes of projections is_____

_____

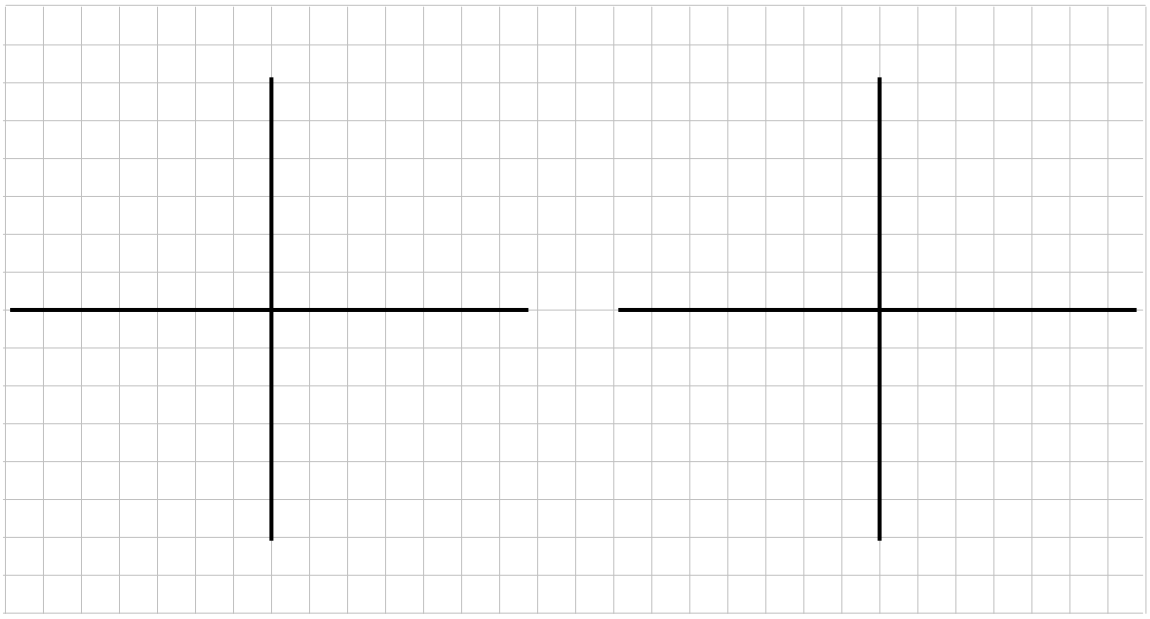
4.To construct projections of line AB *A* (5,4,1), *B* (2,2,4).



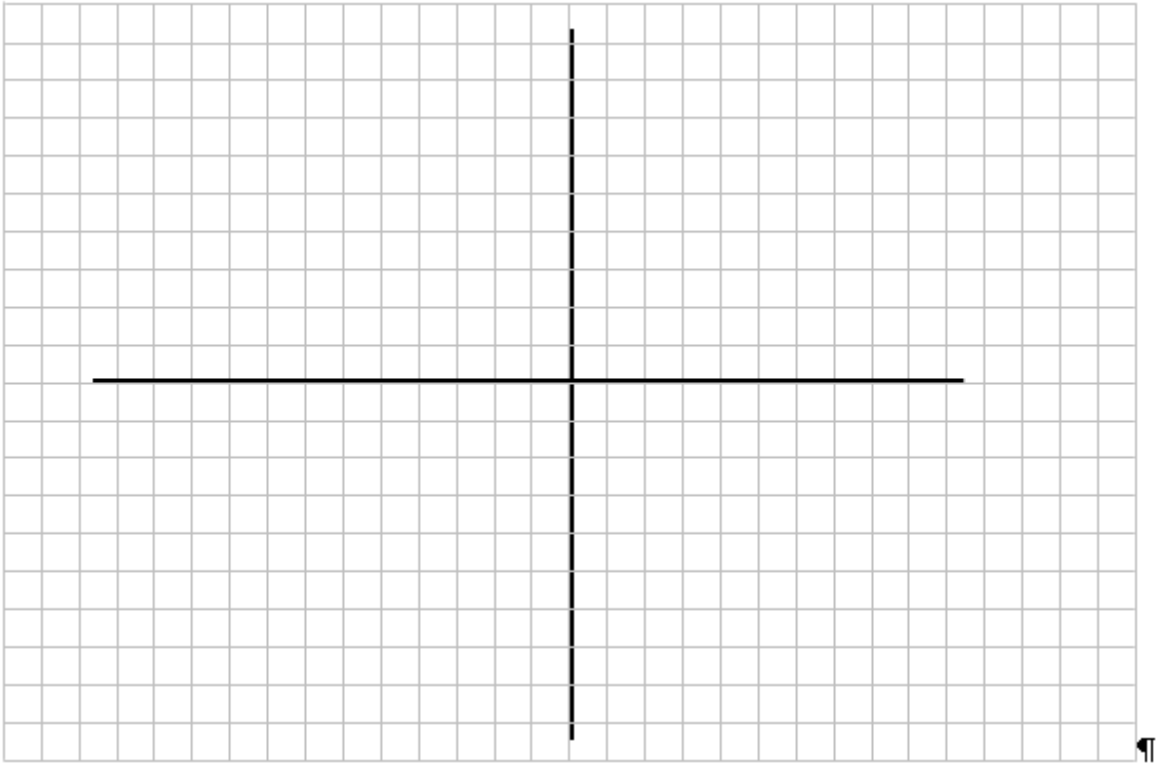
5. To construct projections of level lines



6. To construct projections of projecting lines

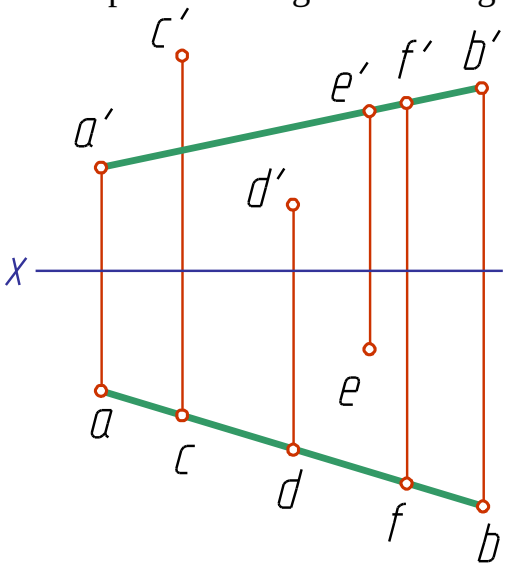


7. Through a point C (4,4,3) carry out a straight line CD (length of 4 units), parallel to a plane H.



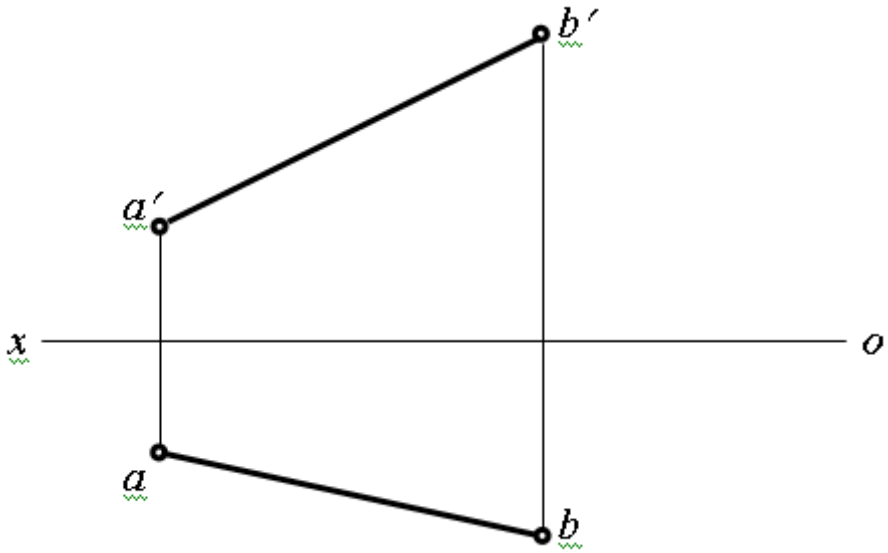
2.3 MUTUAL POSITIONS OF A POINT AND A LINE

8. Determine whether the points belong to the straight line AB/

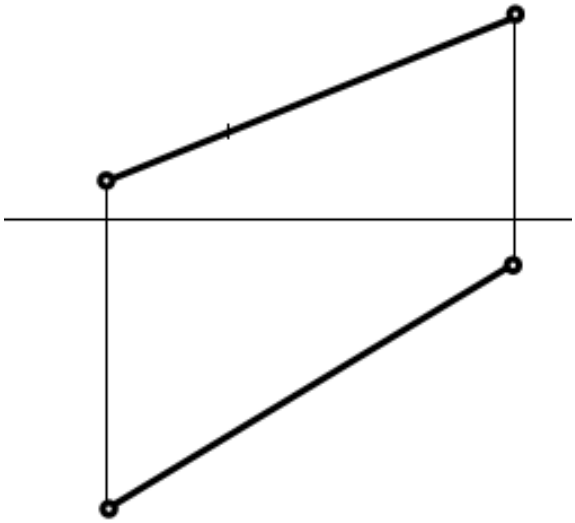


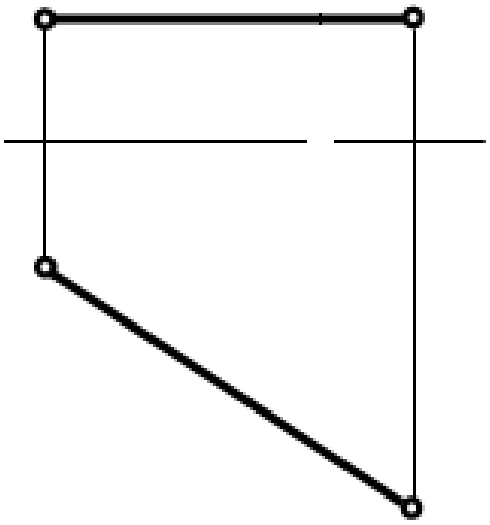
2.4 TRACES OF A LINE

9. To construct traces of a straight line AB.



10. To construct traces of a straight line.

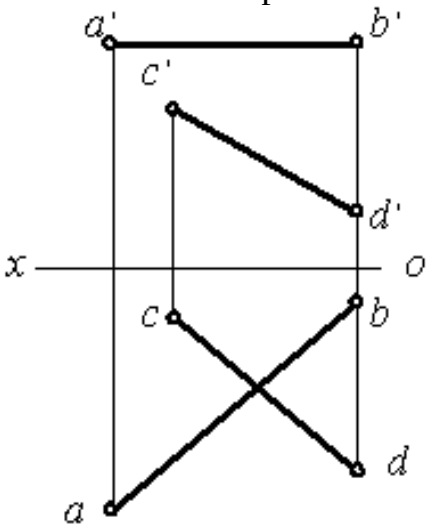


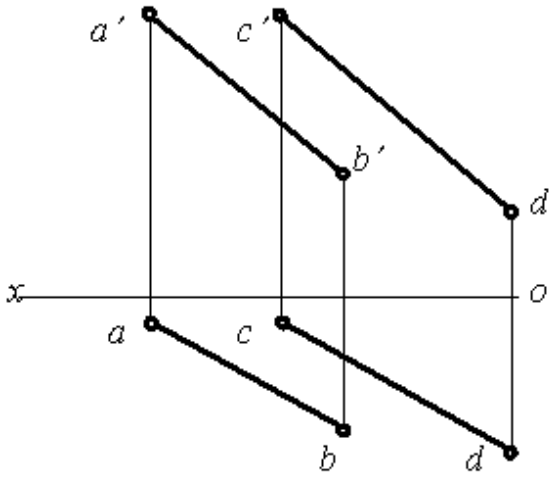


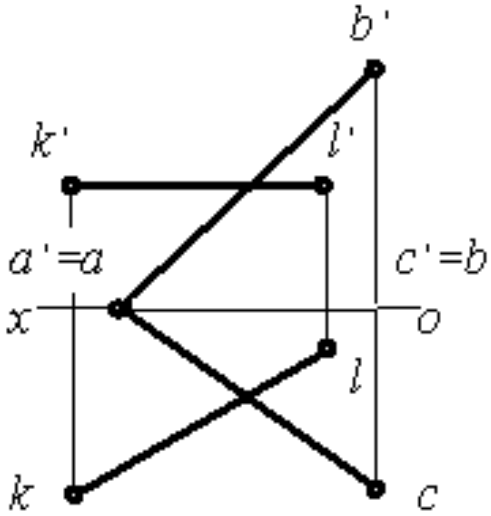
2.5 THE RELATIVE POSITIONS OF STRAIGHT LINES

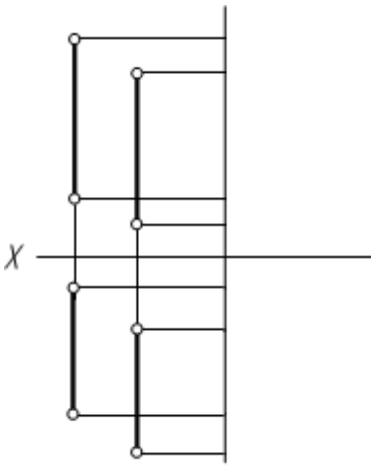
The straight lines in the space may

11.Determine mutual position of two straight lines.

