Ministry of Education and Science of Ukraine
National University of Water and Environmental Engineering
Department of Architectural Design Bases, Construction and Graphics

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METHODICAL GUIDELINES

and tasks to a practical training and independent work
IN THE DISCIPLINE
«DESCRIPTIVE GEOMETRY»
PART 1. ORTHOGONAL PROJECTIONS
for higher education students of the first (bachelor) level
in the field of study 191 «Architecture and Urban planning»
of full-time education form

МЕТОДИЧНІ ВКАЗІВКИ

та завдання до практичних занять і самостійної роботи
З НАВЧАЛЬНОЇ ДИСЦИПЛІНИ
«НАРИСНА ГЕОМЕТРІЯ»
ЧАСТИНА 1. ОРТОГОНАЛЬНІ ПРОЕКЦІЇ
для здобувачів вищої освіти першого (бакалаврського) рівня
за спеціальністю 191 «Архітектура та містобудування»
денної форми навчання

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INTRODUCTION

Methodical guidelines and tasks to a practical training and independent work are developed according to the syllabus of the course for higher education students of the first (bachelor) level in the field of study 191 “Architecture and Urban planning” of full-time education form.

The purpose of practical training is fixing of theoretical knowledge, acquisition of skills of the solution of the various problems of descriptive geometry arising in practice of architectural and construction design and also development of space imagination by correlation of geometrical objects in three-dimensional space with their image on the plane.

Each subject consists of questions of independent training, tasks and short methodical guidelines.

All tasks are performed by pencil on A3 format. Basic data and results are allocated with the reinforced line. Auxiliary constructions are shown with a thin line with a hard pencil. Results of the carried-out tasks serve for control of the current progress and admission to examinations.

1. POINT, STRAIGHT LINE AND PLANE

1.1. QUESTIONS FOR INDEPENDENT TRAINING

1. What is orthogonal projection of point?
2. How many coordinates of point are necessary to set the provision of point in three-dimensional space?
3. How many orthogonal projections of point set its situation in three-dimensional space?
4. Do two points define a segment or a straight line?
5. What lines of special position do you know? And planes?
6. What straight lines by their mutual situation exist?
7. How it is possible to set the plane?
8. What is straight line trace? Planes? How to construct them?
9. What main lines of the plane do you know? Their characteristics.
10. How to construct crossing of two planes?
11. How to construct crossing of the plane and straight line?
12. How to construct a straight line that is perpendicular to a plane?

Literature: 1 (pp. 5-54), 2 (pp.4-16), 3 (pp.12-28), 4 (pp.7-16), 5 (pp.10-12; 25-28; 40-46), 7 (pp.33-78), 8 (pp.10-28).

1.2. CREATION OF POINT PROJECTIONS

Task: construct three projections of eight points according to their coordinates given in table 1 (in centimeters).

Methodical guidelines: when constructing projections of points, it is necessary to imagine by their coordinates in which octant they are located and where to put their coordinates after turning the horizontal and profile planes of the projections.

Literature: 1 (p. 184), 3 (pp. 12-14), 5 (pp. 25-28), 7 (pp. 33-43), 8 (pp. 10-12).

Table 1

Task	*A*			*B*			*C*			*D*			*E*			*K*			*L*			*M*		
	x	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***
1	+2	+3	+4	+3	-2	+8	+4	+4	-2	+5	-4	-4	-5	+6	+2	-4	-6	+0	-3	+4	-6	-2	-0	-2
2	+1	+5	+6	+2	-4	+4	+5	+2	-6	+6	-2	-2	-1	+4	+4	-2	-3	+2	-3	+6	-5	-6	-6	-3
3	+3	+2	+5	+4	-3	+3	+6	+3	-1	0	-5	-3	-3	+5	+8	-5	-2	+4	-5	+4	-2	-6	-1	-5
4	+4	+1	+2	+1	-5	+1	+3	+6	-5	+2	-1	-4	-4	+3	+3	-1	0	+5	-2	+5	0	-4	-2	-2
5	+5	+2	+3	+3	-1	+5	+2	+4	-3	+6	-2	-5	0	+5	+6	-4	-4	0	-3	+6	-2	-2	-3	-6