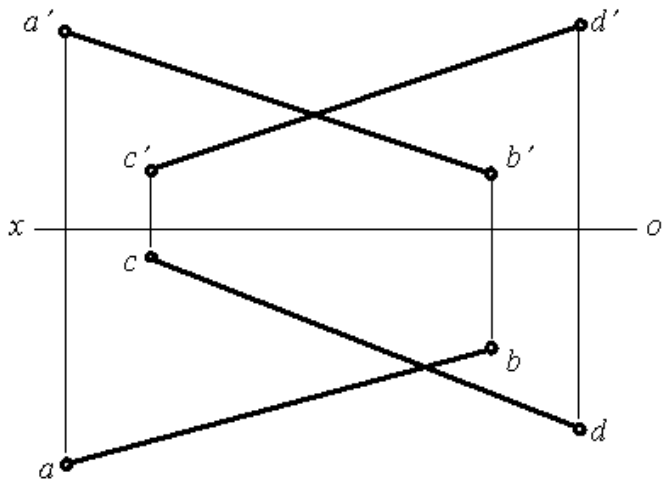




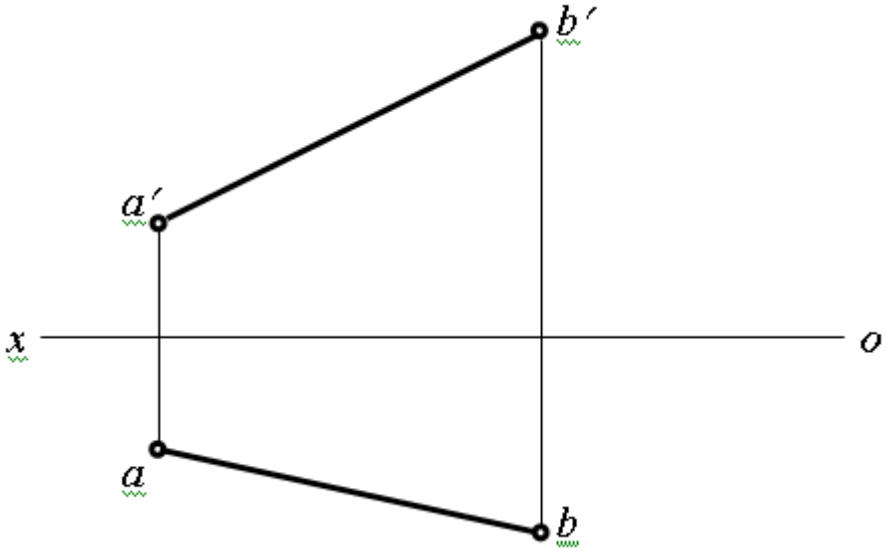




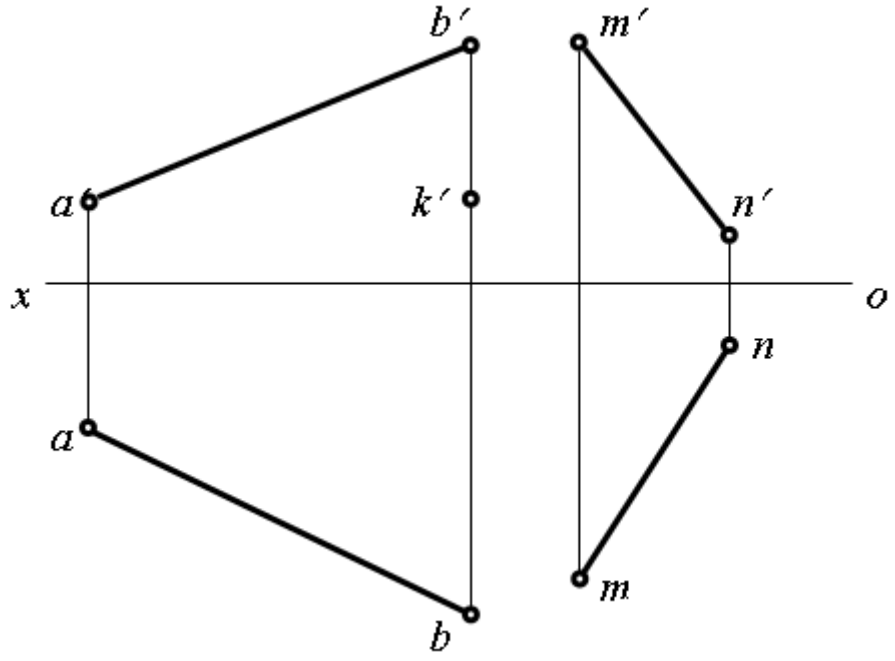
12.Determine mutual position of two straight lines.



13. To construct two projections of direct *CD* if it is known, that straight lines *AB* and *CD* are parallel, length *AB* is equal *to CD*. The point *C* belongs to plane *V*.

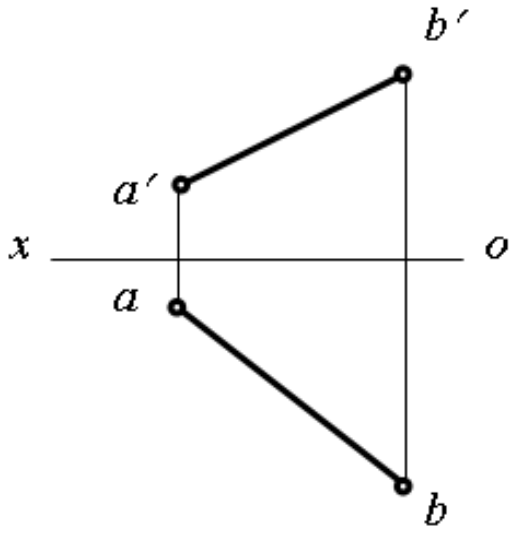


14.Through a point *K* carry out straight line *KL* parallel to straight line *MN* which crosses straight line *AB*. To make the plan of the decision.

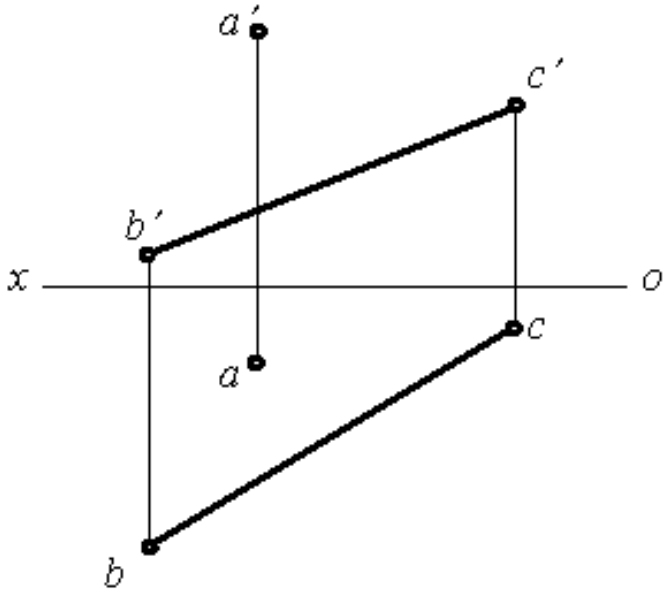


2.6 METHOD OF REPLACING PLANES OF PROJECTION

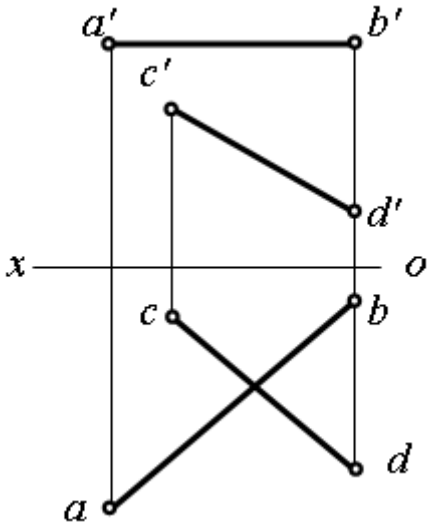
15. To determine full size and corners of an inclination of straight line *AB* to horizontal and frontal planes of projections. To write down the plan of the decision.



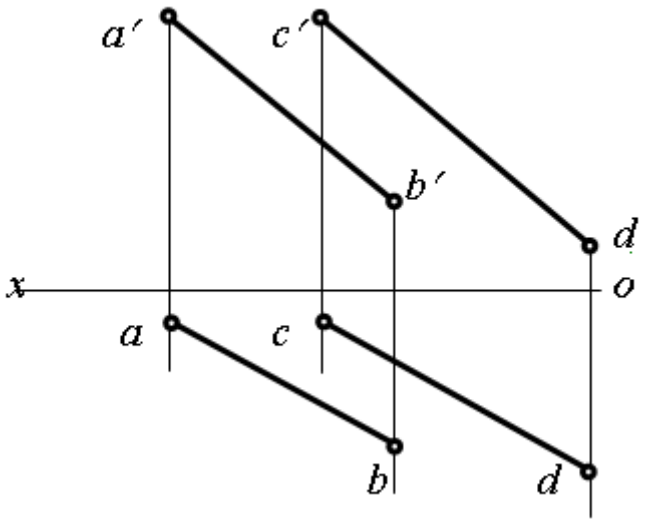
16. To determine distance from a point *A* up to straight line *BC* - piece *AN*. To construct projections of a piece. To write down the plan of the decision.



17. To determine the shortest distance between straight lines *AB* and *CD* - piece *MN*. To construct projections of piece *MN*. To write down the plan of the decision.



18. To determine the shortest distance between straight lines *AB* and *CD* - piece *MN*. To construct projections of piece *MN*. To write down the plan of the decision.



CHAPTER 3. REPRESENTATION OF A PLANE IN A DRAWING

3.1 WAYS OF SPECIFYING A PLANE

1.

2.

3.

4.

A plane may have the following positions relative to the projection planes

_____

_____

_____

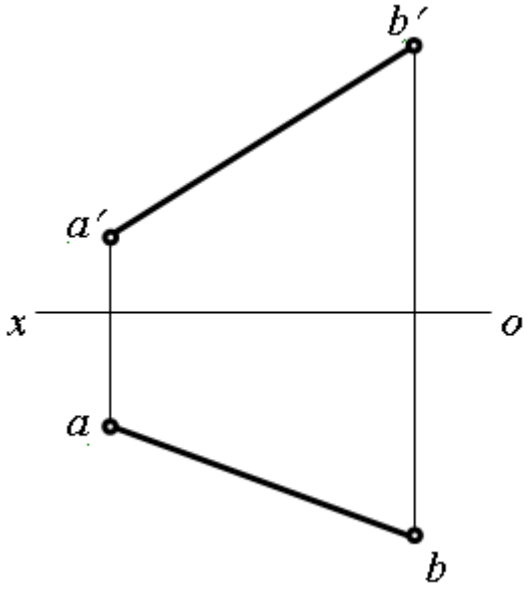
The planes perpendicular or parallel to the projection planes are called the planes _____

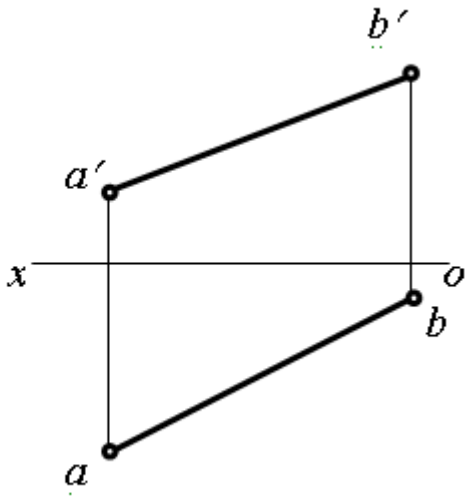
The planes parallel to the projection planes are called the planes _____

A plane perpendicular to a projection plane _____

19. Through straight line *AB* to carry out a plane:

а) general position; б) The horizontal projecting plane.

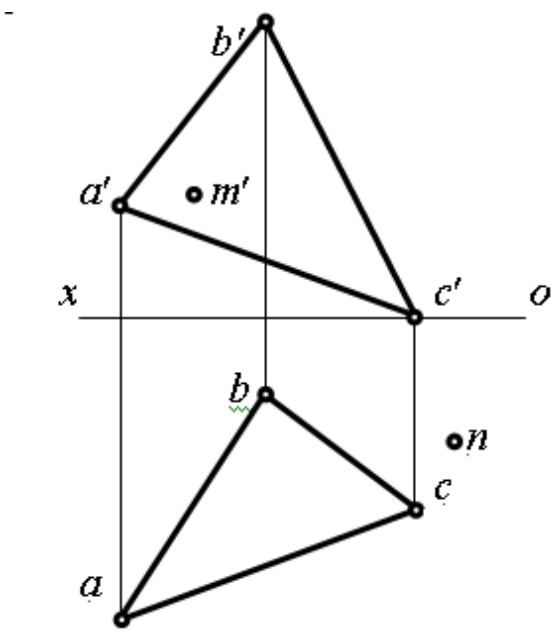




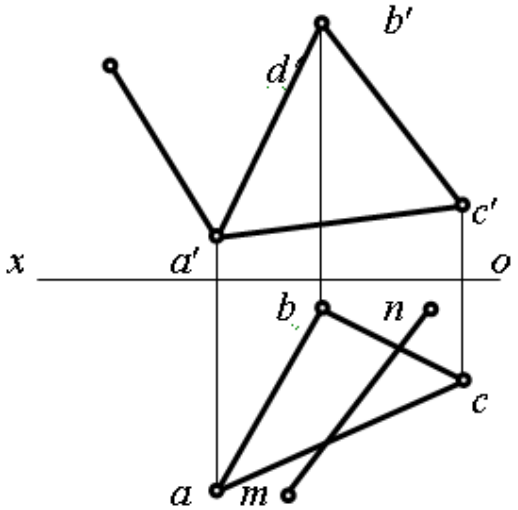
3.2 THE POINT AND THE LINE IN THE PLANE

A point belongs to a plane if it lies on a line contained in this plane.

20. To construct missing projections of points *M* and *N*, belonging to a plane ∆*ABC*.



21. To construct missing projections of straight lines *AD* and *MN*,belonging to a plane ∆*ABC*.



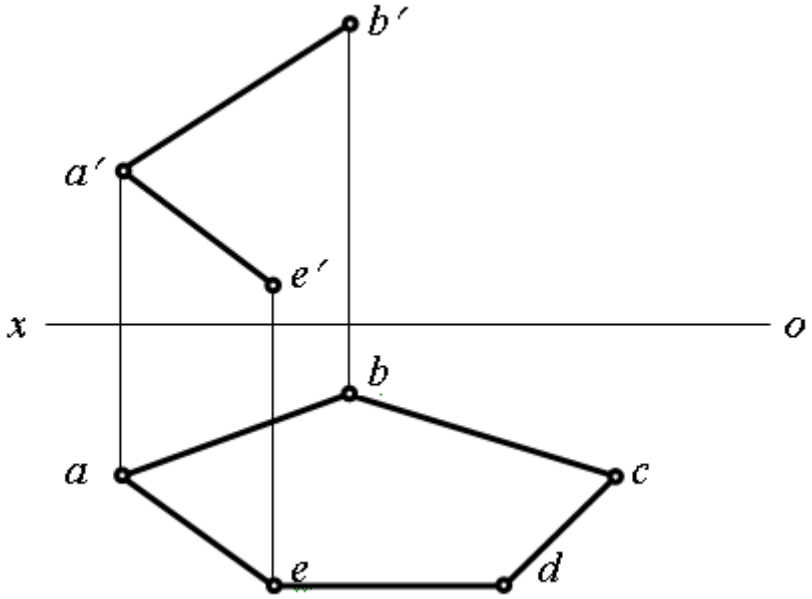
The relative positions of a line and a plane are determined by the quantity of points belonging both to the plane and to the line:

a) if a line and a plane have two common points, the line belongs to the plane;

b) if a line and a plane have one common point, the line intersects the plane;

c) if the point of intersection of a line and a plane is at infinity, the line and the plane are parallel.

22. To complete a vertical projection of a pentagon if its horizontal projection and vertical projections of two adjacent sides is set.



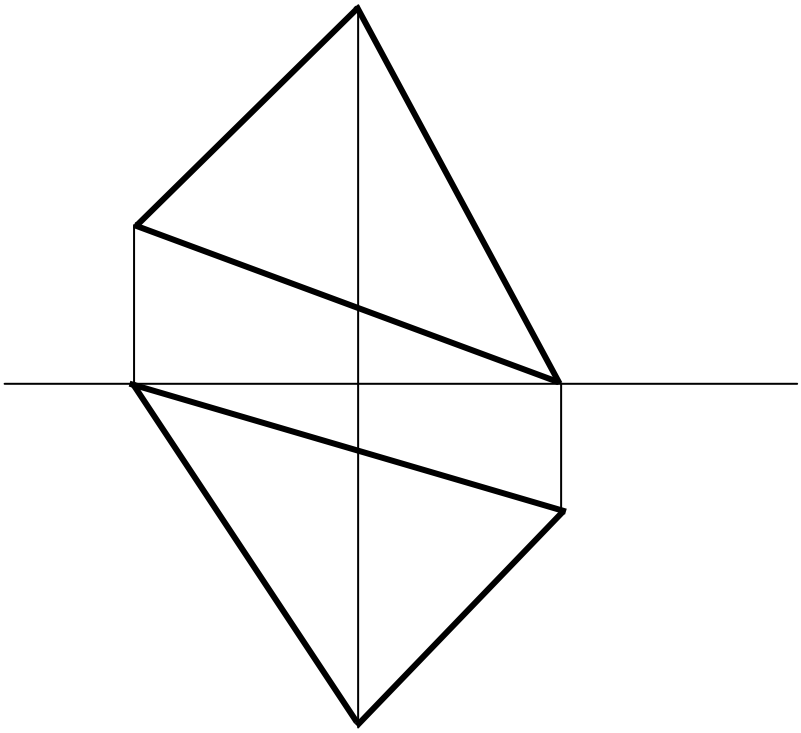
3.3 THE PRINCIPAL LINES OF THE PLANE

H parallels or horizontal lines

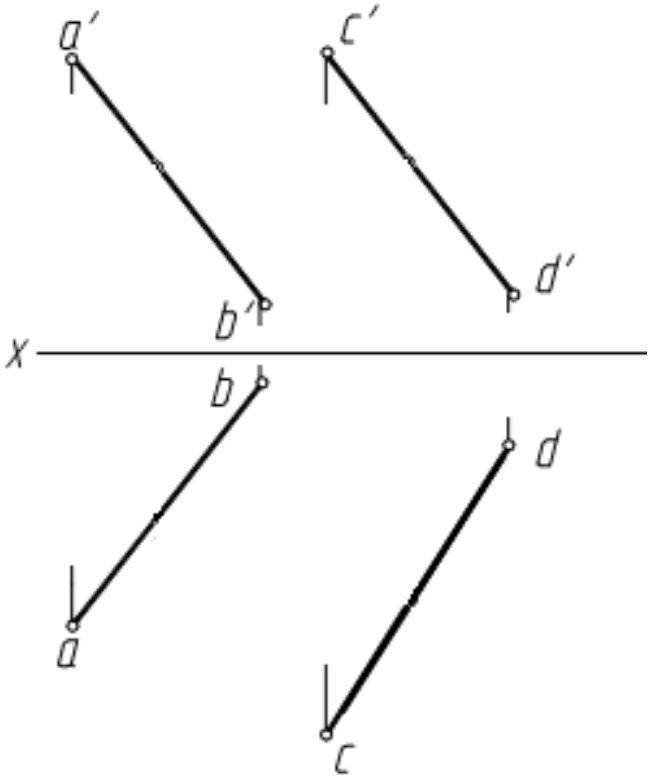
V parallels or frontal or vertical lines

Profile lines

23. To construct the Principal Lines of the Plane.



24. To construct the Principal Lines of the Plane.

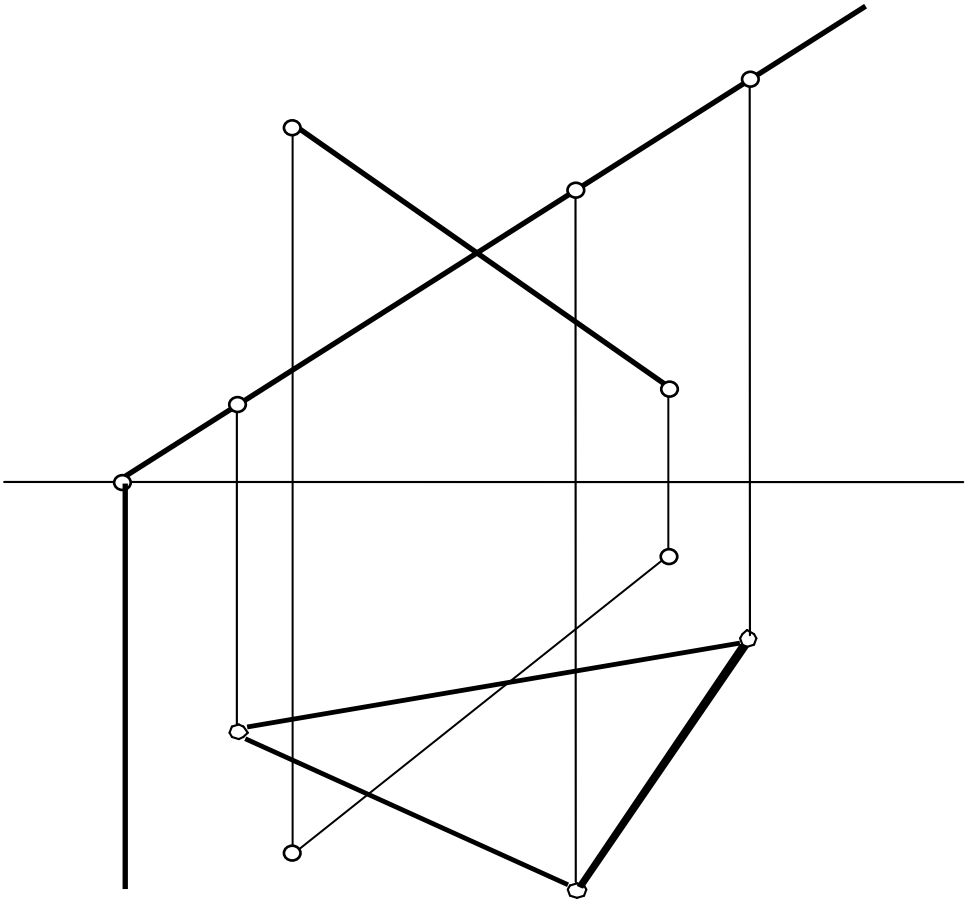


3.4 THE LINE INTERSECTS THE PLANE

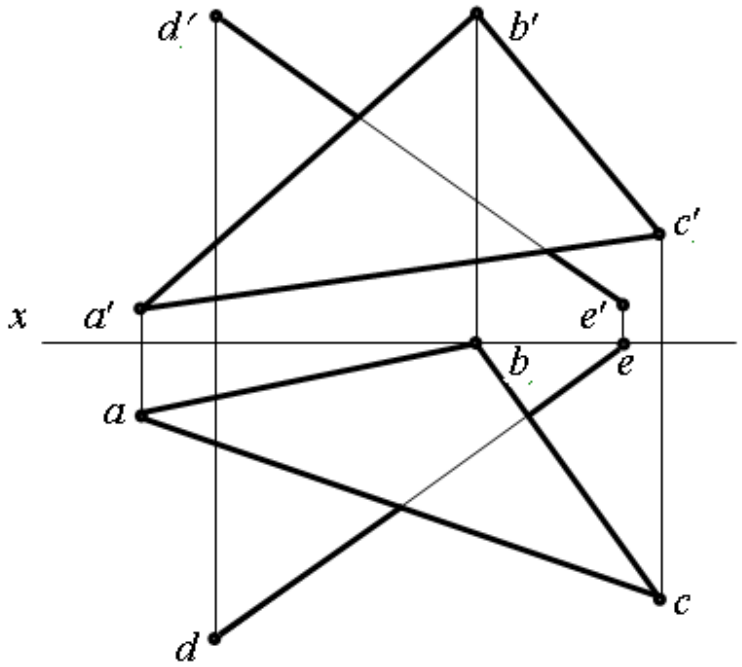
Construction of the intersection point of a line and a plane.

To construct the point of intersection of a line and a plane means to find a point belonging to both, a given line and a plane. Graphically this is a point of intersection of the straight line and a line contained in the plane.

25. To construct a point of crossing of straight line *DE* and the plane of the general position set ΔABC. To determine visibility of straight line *DE*.



26. To construct a point of crossing of straight line *DE* and the plane of the general position set Δ*ABC*. To determine visibility of straight line *DE*.

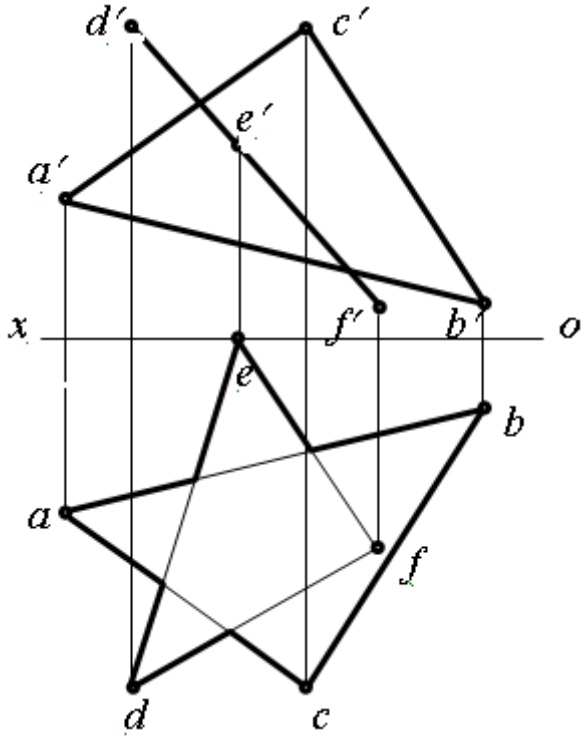


3.5 MUTUAL POSITIONS OF THE PLANES

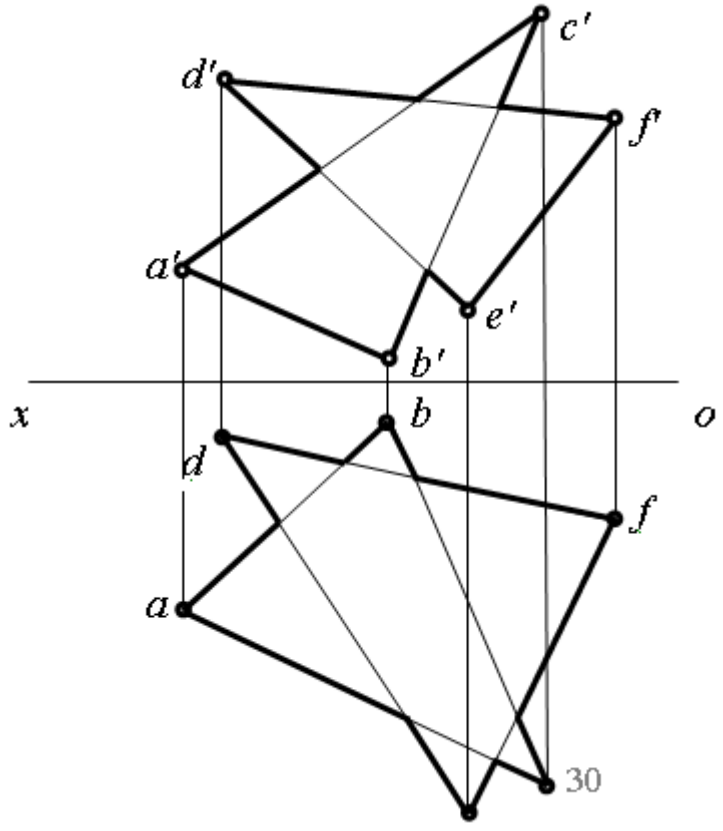
The planes are considered to be parallel if

The line of intersection of two planes is

27. To construct projections of a line of crossing of two planes set by triangles *ABC* and *DEF*. To determine mutual visibility of triangles.



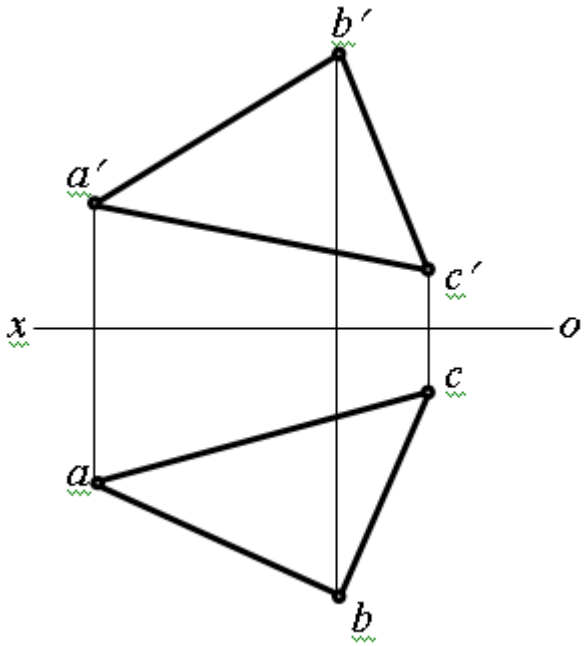
28. To construct projections of a line of crossing of two planes set by triangles *ABC* and *DEF*. To determine mutual visibility of triangles.



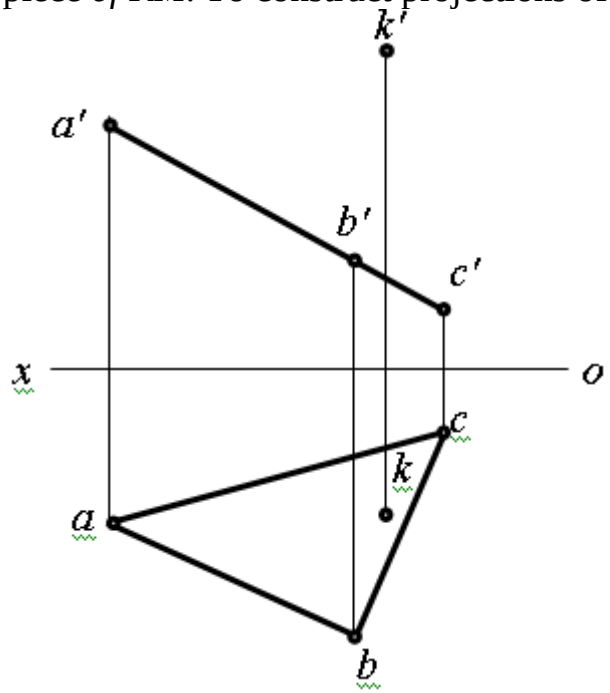
3.6 METHOD OF REPLACING PLANES OF PROJECTION

Two primary goals of transformation of the drawing of a plane

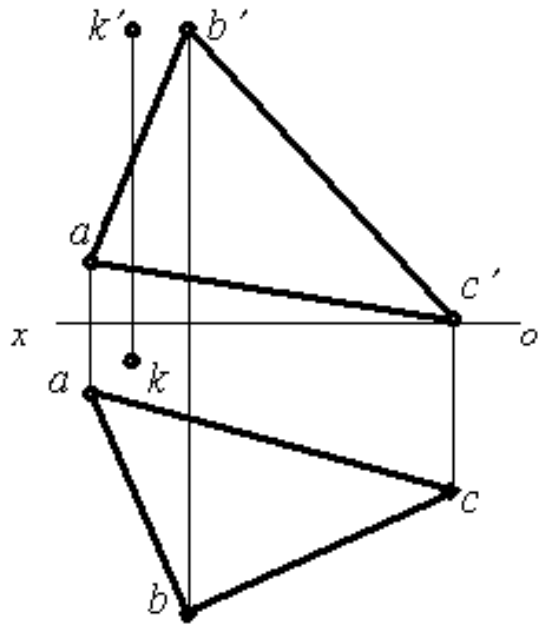
29. To determine corners of an inclination of a plane ΔABC to horizontal and face-to-face planes of projections. To write down the plan of the decision.