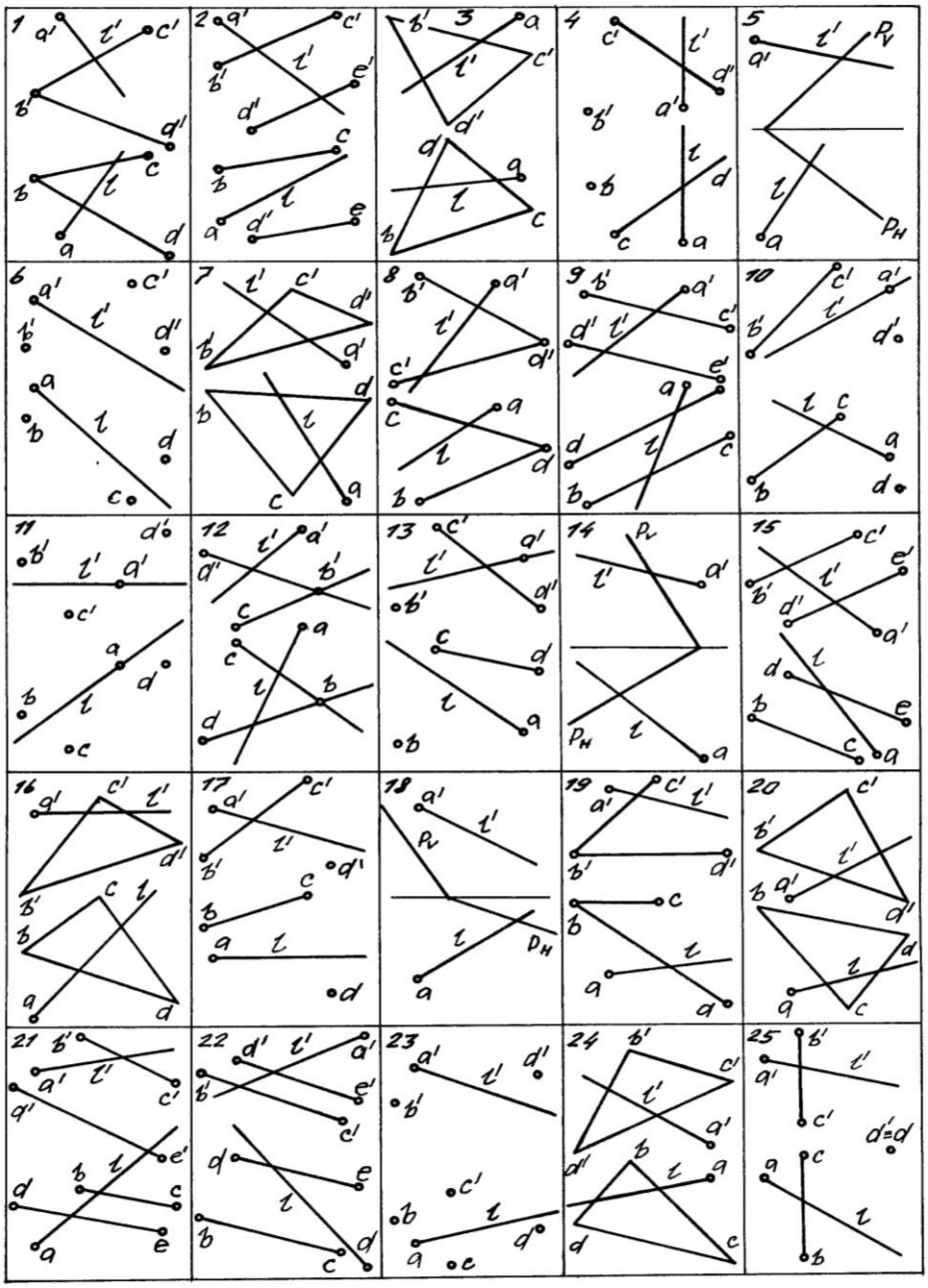
Task	*A*			*B*			*C*			*D*			*E*			*K*			*L*			*M*		
	x	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***	***x***	***y***	***z***
6	+2	+6	+4	+6	-6	+2	+1	+5	-1	+4	-3	-2	-2	+4	+3	-9	-5	+4	-4	+3	-3	-5	-2	-4
7	+3	+3	+4	0	-4	+6	+7	+1	-4	+8	-6	-6	-6	+2	+2	-4	-1	+1	-1	0	-2	-3	-5	0
8	+4	+5	+6	+7	-1	+4	+3	+3	-2	+5	-5	-4	-5	+2	+2	-3	-7	+8	-1	+6	-5	-7	-2	-7
9	+5	+2	+5	+8	-5	+3	+6	+4	-1	+4	-3	-3	-8	+6	+4	-4	+8	-5	-2	0	-5	-2	-0	-7
10	+4	+1	+2	+7	-4	+4	+5	+3	-3	+3	-3	-5	-3	+5	+6	-5	-5	+8	0	+7	-7	-7	-7	-2
11	+3	+2	+3	+6	-2	+1	+2	+4	-8	+7	-4	-6	-1	+6	+5	-3	-6	+7	-5	+8	-2	0	-8	-4
12	+2	+6	+1	+5	-8	+3	+7	+2	-1	0	-6	-3	-2	+8	+7	-4	-4	+5	-6	+4	-5	-8	-2	-7
13	0	+3	+5	+4	-4	+1	+2	+1	-3	+6	-3	-5	-8	+5	+3	-6	-5	+7	-4	+7	-7	-2	-7	0
14	+3	+6	0	+8	-3	+2	+6	+4	-2	+4	-4	-2	-2	+3	+4	0	-7	+6	-4	+2	-6	-8	-3	-8
15	+1	+2	+4	+3	-1	+6	+5	+6	0	+7	-3	-2	-1	+4	+8	-3	-5	+2	-5	+8	-4	-7	-7	-6
16	+2	+1	+6	+7	-2	+4	0	+3	-3	+4	-4	-5	-7	+5	+2	-5	-6	+8	-3	+7	-7	-1	-8	-4
17	+3	+2	+5	+6	-1	+7	+5	+4	-1	+1	-3	-3	-9	+6	+9	-7	-5	+4	-5	+8	-5	-3	-7	-7
18	+4	+5	+3	+5	-9	+4	+2	+3	-2	0	-7	-4	-2	+7	+6	-4	-3	+9	-6	+9	-6	-8	-5	0
19	+5	+3	+2	+4	-1	+5	+7	+1	-7	+2	-7	-5	0	+5	+7	-2	-5	0	-4	+6	-9	-6	-3	-1
20	+4	+3	+1	+3	-3	+3	+6	+8	-1	+8	-5	-3	-1	+6	+5	-3	-7	+6	-5	+4	-7	-7	0	-5
21	+3	+5	+6	+5	-5	+4	+1	+6	-3	+7	-3	-5	-3	+4	+2	-5	-1	+8	-7	+8	-7	-9	-9	-1
22	+2	+2	+5	+8	-7	+7	+6	+4	-5	+4	-1	-7	-5	0	+3	-7	-3	+8	-9	+6	-5	-1	-5	-3
23	+1	+1	+4	+5	-9	+2	+3	+7	-7	0	-7	-9	-7	+5	+6	-9	-5	+5	-1	+3	-3	-3	-3	-1
24	0	+6	+3	+3	0	+8	+2	+2	-2	+5	-2	0	-9	+4	+4	-1	-4	+6	-3	+8	-4	-5	-6	-7
25	+2	+3	+2	+4	-2	+3	+6	+5	-8	+8	-4	-2	-2	+7	+4	-8	-6	+6	-6	+8	-4	-4	-8	-2

1.3. INTERSECTION OF A STRAIGHT LINE AND A PLANE

Task: a) construct the intersection point *K* of the straight line *L* with the plane *BCD*; ***b***) determine the distance from a given point *A* lying on a straight line *L* to the same plane *BCD*; ***c***) determine the distance from the point *K* to the point of intersection of the perpendicular to the plane *BCD* lowered from the point *A*; ***d***) determine the angle between a straight line *L* and a plane *BCD*.

Basic data are given in table 2.

Table 2



Methodical guidelines: a) to solve the task ***b***, it is necessary to first determine the direction of the perpendicular to the plane *BCD*; and then determine the point of its intersection with this plane; ***b***) if *L* is a profile line, a profile projection of the line *L* and the plane *BCD* should be constructed; ***c***) the angle between the line *L* and the plane *BCD* can be determined by constructing the natural size of the triangle *ATK*.

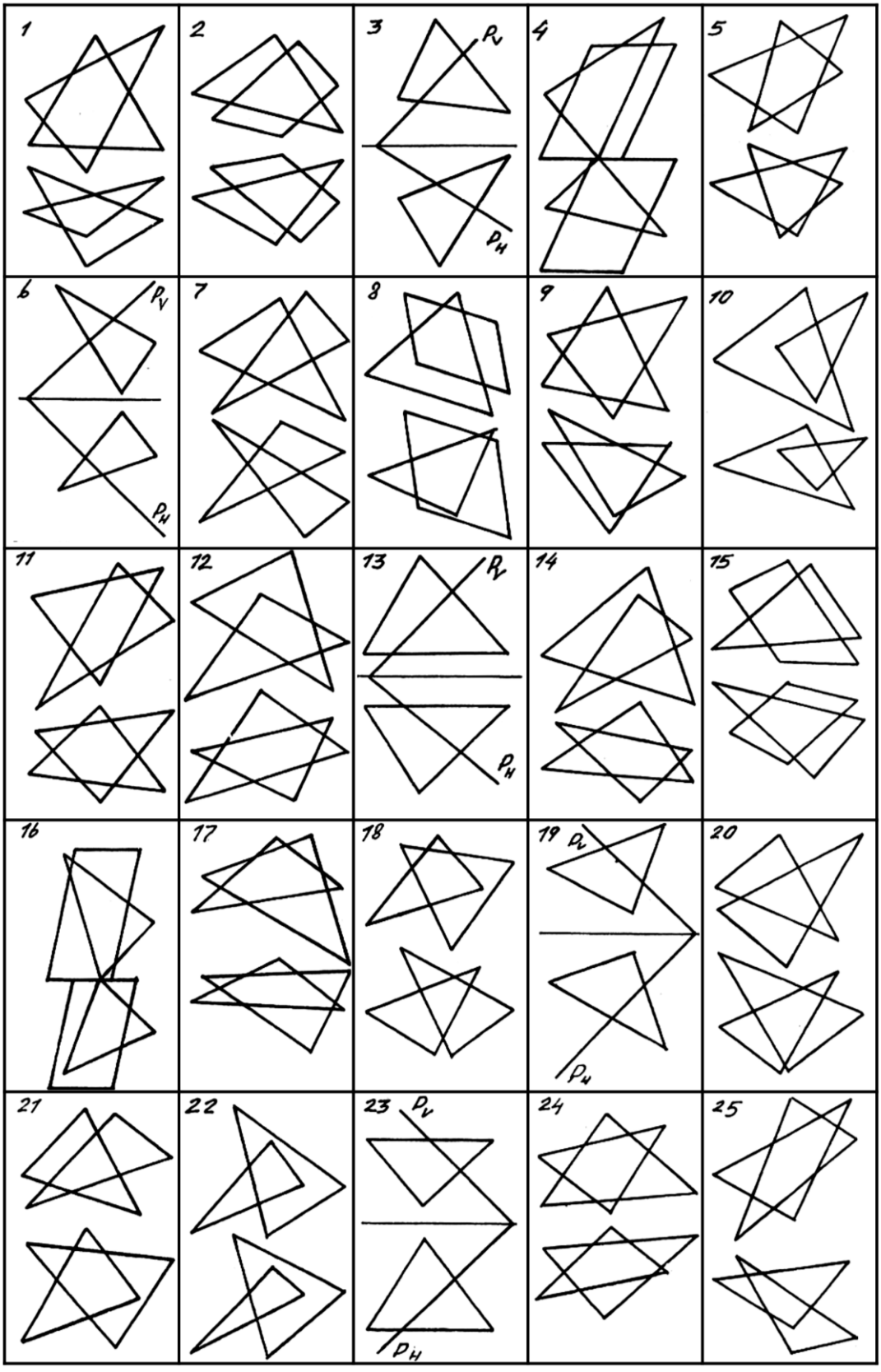
Literature: 1 (p. 185), 2 (p. 14), 3 (pp. 24-28), 4 (p. 14), 5 (pp. 40-44), 6, 7 (pp. 73-78), 8 (pp. 22-28).