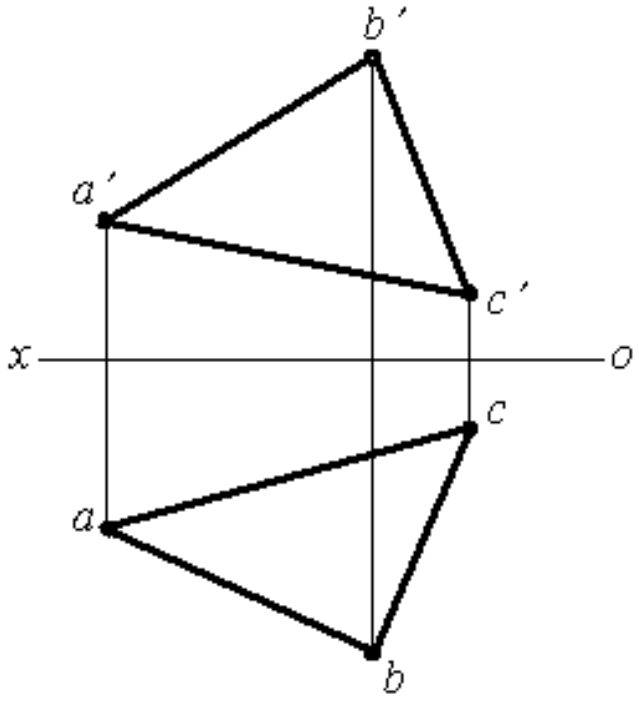
30. To determine distance from a point *To* up to a plane of triangle *ABC* - a piece *of KM*. To construct projections of a piece.



31. To determine distance from a point *To* up to a plane of triangle *ABC* - piece *KS*. To construct projections of a piece and to determine full size ΔABC. To write down the plan of the decision.



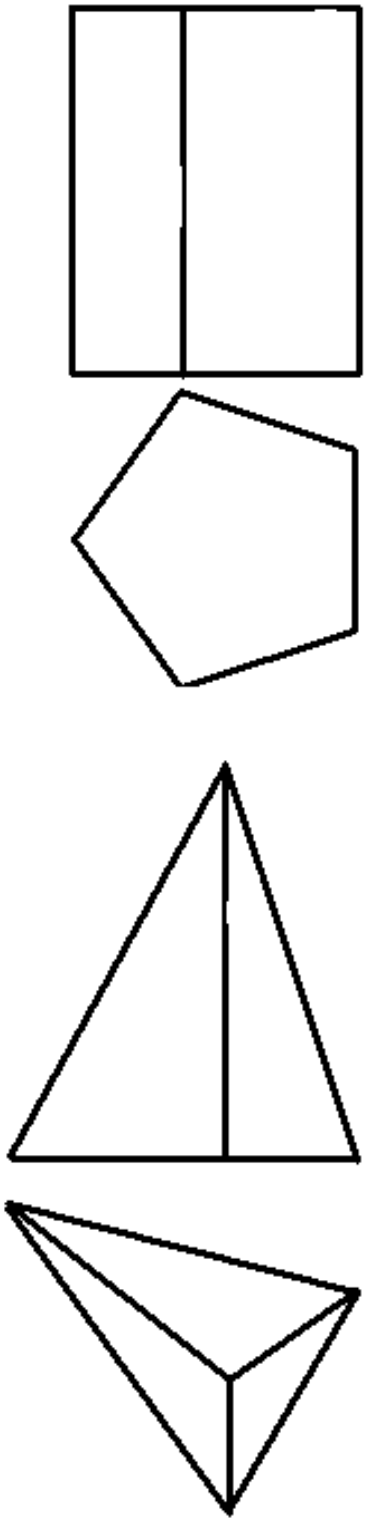
32. To construct projections of a hypotenuse of a Angle A triangle ABC.



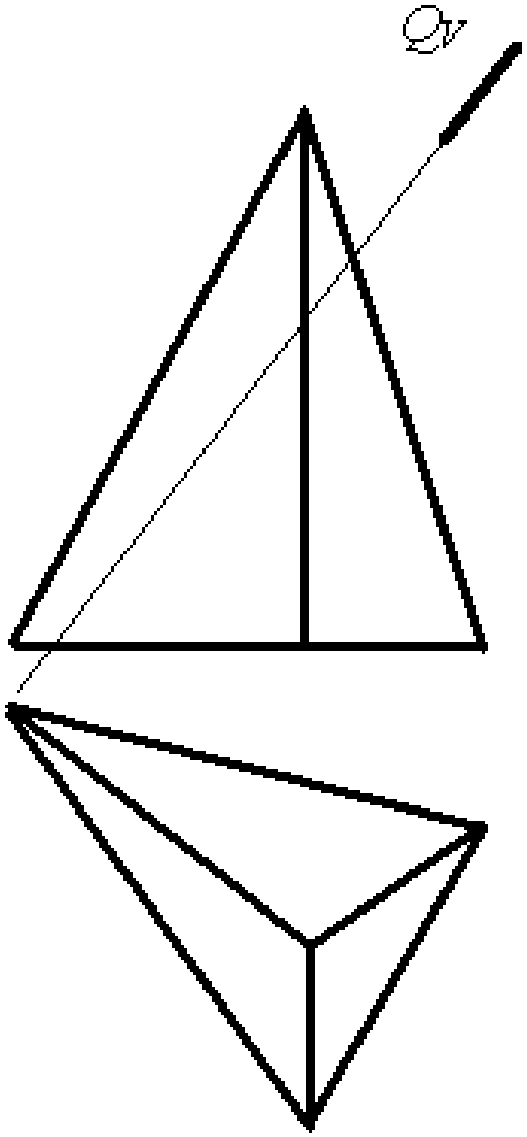
CHAPTER 4. SURFACES

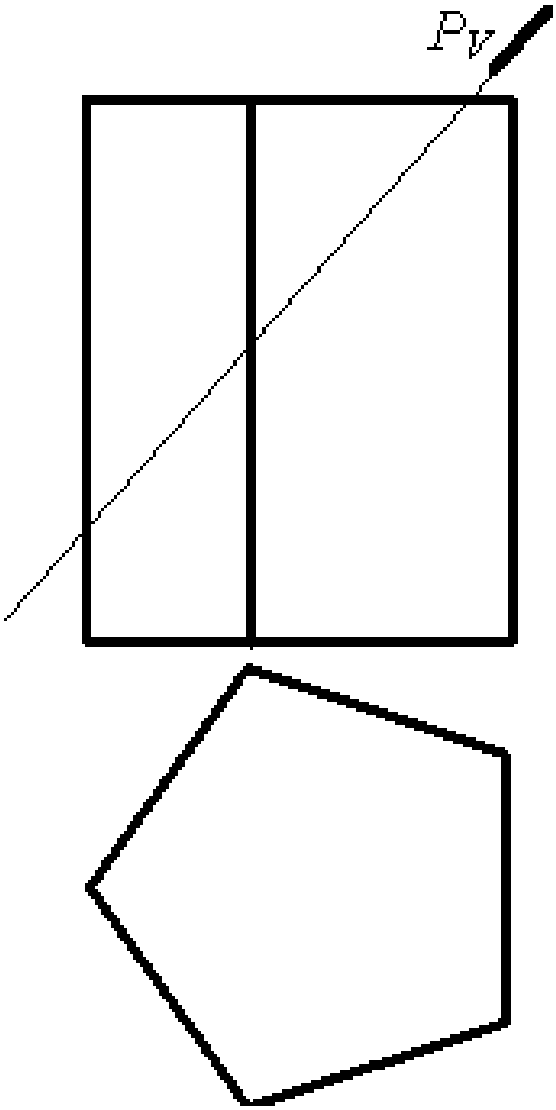
4.1 RULED SURFACES

33. To construct projections of points belonging to a surface.

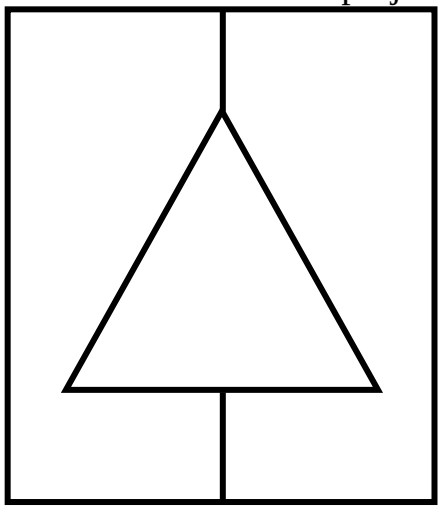


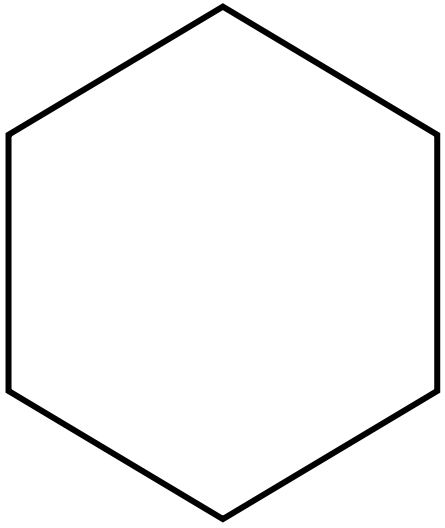
34. To construct: - profile projections of surfaces; full size of section.