1.4. INTERSECTION OF PLANES

Task: to construct straight line of crossing of two planes set in the different ways.

Basic data are given in table 3.

Table 3



Methodical guidelines: the exercise can be solved in the different ways (the required straight line decides by two points of intersection of two straight lines lying in one plane on the second plane; in the way of auxiliary projection; in the way of auxiliary secants of the planes) at the choice of the student.

Literature: 1 (p. 185), 2 (p. 6), 3 (pp. 22-24), 4 (p. 11), 5 (pp. 44-46), 6, 7 (p. 26).

1.5. CONSTRUCTION OF THE LINE OF INTERSECTION OF THE ROOF SLOPES

Task: construct the lines of intersection of the roof slopes under the condition that the overhang lines of the roof lie in the same horizontal plane and tilt angles of all roof slopes are the same.

Basic data are given in methodical guidelines 03-07-61 " Construction of the line of intersection of the roof slopes " [9].

Methodical guidelines: the main condition of creation of the plan of roof is that the horizontal projection of straight line of crossing of adjacent slopes is bisector between lines of their overhang. Methodical instructions for the construction of intersecting lines of roof slopes and examples of construction are given in the methodical guidelines 03-07-61 [9].

Literature: 1 (p. 185), 3 (pp. 47, 48), 5 (pp. 66-67), 7 (pp. 177, 178), 8 (p. 47), 9.

2. METHODS OF CONVERTING PROJECTIONS

2.1. QUESTIONS FOR INDEPENDENT TRAINING

1. Why are projection conversion methods used? What methods of converting projections do you know?
2. Give examples of tasks which are convenient for solving in the way of conversion of projections?
3. What is the main idea of the method of replacing projection planes?
4. What is the main idea of the method of rotation around the axes perpendicular to the projection planes? Around the straight line?
5. What is the essence of the method of plane-parallel movement? What is its advantage compared to the rotation method?
6. What is the essence of the method of auxiliary oblique projection? What problems are solved with its help?

Literature: 1 (pp. 55-70), 2 (pp. 17, 48), 3 (pp. 28-36), 4 (pp. 16-20), 5 (pp. 47-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

2.2. DETERMINATION OF THE DISTANCE FROM A POINT TO A STRAIGHT LINE

Task: determine the distance from point *A* to straight line *L* by the given projection conversion method.

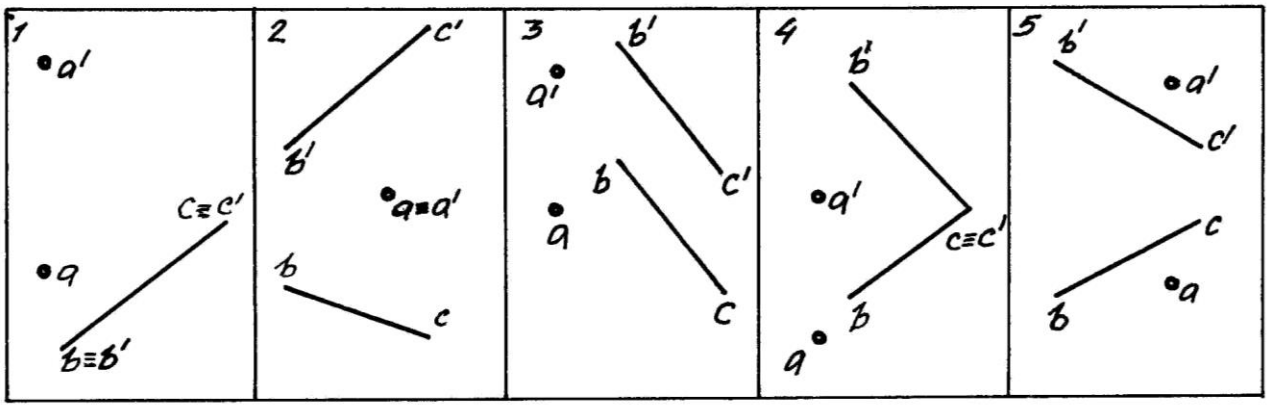
Basic data are given in tables 4 and 5.

Table 4

Task	Drawing number	Projection conversion method	Task	Drawing number	Projection conversion method
1	1	RPP	14	4	R
2	2	R	15	5	PPM
3	3	PPM	16	1	RPP
4	4	RPP	17	2	R
5	5	R	18	3	PPM
6	1	PPM	19	4	RPP
7	2	RPP	20	5	R
8	3	R	21	1	PPM
9	4	PPM	22	2	RPP
10	5	RPP	23	3	R
11	1	R	24	4	PPM
12	2	PPM	25	5	RPP
13	3	RPP			

Conventional designations of projection conversion methods: **RPP** – replacing projection planes; **R** – rotation; **PPM** – plane-parallel movement; **AOP** – auxiliary oblique projection.

Table 5



Methodical guidelines: to determine the distance from a point to a straight line, it is necessary to turn the straight line into a projecting one, then the required distance will be projected in natural size.

Literature: 1 (pp. 55-67), 2 (p. 17), 3 (pp. 28-36), 4 (pp. 16-19), 5 (pp. 50-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

2.3. DETERMINATION OF THE DISTANCE BETWEEN TWO STRAIGHT LINES

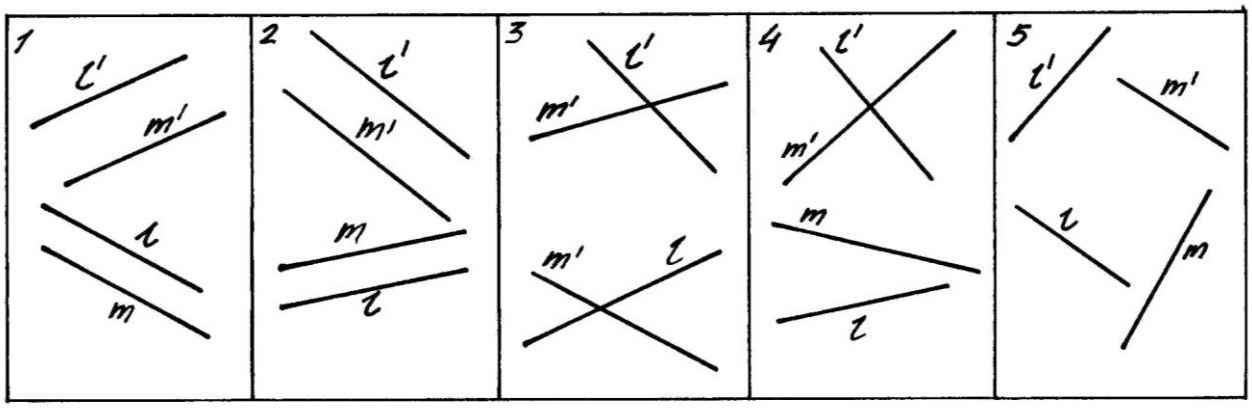
Task: determine the distance between two parallel or passing straight lines by the given method of converting projections.

Basic data are given in tables 6 and 7.

Table 6

Task	Drawing number	Projection conversion method	Task	Drawing number	Projection conversion method
1	1	R	14	4	PPM
2	2	PPM	15	5	RPP
3	3	RPP	16	1	R
4	4	R	17	2	PPM
5	5	PPM	18	3	RPP
6	1	RPP	19	4	R
7	2	R	20	5	PPM
8	3	PPM	21	1	RPP
9	4	RPP	22	2	R
10	5	R	23	3	PPM
11	1	PPM	24	4	RPP
12	2	RPP	25	5	R
13	3	R			

Table 7



Methodical guidelines: ***a***) in order to determine the distance between two parallel lines, it is necessary to convert them into projecting ones, then the required distance will be the distance between two points that are projections of the lines; ***b***) to determine the distance between two passing straight lines, it is necessary to turn one of them into a projecting one, then the required distance will be the perpendicular dropped from the point that is the projection of one straight line to the projection of the second straight line.

Literature: 1 (pp. 55-67), 2 (p. 17), 3 (pp. 28-36), 4 (pp. 16-19), 5 (pp. 50-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

2.4. DETERMINATION OF THE DISTANCE BETWEEN A STRAIGHT LINE AND A PLANE

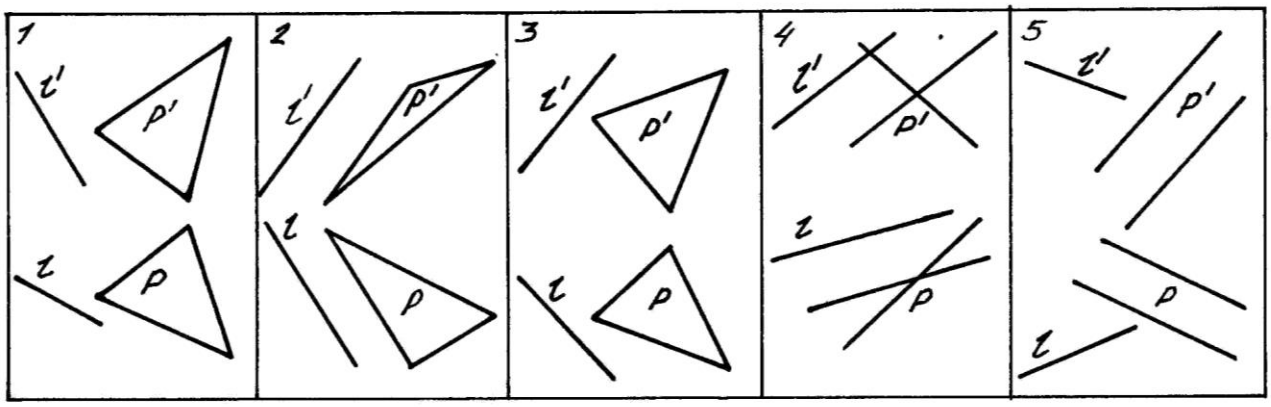
Task: determine the distance from the straight line to the plane by the given method of projection conversion.

Basic data are given in tables 8 and 9.

Table 8

Task	Drawing number	Projection conversion method	Task	Drawing number	Projection conversion method
1	1	PPM	14	4	RPP
2	2	RPP	15	5	R
3	3	R	16	1	PPM
4	4	PPM	17	2	RPP
5	5	RPP	18	3	R
6	1	R	19	4	PPM
7	2	PPM	20	5	RPP
8	3	RPP	21	1	R
9	4	R	22	2	PPM
10	5	PPM	23	3	RPP
11	1	RPP	24	4	R
12	2	R	25	5	PPM
13	3	PPM			

Table 9



Methodical guidelines: a) the distance between a straight line and a plane can be determined only if *the straight line is parallel to the plane* (that is, the straight line must be set correctly); ***b***) to determine the distance from a straight line to a plane, it is necessary to turn the plane into a projecting plane; ***c***) the required distance will be perpendicular between two parallel straight lines, one of which is plane projection, and the second is the straight line.

Literature: 1 (pp. 55-67), 2 (p. 17), 3 (pp. 28-36), 4 (pp. 16-19), 5 (pp. 50-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

2.5. DETERMINATION OF THE DISTANCE BETWEEN TWO PLANES

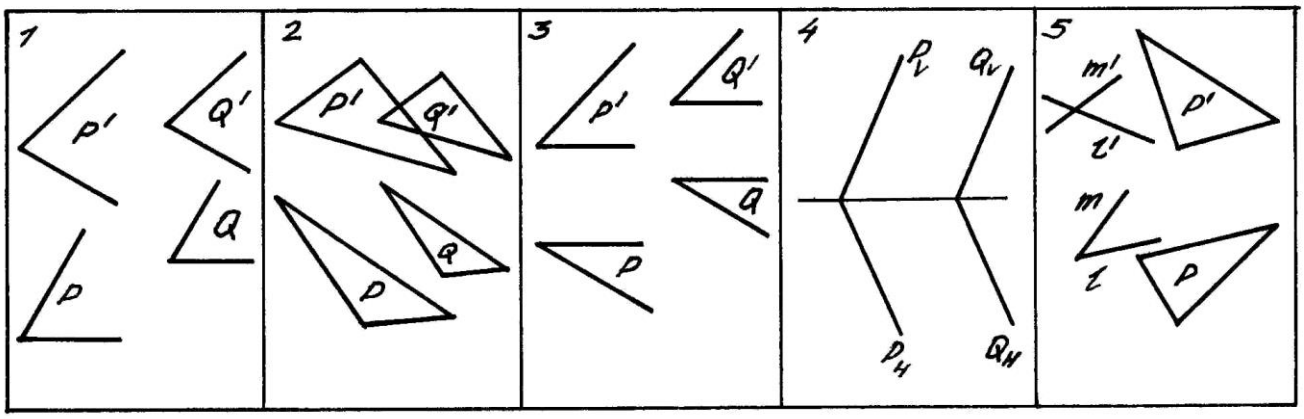
Task: determine the distance between two parallel planes by the given method of converting projections.