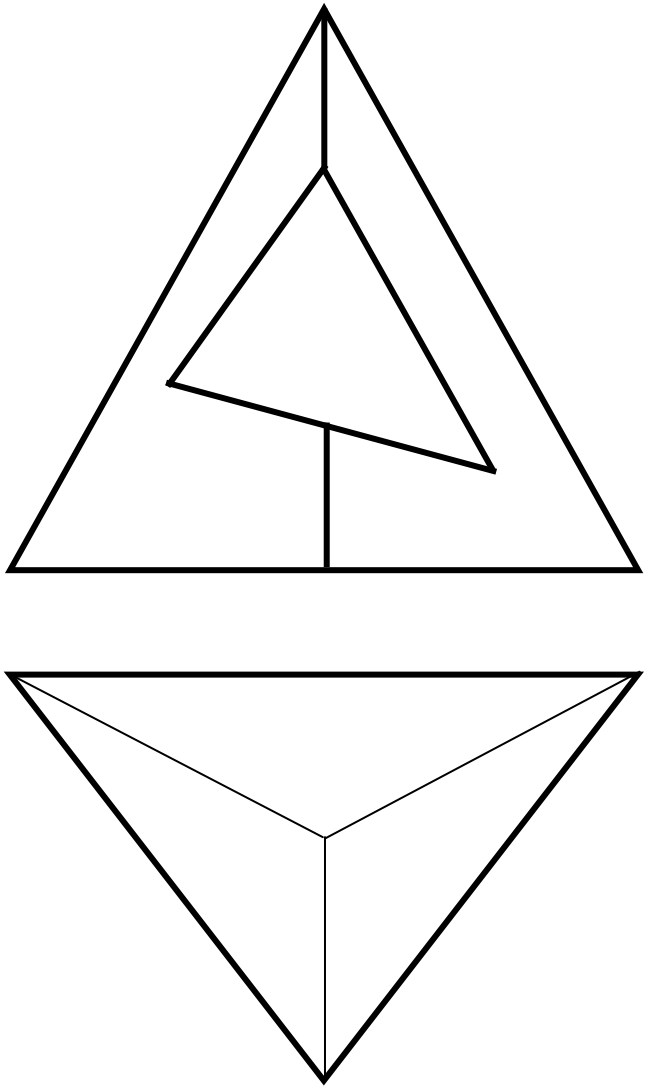

P_V

35. To construct three projections of a prism with a Notch

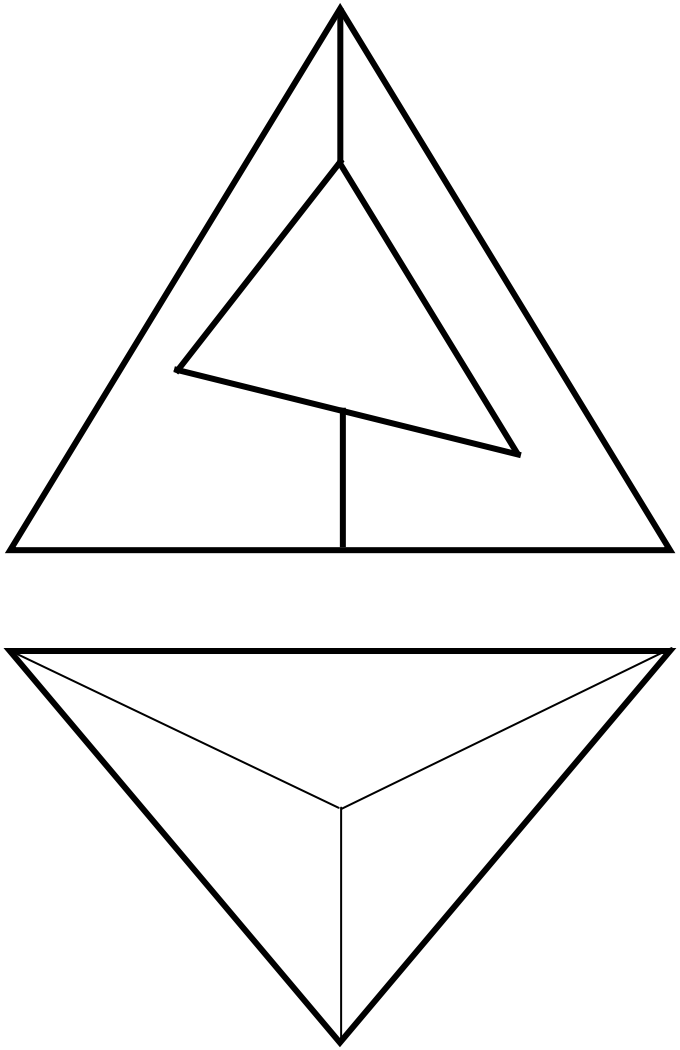


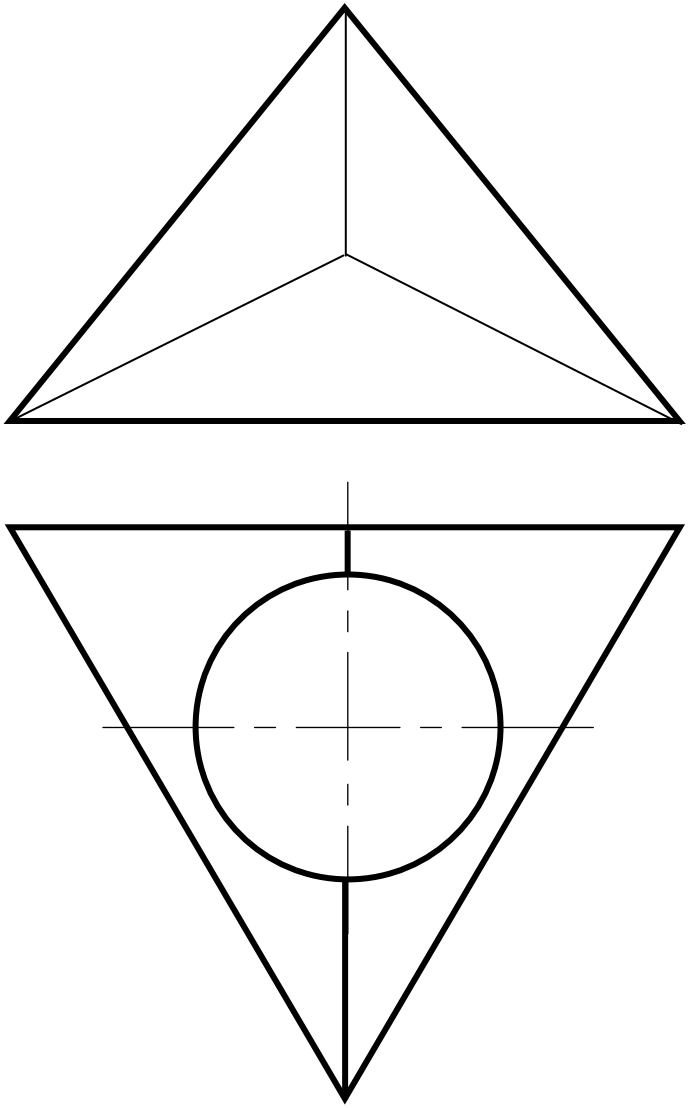


36. To construct three projections of a Pyramid with a Notch

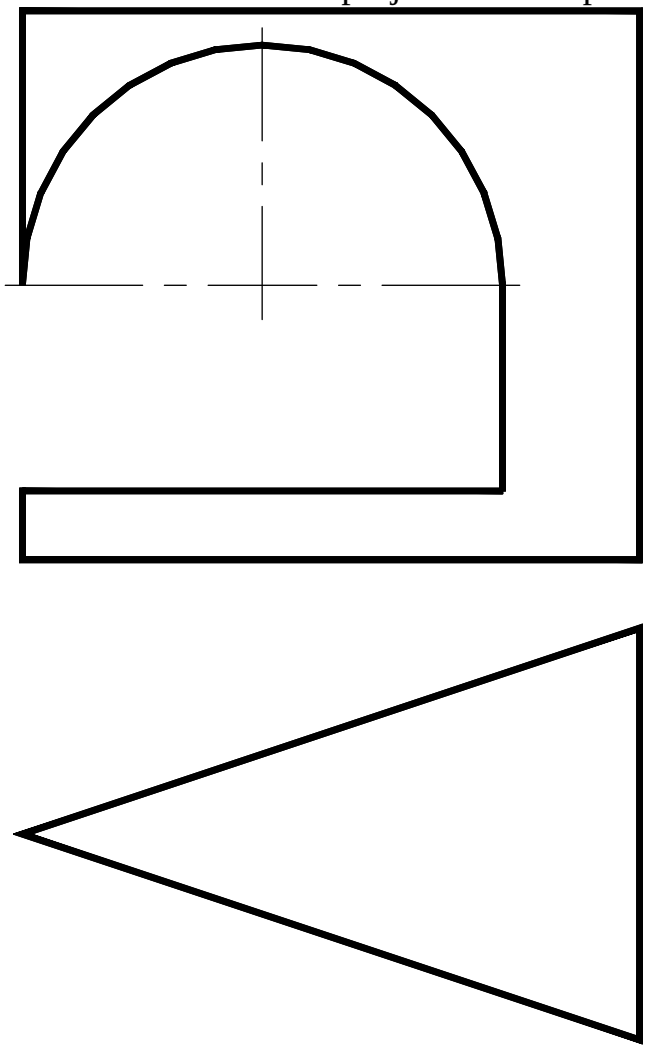


37. To construct three projections of a Pyramid with a Notch



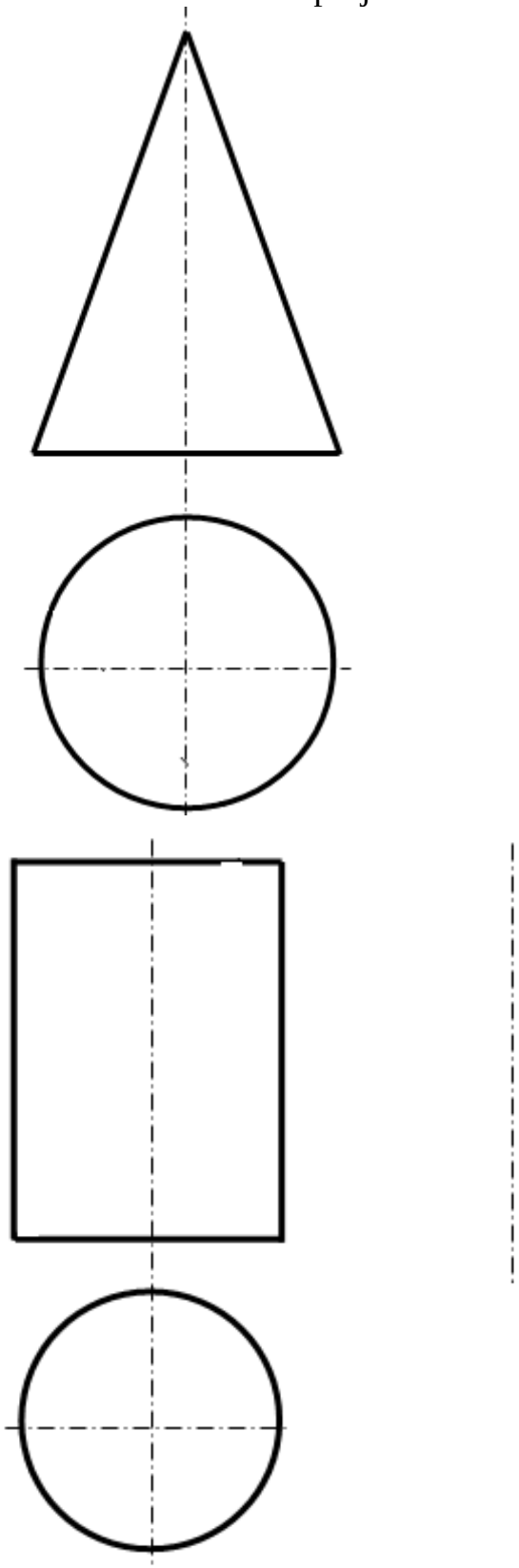


38. To construct three projections of a prism with a Notch

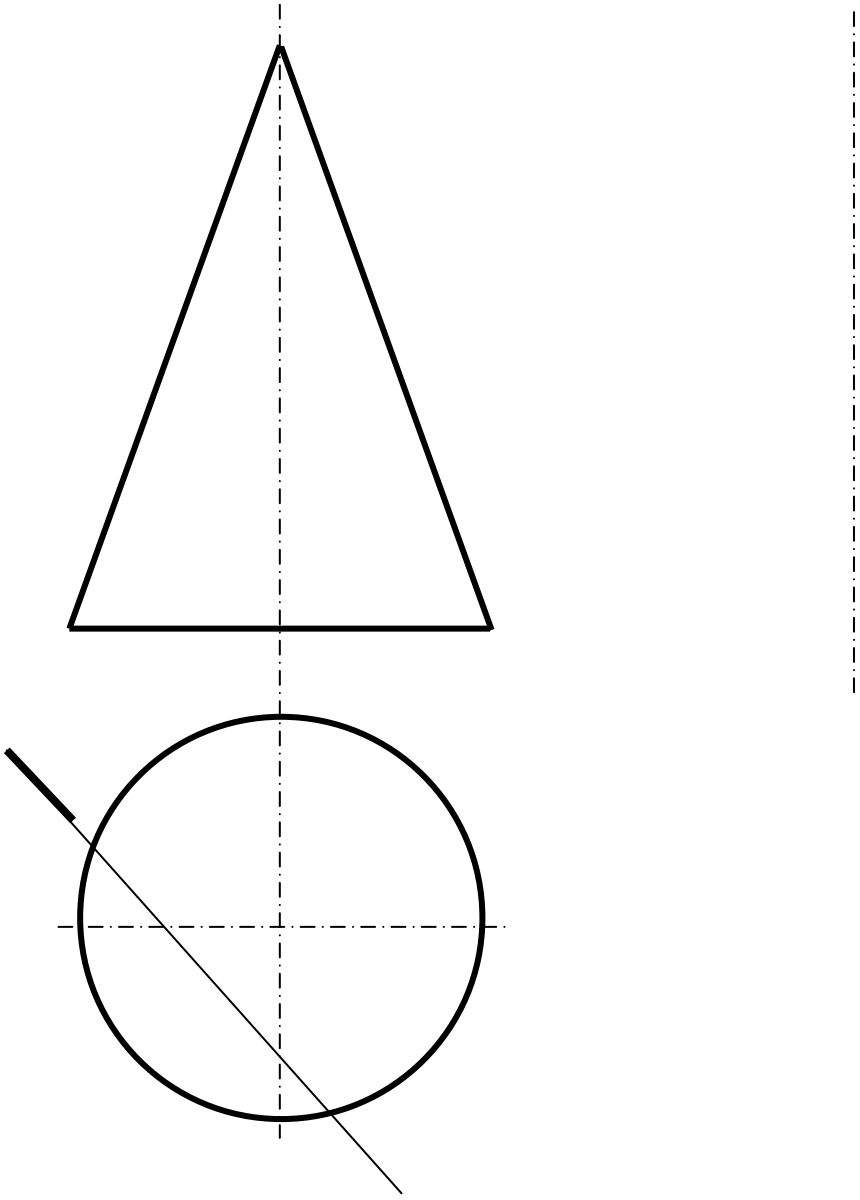


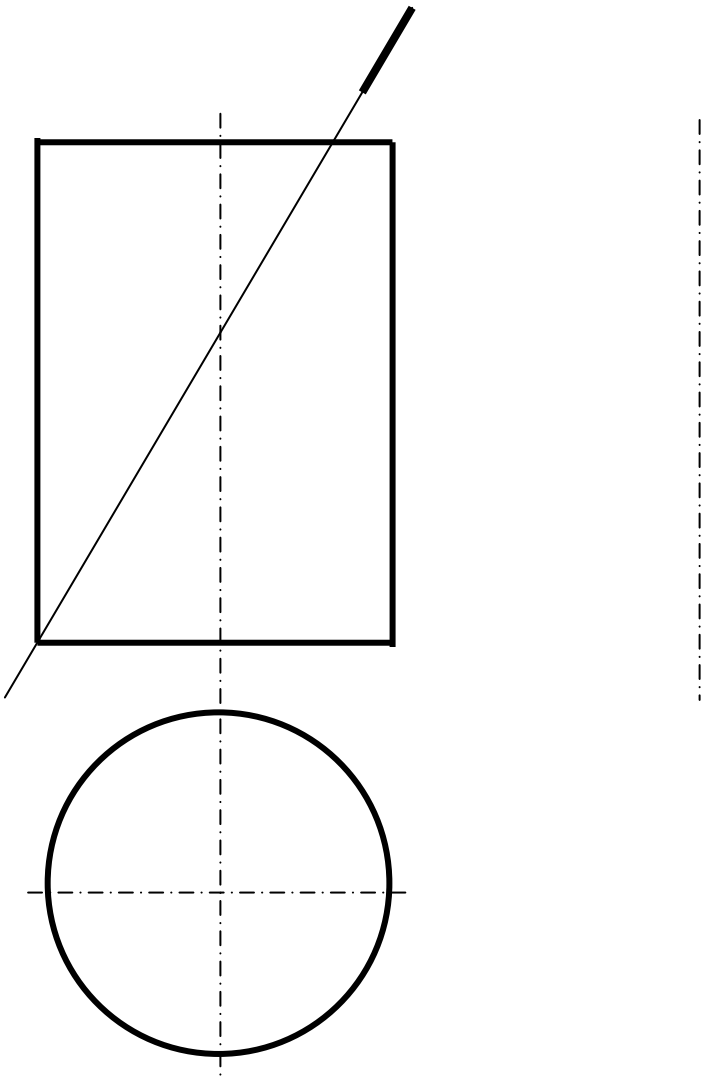
4.2 ROTATION SURFACES

39. To construct projections of points belonging to a surface.

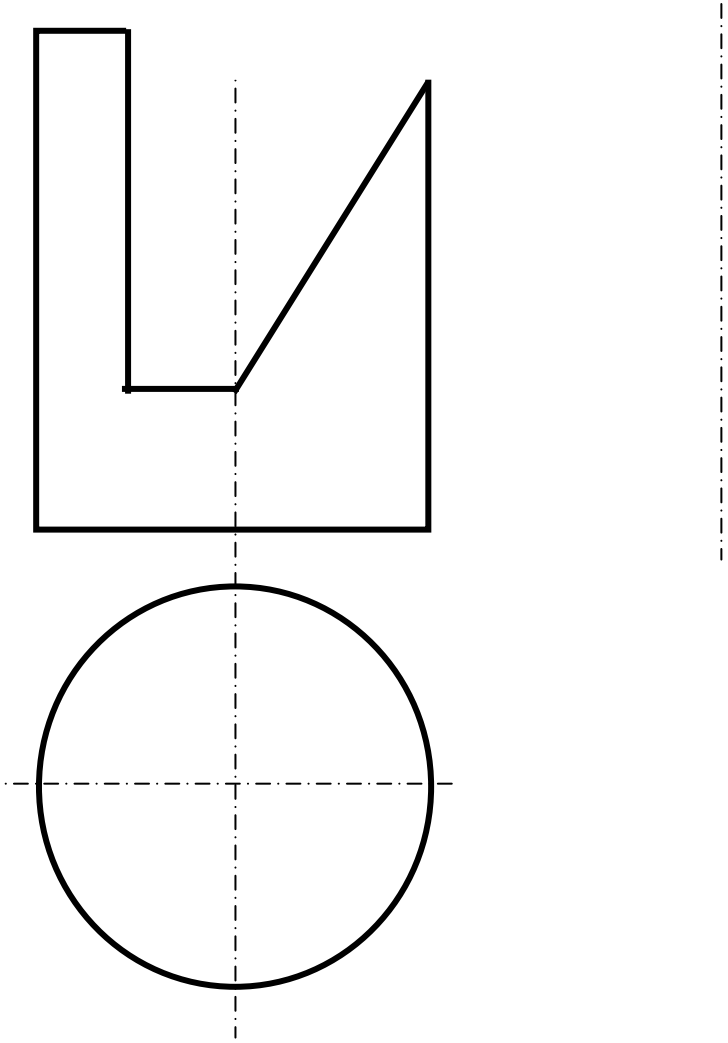


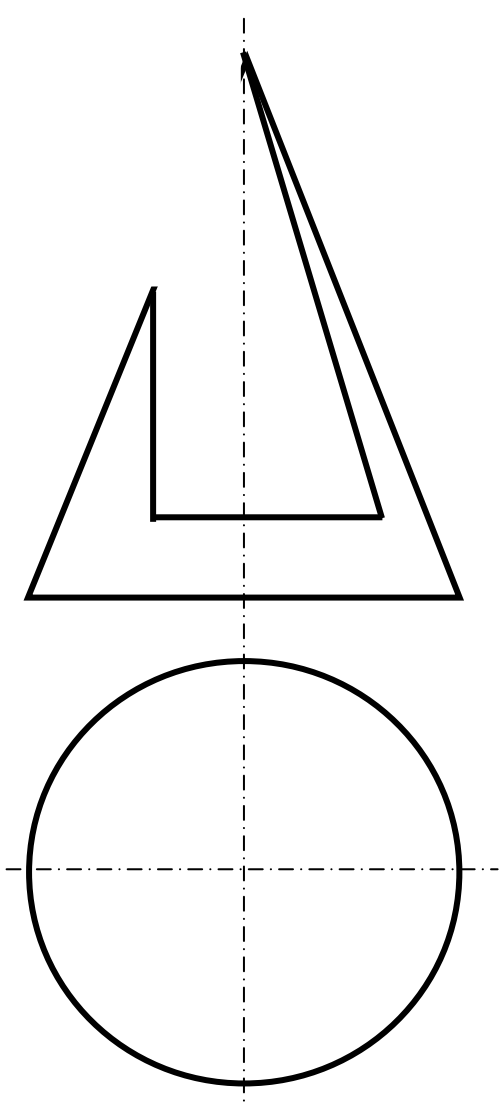
40. To construct: - profile projections of surfaces; full size of section.