Basic data are given in tables 10 and 11.

Table 10

Task	Drawing number	Projection conversion method	Task	Drawing number	Projection conversion method
1	1	RPP	14	4	PPM
2	2	R	15	5	R
3	3	PPM	16	1	RPP
4	4	RPP	17	2	RPP
5	5	R	18	3	R
6	1	PPM	19	4	PPM
7	2	RPP	20	5	RPP
8	3	R	21	1	R
9	4	PPM	22	2	PPM
10	5	RPP	23	3	RPP
11	1	R	24	4	R
12	2	PPM	25	5	PPM
13	3	AOP			

Table 11



Methodical guidelines: ***a***) check the parallelism of the planes you set; ***b***) to determine the distance between two parallel planes, it is necessary to turn them into projecting ones, using level lines (horizontal or frontal); ***c***) the required distance will be the common perpendicular between two parallel straight lines which are traces of planes.

Literature: 1 (pp. 55-67), 2 (p. 17), 3 (pp. 28-36), 4 (pp. 16-19), 5 (pp. 50-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

2.6. DETERMINATION OF THE ANGLE BETWEEN TWO PLANES

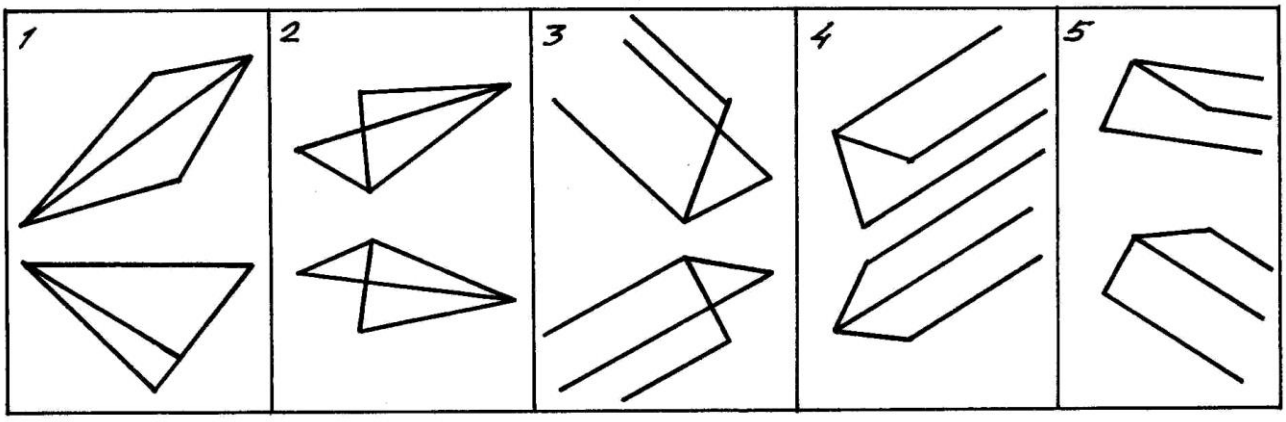
Task: determine the angle between two planes that have a common edge, using the given projection conversion method.

Basic data are given in tables 12 and 13.

Table 12

Task	Drawing number	Projection conversion method	Task	Drawing number	Projection conversion method
1	1	R	14	4	RPP
2	2	RPP	15	5	PPM
3	3	PPM	16	1	R
4	4	R	17	2	RPP
5	5	RPP	18	3	PPM
6	1	PPM	19	4	R
7	2	R	20	5	RPP
8	3	RPP	21	1	PPM
9	4	PPM	22	2	R
10	5	R	23	3	RPP
11	1	RPP	24	4	PPM
12	2	PPM	25	5	R
13	3	R			

Table 13



Methodical guidelines: ***a***) to determine the angle between two planes, it is necessary to turn their common edge into a projecting edge; ***b***) the required angle will be the angle between the two straight lines which are the traces of the planes.

Literature: 1 (pp. 55-67), 2 (p. 17), 3 (pp. 28-36), 4 (pp. 16-19), 5 (pp. 50-61), 6, 7 (pp. 79-108), 8 (pp. 28-39).

3. CURVES

3.1. QUESTIONS FOR INDEPENDENT TRAINING

1. Name the ways of setting lines.
2. What is order and class of flat curve?
3. Give definition of tangent and normal to flat curve.
4. What is curvature of flat curve and radius of curvature?
5. What curves of the second order do you know?
6. Call properties of points of ellipse, parabola and hyperbole on which they can be constructed.
7. What special points of flat curves do you know?
8. Explain the question "accompanying trihedron" of space curve. Of what parts does it consist?
9. What space curves do you know?
10. Name the property of the helix points by which they can be constructed
11. What line does the cylindrical spiral line turn into on the cylinder sweep?
12. In which line is the conical spiral line projected onto the horizontal plane?

Literature: 3 (pp. 55-63), 5 (pp. 67-78), 7 (pp.79-108), 8 (pp. 55-62).

3.2. CONSTRUCTION OF CURVES OF THE SECOND ORDER

Task: to construct ellipse, parabola and hyperbole (with asymptotes) on the basic data given respectively in tables 14 (ellipse), 15 (parabola) and 16 (hyperbole).

Table 14

Task	Half shafts of ellipse, mm		Task	Half shafts of ellipse, mm	
	a	*b*		*a*	*b*
1	60	40	14	25	50
2	50	30	15	20	50
3	45	60	16	30	70
4	35	50	17	70	60
5	20	55	18	70	50
6	30	65	19	70	40
7	40	70	20	75	55
8	45	30	21	65	30
9	50	20	22	40	60
10	65	35	23	40	65
11	70	45	24	45	65
12	55	20	25	45	55
13	30	45			

Table 15

Task	The distance from the focus to the directrix	Task	The distance from the focus to the directrix	Task	The distance from the focus to the directrix
1	20	10	65	19	52
2	25	11	70	20	54
3	30	12	75	21	56
4	40	13	18	22	58
5	50	14	22	23	44
6	60	15	24	24	46
7	35	16	36	25	62
8	45	17	48		
9	55	18	38		

Table 16

Task	Sides of a rectangle, mm		Task	Sides of a rectangle, mm	
	2a	2b		2a	2b
1	25	30	14	28	35
2	20	40	15	34	34
3	30	30	16	35	35
4	35	25	17	48	30
5	40	25	18	54	32
6	50	25	19	56	25
7	60	40	20	62	36
8	65	35	21	68	40
9	45	45	22	66	48
10	50	50	23	25	54
11	60	60	24	30	58
12	65	65	25	35	64
13	26	30			

Note: the values given in tab. 14, 15 and 16 can be increased in proportion for convenience of creation.

Methodical guidelines: a) when constructing curves, it is advisable to use the properties of symmetry of their forms; ***b***) for a more accurate reproduction of the shape of the curves, it is necessary to set more points where the curvature of the curve is large (near the vertices of the parabola and hyperbola, near the two vertices of the ellipse lying on its longer axis); ***c***) connect the received points using a pattern.

Literature: 3 (pp. 56-58), 5 (pp. 71-76), 8 (pp. 56-60).

3.3. CONSTRUCTION OF PROJECTIONS OF SPATIAL CURVES

Task: construct the frontal and horizontal projections of the cylindrical (conical) helical line within one step.

Basic data are given in table 17.