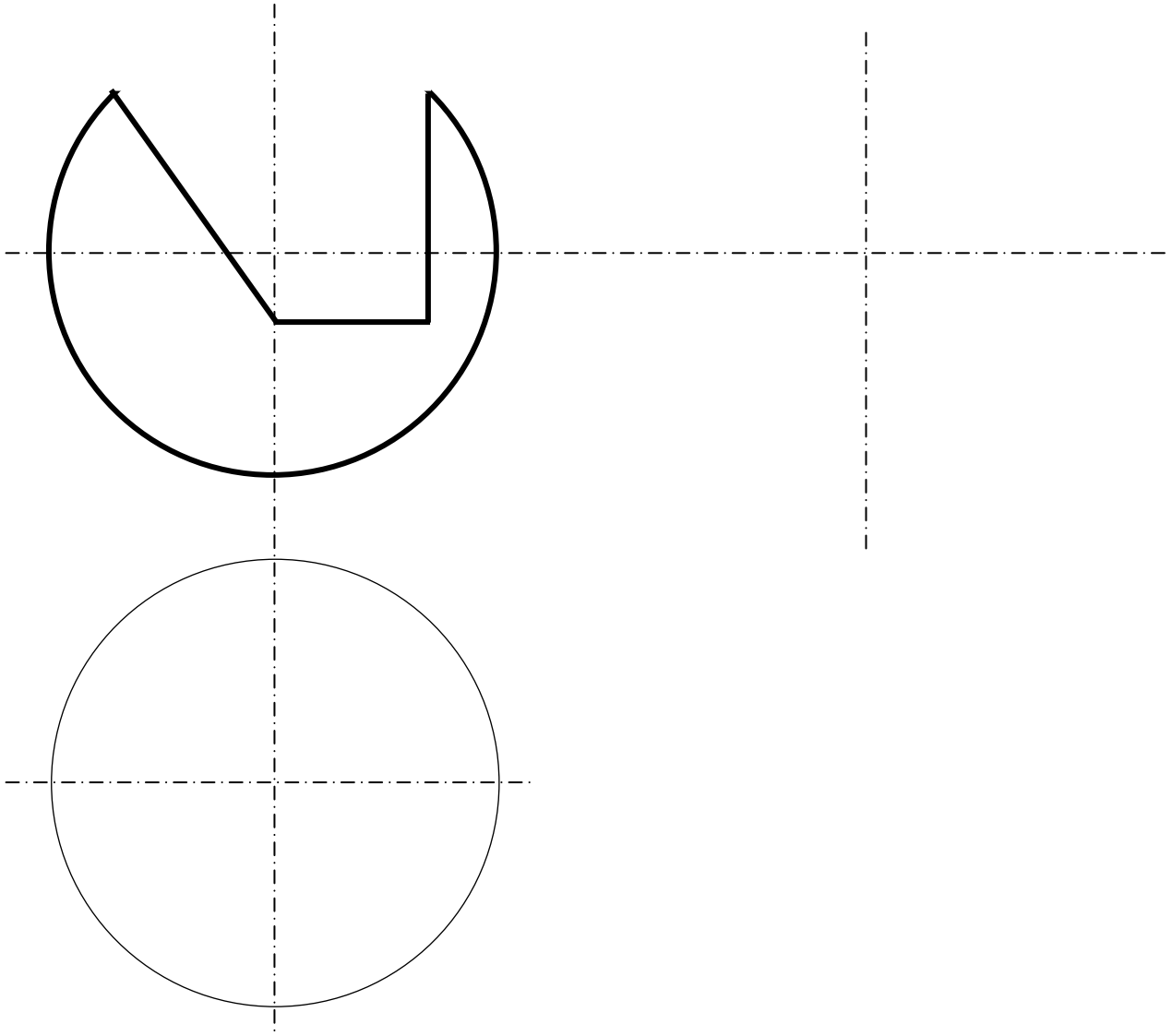




41. To construct three projections

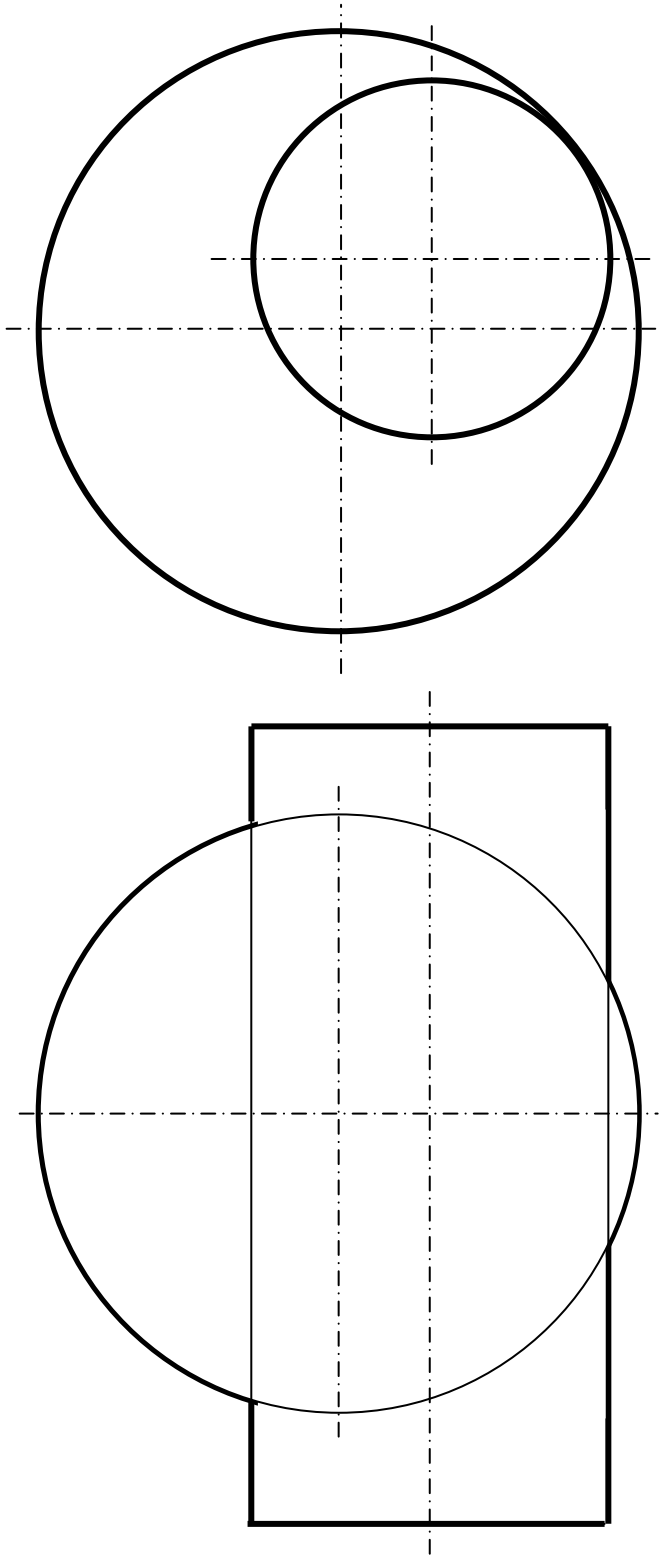




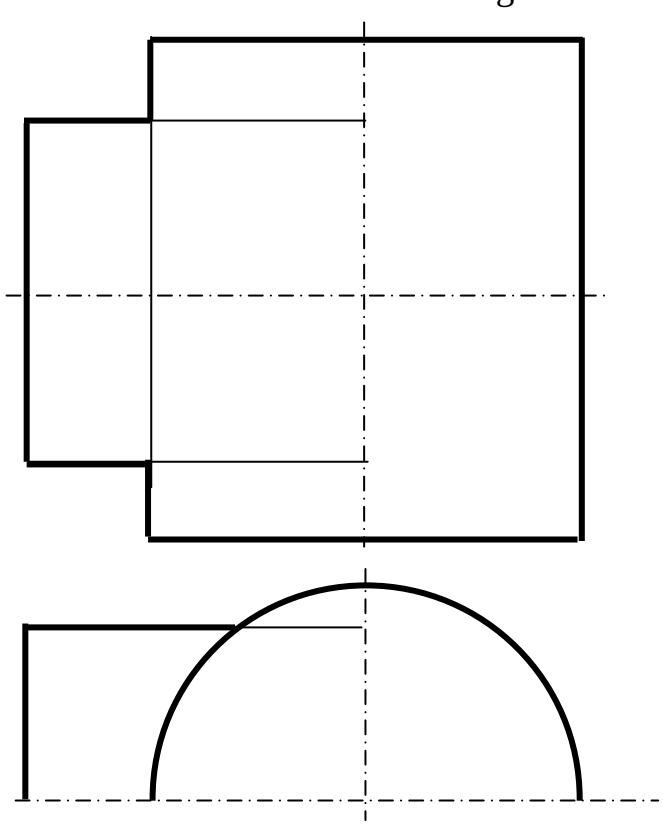


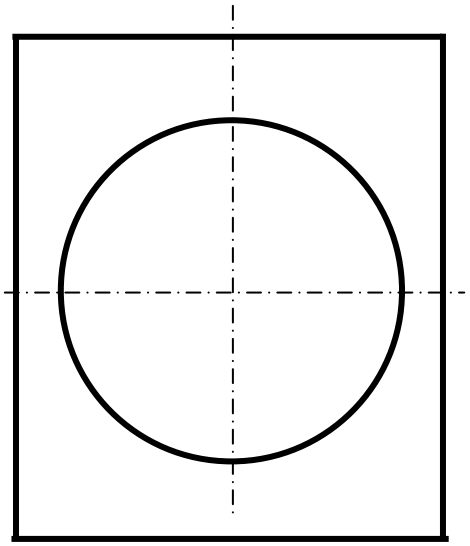
4.3 MUTUAL INTERSECTION OF SURFACES

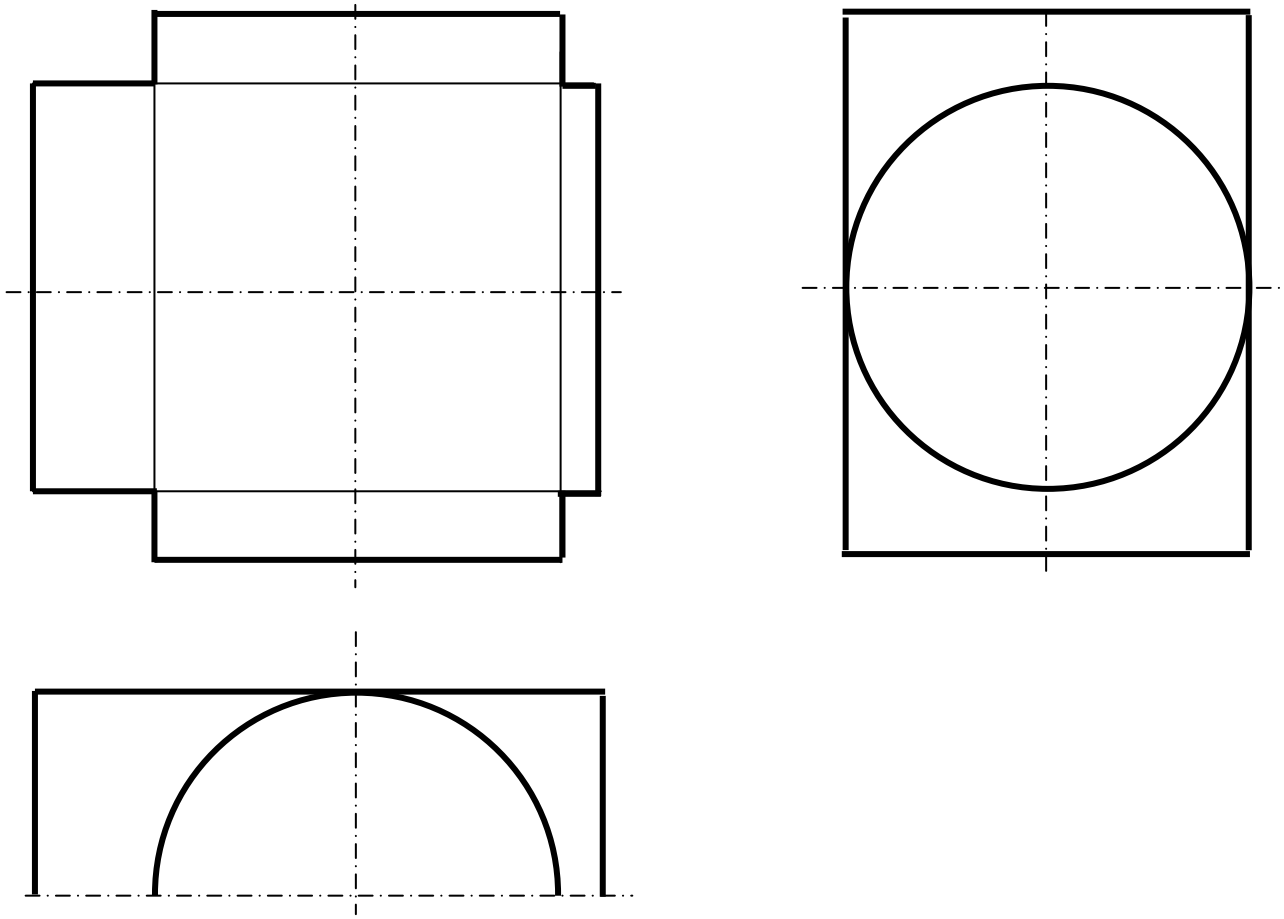
42. To construct a line of crossing of surfaces