Table 17

Task	Spiral line	Step, mm	Radius, mm	Task	Spiral line	Step, mm	Radius, mm
1	CY	120	40	14	CO	125	38
2	CO	110	35	15	CY	135	42
3	CY	100	30	16	CO	122	33
4	CO	90	25	17	CY	115	36
5	CY	80	20	18	CO	105	28
6	CO	120	45	19	CY	95	30
7	CY	110	40	20	CO	85	33
8	CO	100	35	21	CY	118	42
9	CY	90	30	22	CO	128	44
10	CO	80	25	23	CY	134	45
11	CY	140	45	24	CO	138	48
12	CO	130	42	25	CY	126	44
13	CY	120	35				

Conventional designations: **CY** – cylindrical, **CO** – conical.

Methodical guidelines: a) the number of constructed curve points must be at least eight; ***b***) connect the received points using a pattern; ***c***) the radius of the base of a straight circular cone is set for the conical spiral line.

Literature: 3 (pp. 61-63), 5 (pp. 76-78), 7 (pp. 117, 118), 8 (pp. 61, 62).

4. POLYHEDRONS

4.1. QUESTIONS FOR INDEPENDENT TRAINING

1. Define the terms "polyhedral surface" and "polyhedron".
2. Give the definition of the term "convex polyhedron".
3. Give the definition of the term "prismatoid".
4. Give the definition of the term "regular polyhedron".
5. Name the correct polyhedra (Platonic solids) that you know.
6. What geometric object is formed as a result of the intersection of a polyhedron with a plane?
7. How to construct the intersection of a polyhedron with a straight line? How many intersection points will we get if the polyhedron is convex?
8. What geometric object(s) is formed by the intersection of two polyhedra? Explain the terms "complete" and "incomplete" intersection of polyhedra.
9. Tell us about the use of multifaceted surfaces in architectural and construction practice.

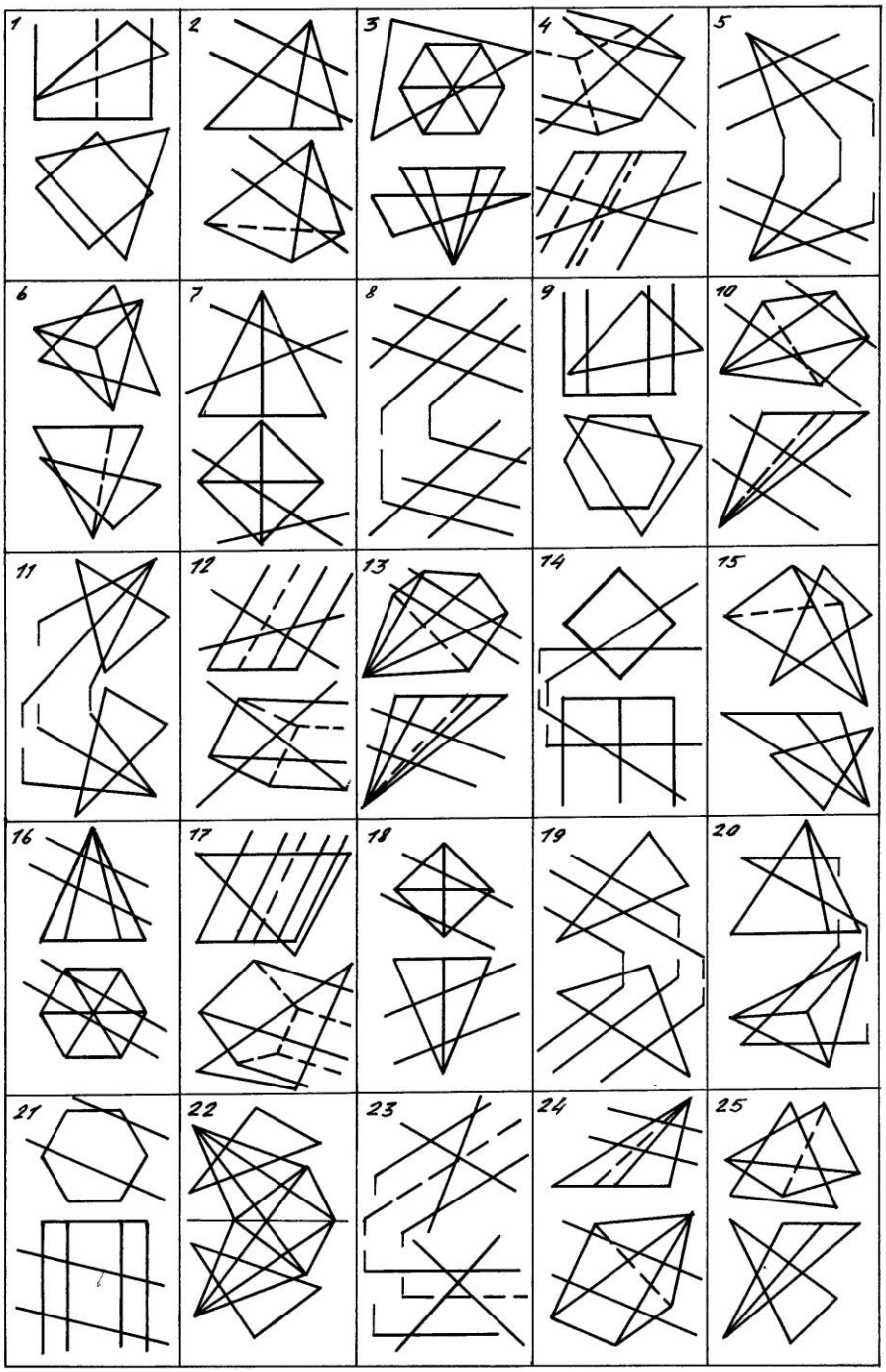
***Literature*:** 3 (pp. 36-55), 5 (pp. 61-67), 6, 7 (pp. 119-123), 8 (pp. 39-55).

4.2. INTERSECTION OF POLYHEDRON WITH A PLANE

Task: construct the intersection of the polyhedron with the plane of the general position and determine the visibility of the elements.

Basic data are given in table 18.

Table 18



Methodical guidelines: ***a***) pay attention to whether the edges of the polyhedron or its faces are projecting; ***b***) if the plane is given by two intersecting straight lines, check whether the projections of their point of intersection lie on the same connecting line; ***c***) if the plane is given by a triangle, consider it limited by it, in other cases – unlimited; ***d***) the method of solving the task is chosen by the student.

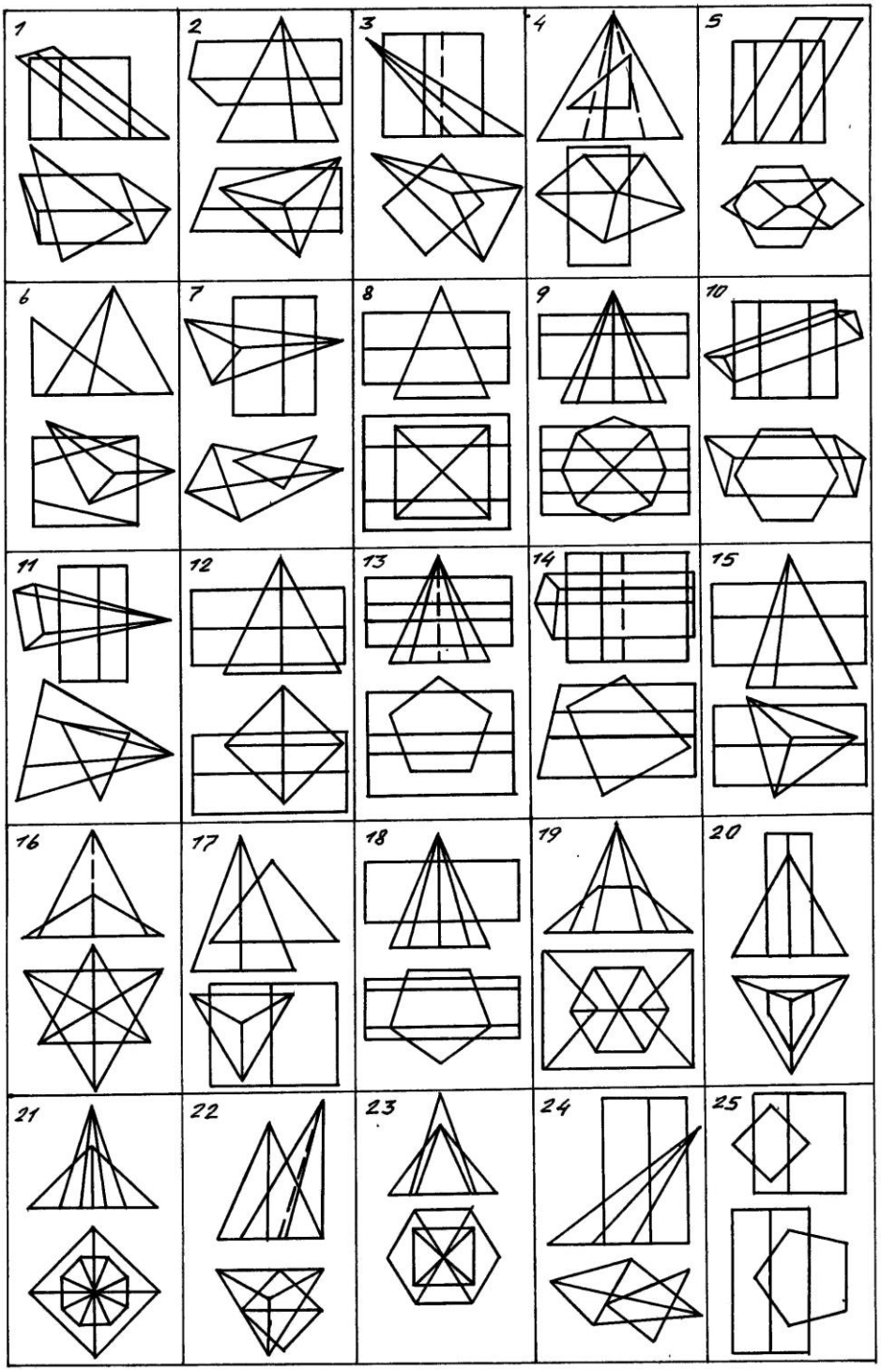
***Literature*:** 1 (pp. 77-81, 187), 3 (pp. 42-45), 4 (pp. 20-21), 5 (pp. 61-67), 6, 8 (p. 42).

4.3. INTERSECTION OF TWO POLYHEDRONS

Task: побудувати перетин двох многогранників і визначити видимість елементів.

Basic data are given in table 19.

Table 19



Methodical guidelines: ***a***) pay attention to whether the edges of the polyhedron or its faces are projecting; ***b***) think first about choosing a way to solve the task; ***c***) if necessary or desired, you can build a third projection.

Literature**:** 1 (pp. 85-87, 187), 3 (pp. 45-47), 4 (p. 21), 5 (pp. 61-67), 6, 7 (pp. 174-178), 8 (pp. 44-46).

5. SURFACES

5.1. QUESTIONS FOR INDEPENDENT TRAINING

1. Give the definition of the term "surface".
2. Give the meaning of the terms "surface determinant", "surface frame". What types of surface frames do you know?
3. Give the meaning of the terms "order" and "class" of an algebraic surface.
4. What is the "visibility contour" of a surface?
5. Explain the term "surface curvature".
6. How are surface points classified by curvature?
7. How do you understand the terms: "surface of positive, negative, zero, different-sign Gaussian curvature"? Give examples.
8. Call property of the unrolled surfaces. Give examples.
9. What linear surfaces do you know?
10. How are Catalan surfaces formed? Give examples of such surfaces.
11. What surface is used to design spiral staircases?
12. How can you set the plane tangent to the surface?
13. Describe the algorithm for determining the points of intersection of a straight line with a surface.
14. Explain the essence of the method of auxiliary intersecting surfaces (planes), which is used to determine the line of mutual intersection of surfaces.
15. Name the cases when an auxiliary oblique projection is used to determine the line of intersection of two surfaces.
16. Name the geometric situations when there are special cases of (simplified) intersection of two surfaces.

***Literature*:** 1 (pp. 97-122), 2 (pp. 21-74), 3 (pp. 64-140), 4 (pp. 26-66), 5 (pp. 95-120), 7 (pp. 124-198), 8 (pp. 62-109).

5.2. INTERSECTION OF A SURFACE BY A PLANE

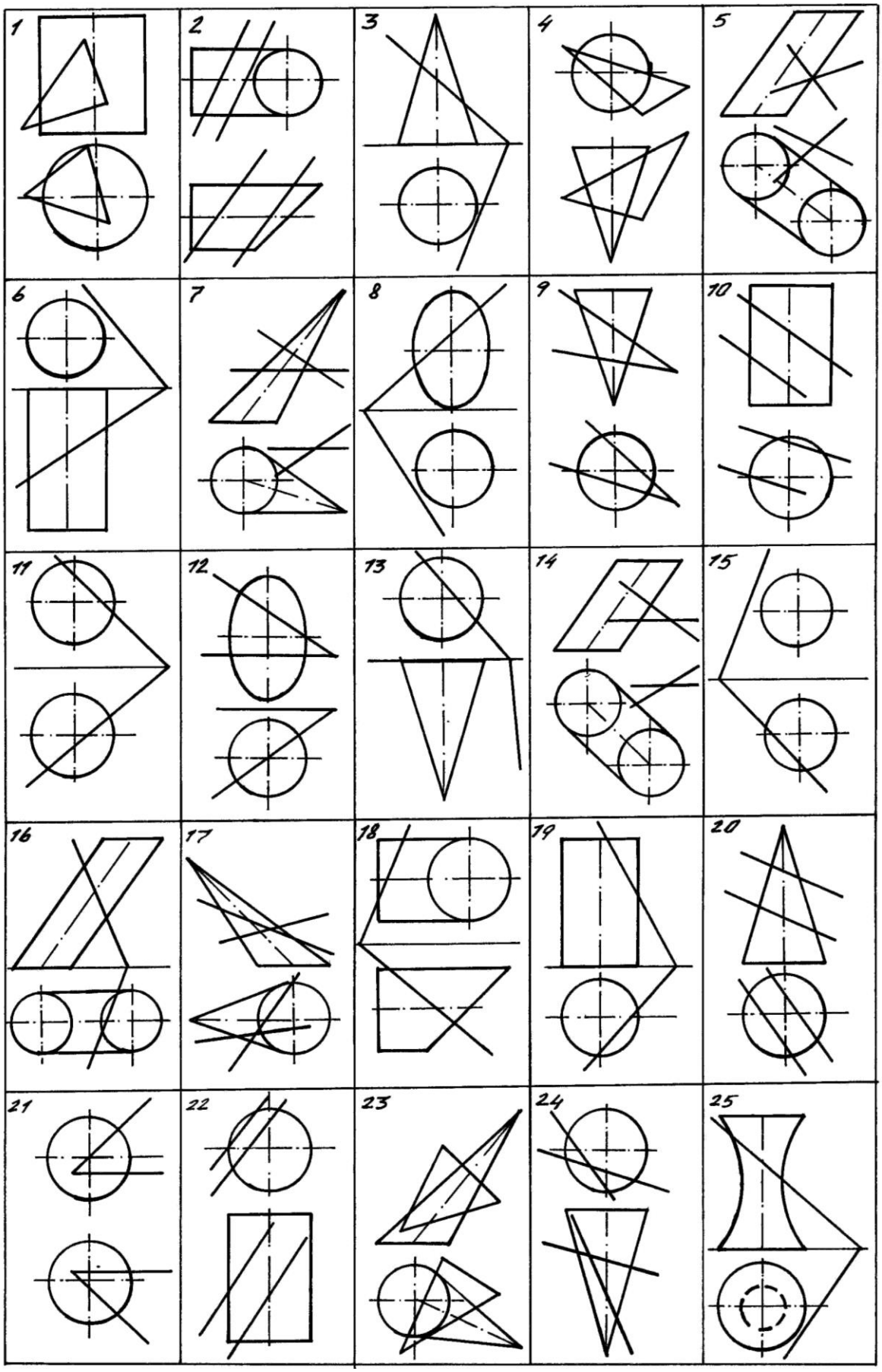
Task: construct a line intersecting the surface with a plane, determine the visibility of elements.