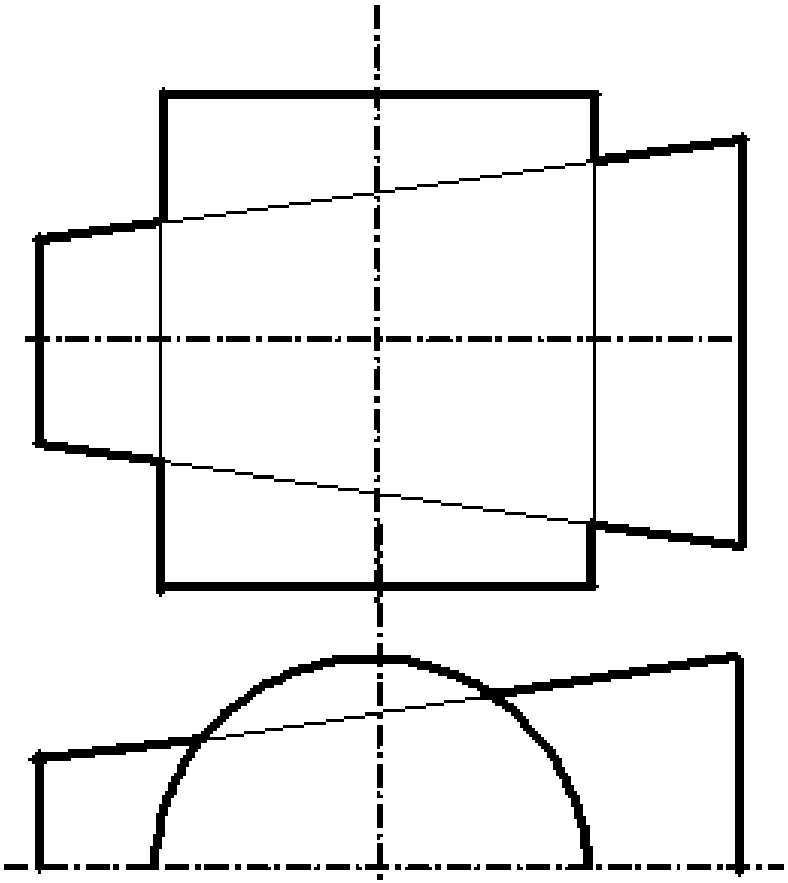
43. To construct a line of crossing of surfaces

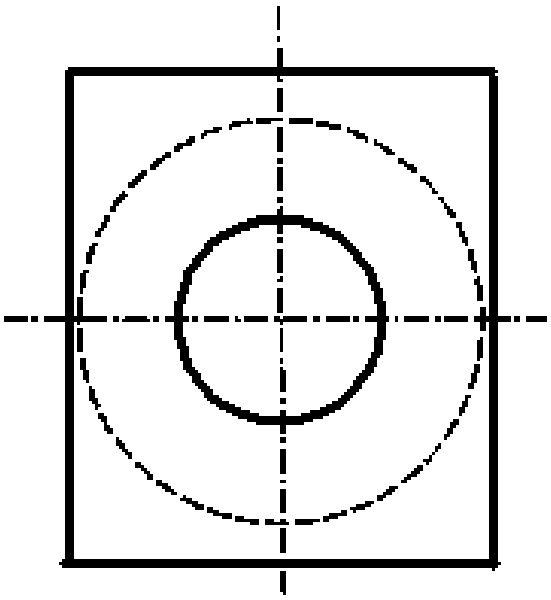


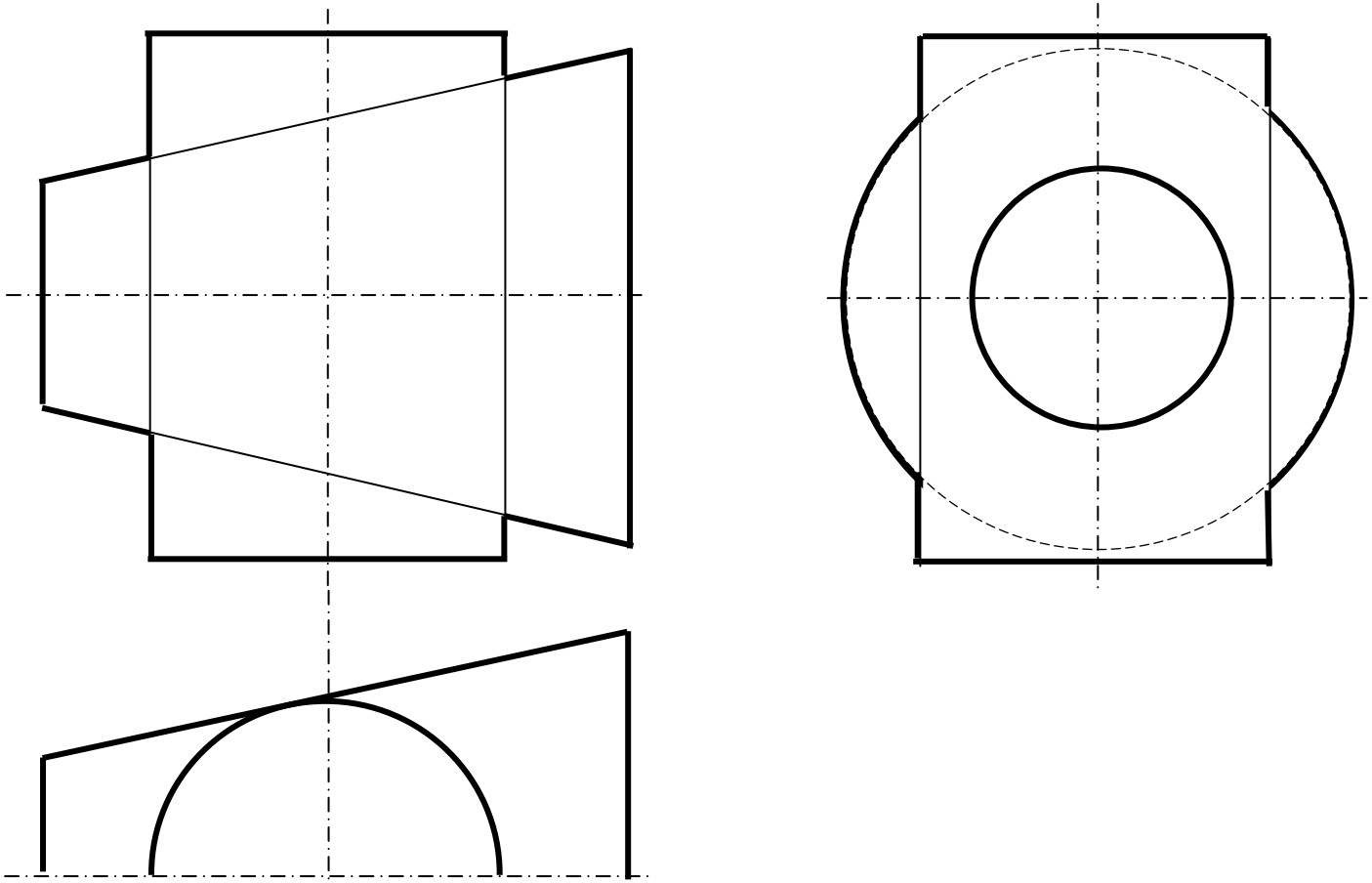




44. To construct a line of crossing of surfaces

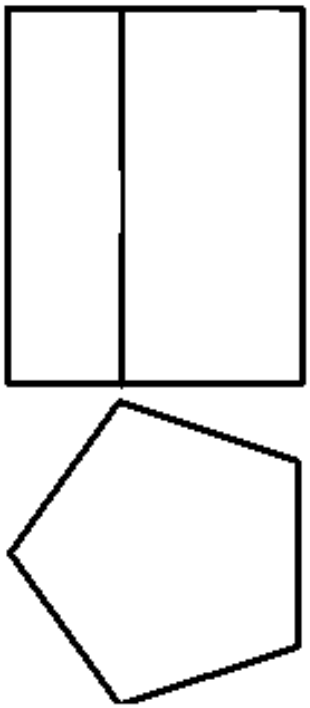


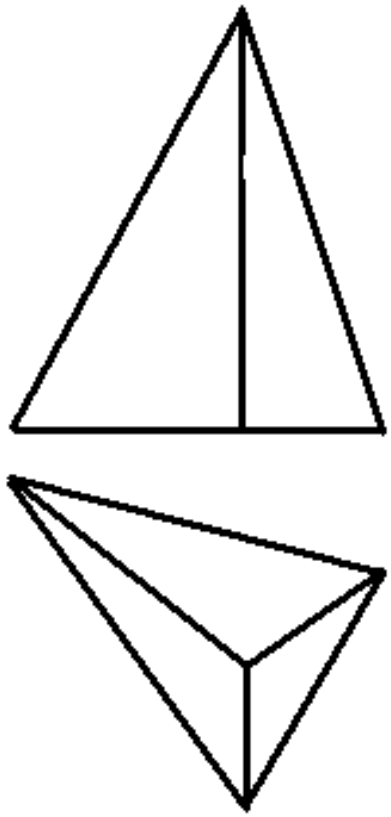


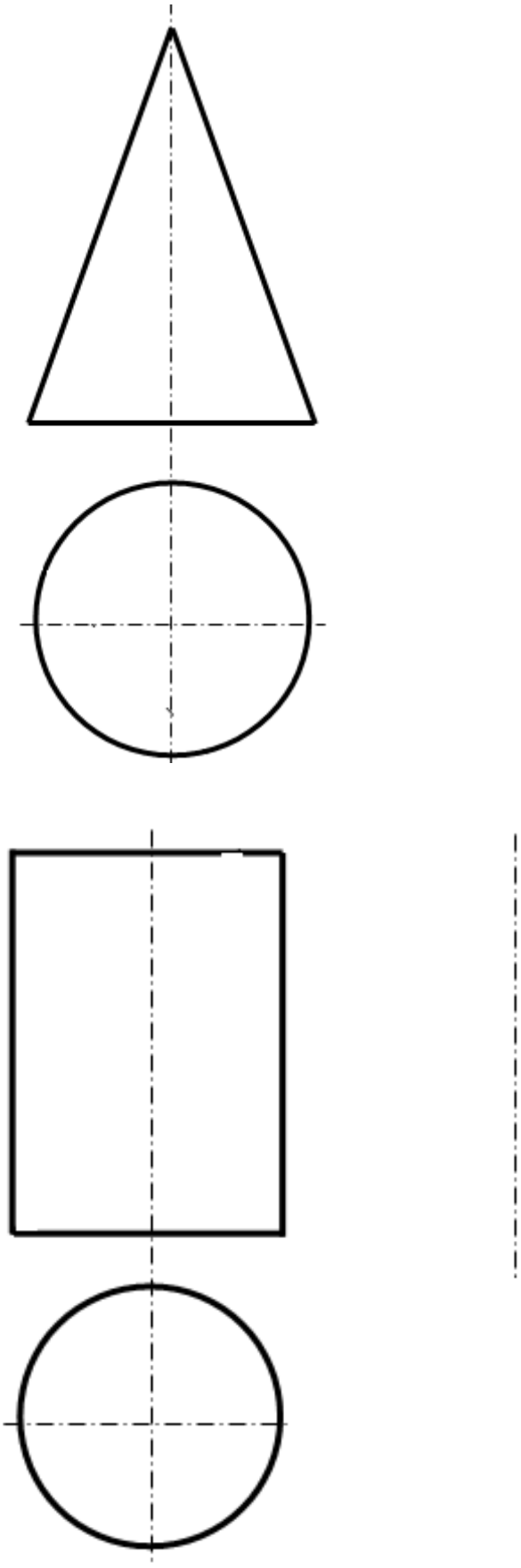


CHAPTER 5. AXONOMETRIC PROJECTIONS

45. TO CONSTRUCT THE ISOMETRY AND DIMETRY SURFACES



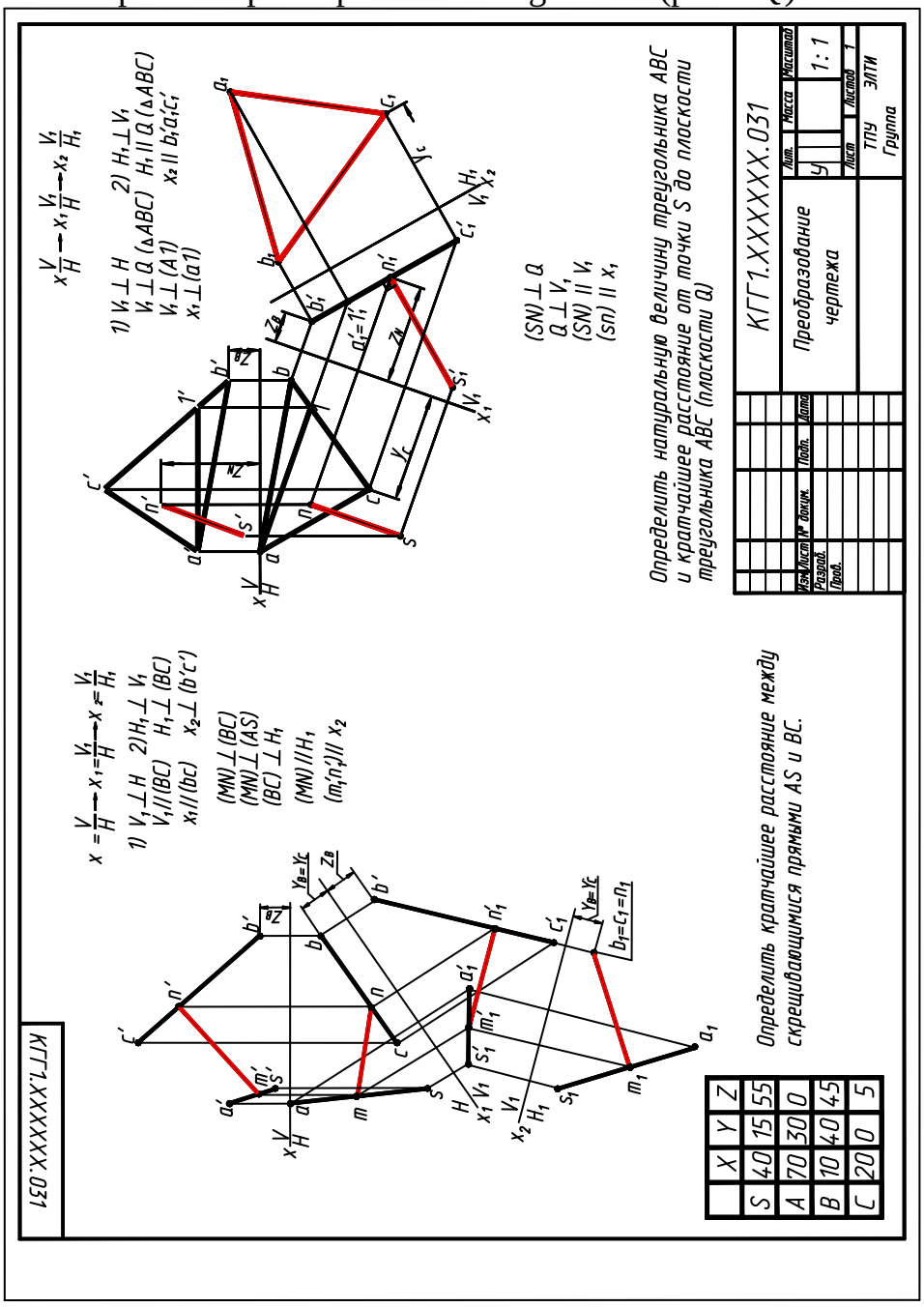




Work № 1 Transformation of the drawing

Task №1. To determine the shortest distance between crossed straight lines *AS* and *BC*.