Methodical guidelines: ***a***) the method of solving the problem is chosen by the student (the method of auxiliary intersecting planes, oblique projection, methods of conversion of projections); ***b***) it is necessary to build the lower and upper points, points of visibility; ***c***) connect the obtained points with the help of a pattern; ***d***) it is necessary to build the entire intersection curve (that is, two of its projections, not one).

Basic data are given in table 20.

***Literature*:** 1 (pp. 97, 98, 188), 2 (pp. 21, 22), 3 (pp. 87-93), 4 (pp. 30, 31), 5 (pp. 104-109), 6, 7 (pp. 162-171), 8 (pp. 80-90).

Table 20

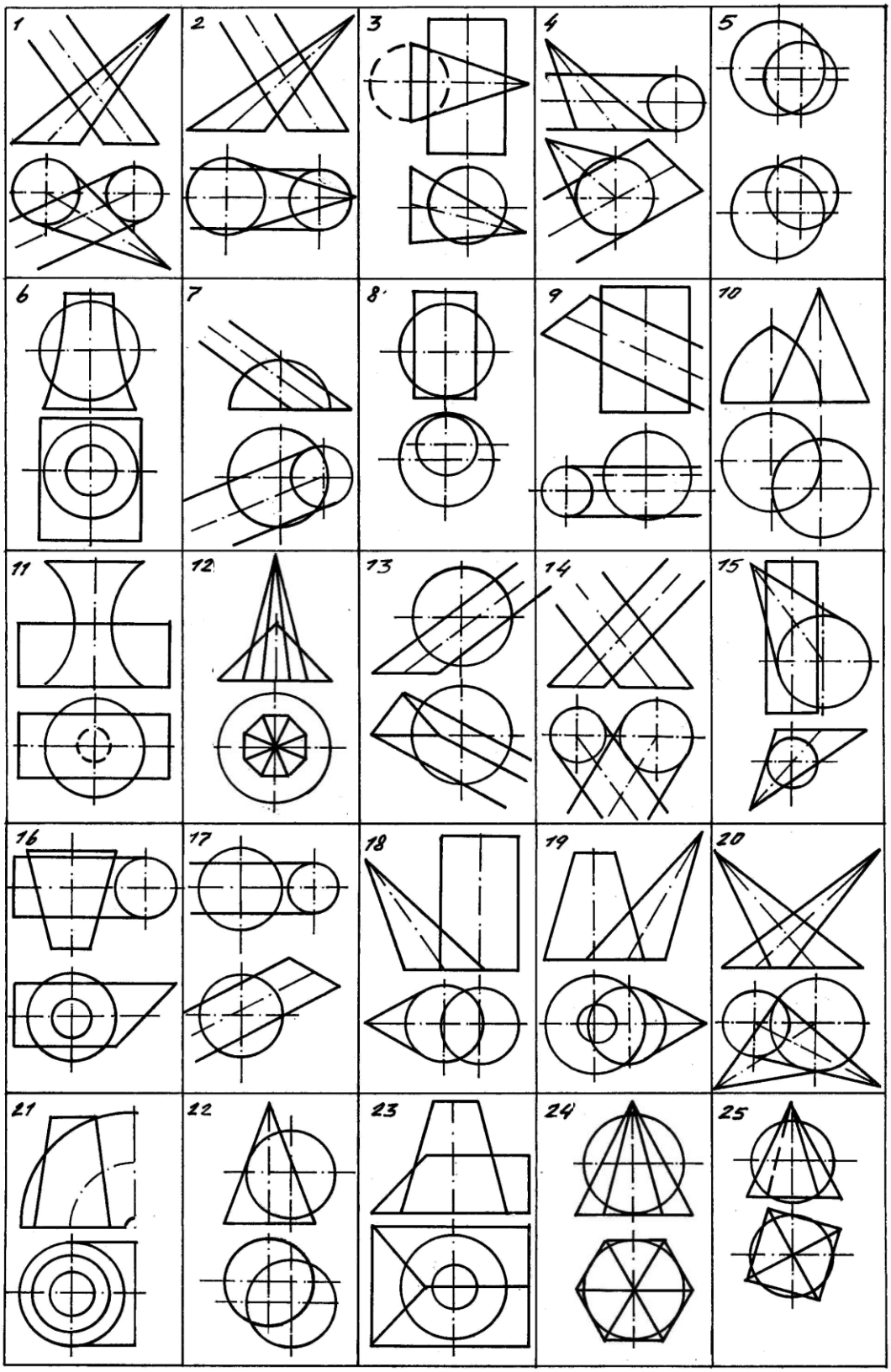


5.3. INTERSECTION OF SURFACES

Task: construct a line of intersection (two projections) of two surfaces and determine the visibility of elements.

Basic data are given in table 21.

Table 21



Methodical guidelines: ***a***) the method of solving the problem is chosen by the student as the most rational for his task (the method of auxiliary intersecting planes, oblique projection, methods of conversion projections); ***b***) it is necessary to build visibility points; ***c***) connect the obtained points with the help of a pattern; ***d***) surfaces must be depicted as large as possible within the A3 format.

Literature**:** 1 (p. 188), 2 (p. 112), 3 (pp. 96-108), 4 (pp. 33-36), 5 (pp. 110-120), 6, 7 (pp. 178-190), 8 (pp. 98-109).

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Методичні вказівки та завдання до виконання практичних робіт та самостійної роботи з навчальної дисципліни «Нарисна геометрія» для здобувачів вищої освіти першого (бакалаврського) рівня за спеціальністю 191 «Архітектура та містобудування» денної форми навчання. Побудова ліній перетину схилів даху. 03-07-61 / Пугачов Є. В., Зданевич В. А., Кундрат Т. М., Літніцький С. І. Рівне : НУВГП, 2019. 30 с.

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