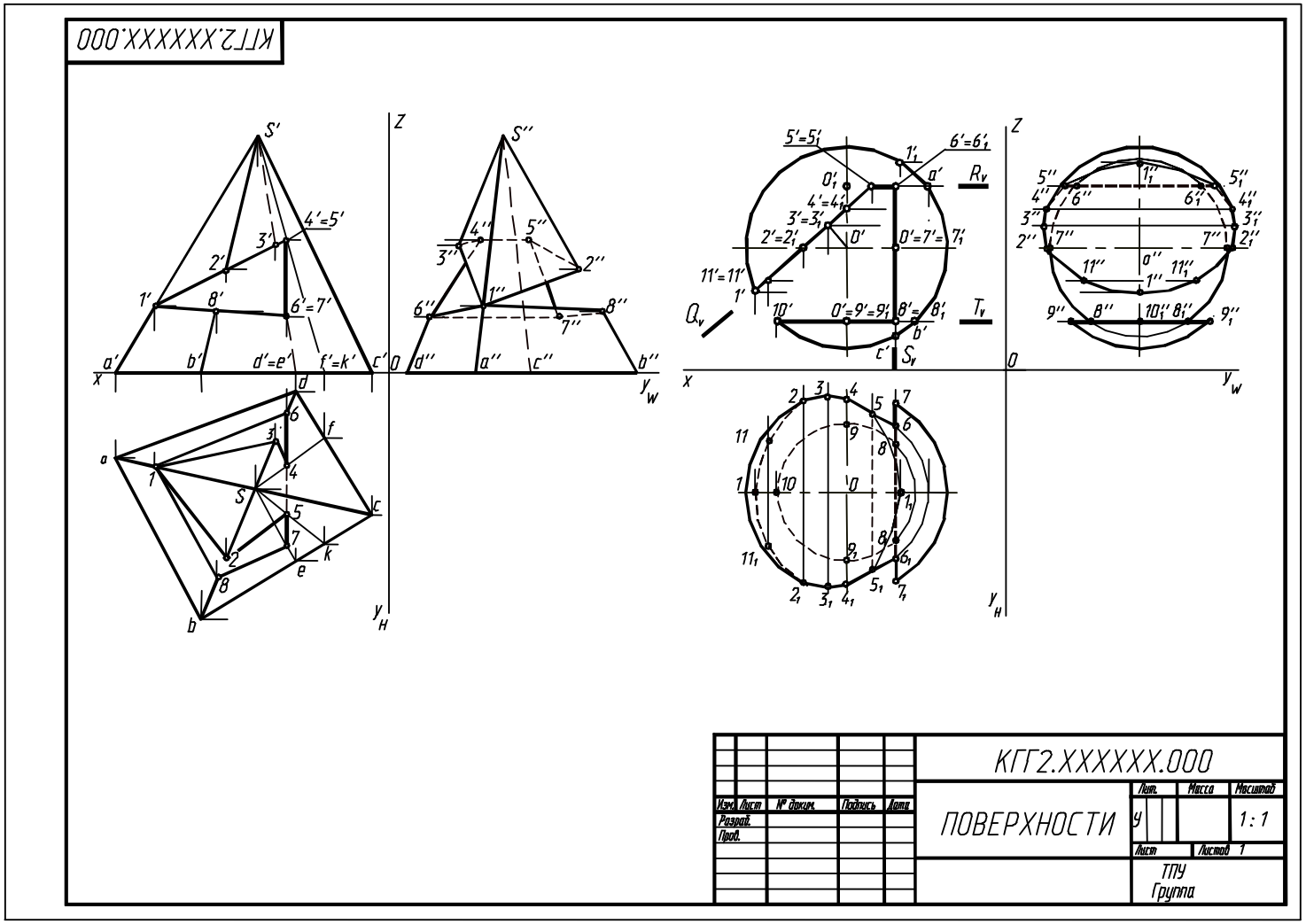
Task №2. To determine full size of triangle *ABC* and the shortest distance from point *S* up to a plane of triangle *ABC* (plane *Q*).



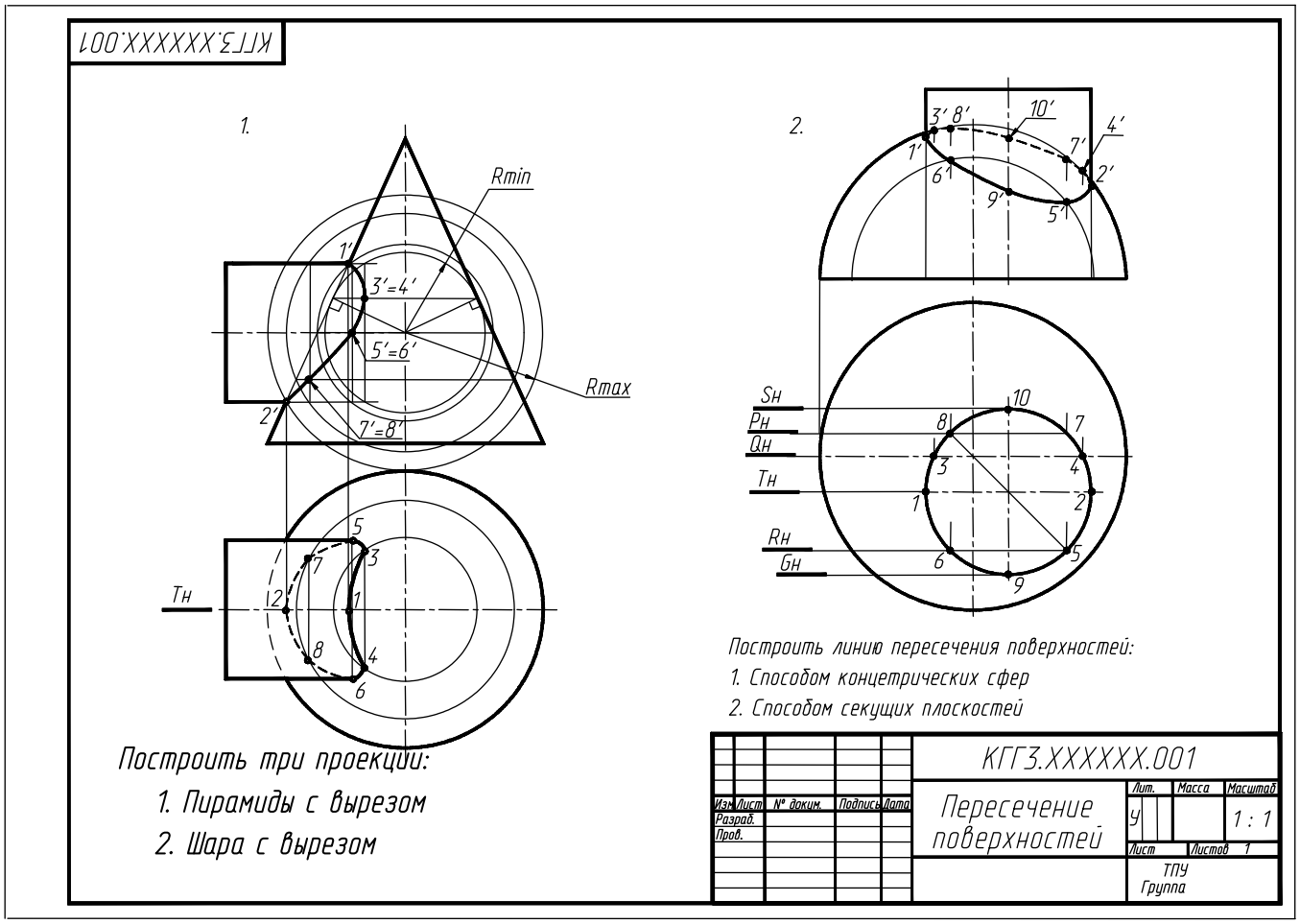
The data to tasks

№	*S*			*A*			*B*			*C*		
	x	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*
1	*60*	*40*	*35*	*25*	*5*	*45*	*10*	*40*	*10*	*65*	*10*	*0*
2	*35*	*60*	*5*	*65*	*20*	*25*	*0*	*50*	*45*	*20*	*10*	*0*
3	*60*	*10*	*50*	*30*	*60*	*35*	*5*	*20*	*10*	*60*	*30*	*5*
4	*10*	*0*	*15*	*70*	*20*	*10*	*40*	*0*	*50*	*10*	*45*	*30*
5	*55*	*40*	*35*	*25*	*0*	*55*	*0*	*50*	*20*	*50*	*20*	*0*
6	*45*	*45*	*10*	*60*	*25*	*45*	*25*	*0*	*0*	*0*	*45*	*20*
7	*50*	*45*	*40*	*65*	*25*	*0*	*30*	*5*	*40*	*10*	*50*	*20*
8	*75*	*20*	*10*	*30*	*10*	*40*	*10*	*25*	*10*	*55*	*50*	*10*
9	*75*	*25*	*15*	*50*	*50*	*15*	*45*	*15*	*45*	*5*	*15*	*5*
10	*60*	*10*	*20*	*35*	*15*	*55*	*0*	*30*	*25*	*50*	*55*	*10*
11	*30*	*50*	*45*	*10*	*20*	*10*	*55*	*50*	*10*	*75*	*0*	*55*
12	*50*	*0*	*40*	*65*	*20*	*0*	*10*	*10*	*15*	*45*	*50*	*30*
13	*65*	*40*	*50*	*35*	*40*	*5*	*5*	*10*	*40*	*60*	*0*	*20*
14	*50*	*45*	*0*	*60*	*0*	*30*	*15*	*10*	*5*	*40*	*30*	*50*
15	*65*	*30*	*45*	*30*	*40*	*5*	*10*	*10*	*45*	*70*	*0*	*15*

Work of №2 Surfaces



Work №3 Crossing of surfaces



QUESTIONS

QUESTIONS TO CHAPTER PROJECTION METHOD

1. What is the method of construction of the central projection of a point?
2. In what case is the central projection of a straight line represented by a point?
3. What is the essence of the parallel projection method?
4. How is the parallel projection of a line constructed?
5. Can the parallel projection of a line be represented by a point?
6. What are the positions of a point and a line projections if the point lies on the line?

QUESTIONS TO CHAPTER THE POINT AND THE STRAIGHT LINE

1. What location relative to the projection planes causes a line to be called "a line of general position"?
2. What is the locus of a line in the system of the planes *H, V, W* given all three projections of the line are equal in length?
3. How do we construct a profile projection of a line of general position given its frontal and horizontal projections?
4. What positions of a straight line in the system of *H*, *V*, *W* planes are considered to be the particular ones?
5. What is the position of a frontal projection of a line-segment given its horizontal projection is equal to the line-segment proper?
6. What is the position of a horizontal projection of a line-segment given its frontal projection is equal to the line-segment proper?
7. What is referred to as "the trace of a straight line on a projection plane"?
8. Which coordinate is equal to zero:
   a) for a frontal trace of a line;
   b) for a horizontal trace of a line?
9. What is the locus of a horizontal projection of a straight line frontal trace ?
10. What is the locus of a frontal projection of a straight line horizontal trace ?
11. How are two skew lines denoted in the system of *H, V* planes?
12. What can you say about the intersection point of the projections of two skew lines?
13. What property of parallel projection refers to the parallel lines?
14. Is it possible to determine parallelism of two profile lines by a drawing in the system of *H, V* planes?

15. In what case is a right angle projected as a right angle?
16. Can a projection of an acute or obtuse angle, one arm of which is parallel to a projection plane, be equal to the given angle in space?
17. How do we construct right triangles in a drawing in order to determine the length of a segment of a line of general position and its inclination angles to the projection planes *H* and *V*?

QUESTIONS TO CHAPTER REPRESENTATION OF A PLANE IN A DRAWING

1. Are the ways of specifying a plane figure?
2. What are "traces of the plane"?
3. What plane is called a projecting plane?
4. What is the level plane?
5. Under what conditions does a line belong to a plane?
6. Under what conditions does a point belong to a plane? What lines are referred to as the principal lines of the plane?
7. What are the terms of a line and a plane to be parallel?
8. How can you find the meeting point of a line and a plane?
9. What are the relative positions of the planes?
10. What determines mutual parallelism of two oblique planes in a drawing?
11. What is the way of drawing an intersection line of two planes?
12. What is the gist of the replacing planes of projection method?
13. What mutual relations must the old and new planes of projections have?
14. What actions are necessary to obtain the following transformations: of a general position line into a projecting one; of an oblique plane into a level plane?

QUESTIONS TO CHAPTER SURFACES

1. What is "surface"?
2. What is the meaning of the expression "To specify a surface in a drawing"?
3. What surfaces are called "ruled surfaces"?
4. What is the difference between the polyhedral surfaces and polyhedrons?
5. What is the condition of a point belonging to a surface?
6. How do we obtain the surfaces of rotation?
7. What lines on a surface of rotation are referred to as parallels and meridians?
8. How is a surface of helicoid formed?
9. What lines are produced by intersection of a rotation cylinder with the planes?

10. What lines are produced by intersection of a rotation cone with the planes?
11. How to pass a plane to obtain a circle in a torus section?
12. What is the general method of drawing the intersection line of surfaces?
13. In what cases do we use projection planes, spheres as mediators for the construction of intersection lines of surfaces?
14. What points of an intersection line are referred to as control ones?
15. Give the formulation of Monge theorem and introduce the example of its application in practice.

QUESTIONS TO CHAPTER AXONOMETRIC PROJECTIONS

1. What is the essence of the method of axonometric projection?
2. Formulate the principal theorem of axonometry.
3. What is the coefficient of distortion?
4. How are the coefficients of distortion related to each other?
5. How are the axonometric projections classified according to the direction of projecting and the comparable value of the coefficients of distortion?
6. What is the way of determining the direction of the major and minor axes of an ellipse, if ellipse is the isometric and dimetric projection of a circle?
7. What line is called the outline of the axonometric projection of a sphere?
8. What is the value of the coefficients of distortion in an oblique frontal isometry?
9. Name the coefficients of distortion in an oblique frontal isometry?
10. What is the way of constructing the axes in an oblique axonometry?

QUESTIONS TO CHAPTER REPRESENTATIONS

1. What are the principal views? How are they positioned on a drawing?
2. What are the rules of designating a view having no projecting link with the principal view?
3. What representation is called an auxiliary view, a detail view? In what cases are they applied and how are they denoted?
4. When is it permitted to apply a break of a representation?
5. What representation is called a sectional view? How are the sectional views classified depending on a cutting plane position relative to the horizontal projection plane or relative to the object; depending on a number of the cutting planes?
6. What sectional view is referred to as a scrap one?

7. In what cases are the sectional views not designated?
8. What letters denote the sectional views?
9. How are the complex sections classified?
10. What are the peculiarities of drawing a complex step-type sectional view?
11. When is it permitted to join a half view and a half sectional view?
12. What line separates a scrap section from the view and how is it drawn?
13. What elements of an object are not hatched on a section?
14. What simplifications are used when the projections of the intersection lines of surfaces are drawn?
15. Are the small angles of taper and slopes shown in all drawings?
16. How is knurling drawn?
17. What is a covering projection and what are the rules of its construction?
18. What is an extension element?
19. How are the extension elements denoted on drawings?

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