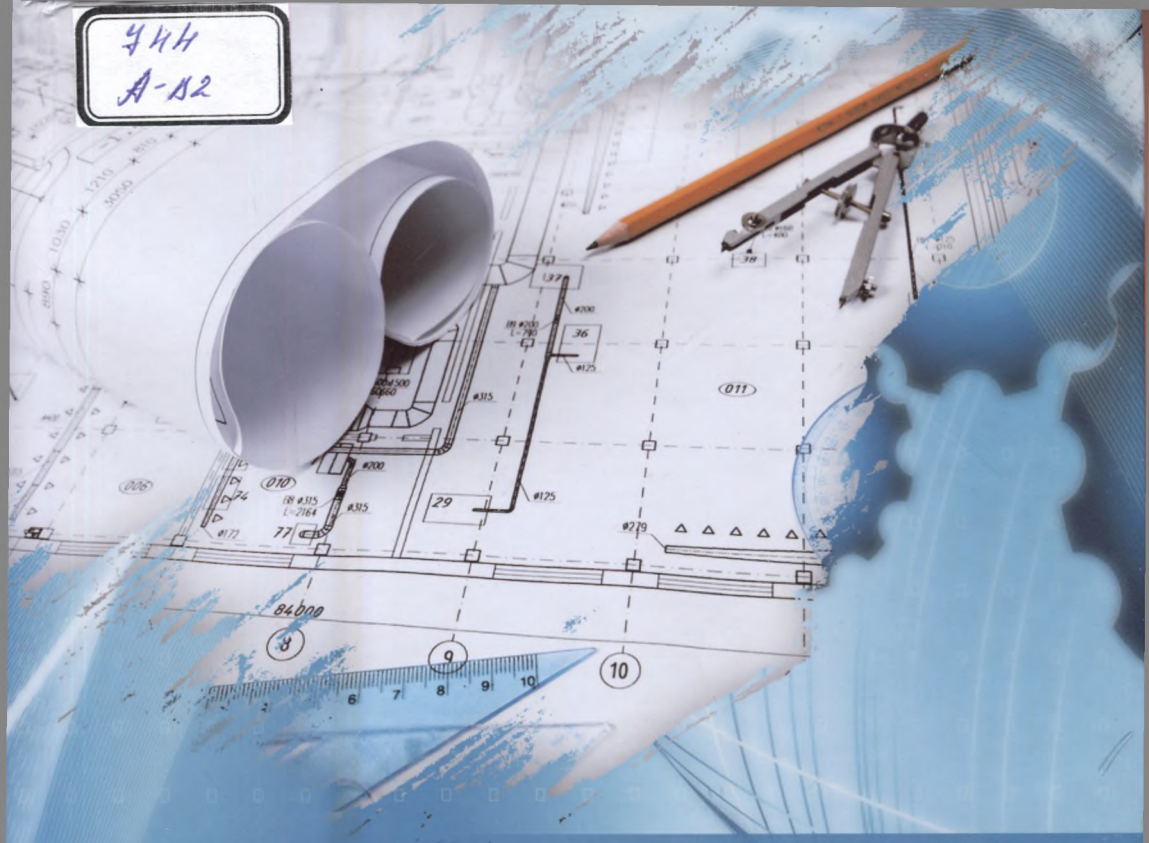

Asadov Shuxrat Qudratovich

MUHANDISLIK VA KOMPYUTER GRAFIKASI

(Fanidan topshiriqlar to'plami)

O'quv qo'llanma

O'ZBEKISTON RESPUBLIKASI OLIY VA O'RTA MAXSUS
TA'LIM VAZIRLIGI

BUXORO MUHANDISLIK-TEXNOLOGIYA INSTITUTI

Asadov Shuxrat Qudratovich

MUHANDISLIK VA KOMPYUTER GRAFIKASI

(Fanidan topshiriqlar to'plami)
O'QUV QO'LLANMA

BUXORO – 2022
«DURDONA» nashriyoti

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MUNDARIJA

ANNOTATSIYA

Mazkur o'quv qo'llanma 5150900 – Dizayn (poyabzal va aksessuarlar dizayni) ta'lim yo'nalishlariga "Muhandislik va kompyuter grafikasi" namunaviy o'quv dasturi asosida tayyorlangan. Ushbu qo'llanma bo'lajak muhandislarga muhandislik grafikasi asoslarini o'rgatishning muhim masalalariga bag'ishlangan bo'lib, икки bo'limdan iborat: chizma geometriya va proyektsion chizmachilik. Qo'llanmada mavzular oddiydan murakkabga qarab berilishi, topshiriqlarni bajarilish namunasi talabalarning fazoviy tasavvurini oshirishda xizmat qiladi. Qo'llanmaning matn qismini loyihalash uchun kursning asosiy geometrik so'zlari va diqqat qilinishi kerak bo'lgan asosiy iboralari alohida rangda ta'kidlangan. Qo'llanmada ko'rsatilgan har bir mavzuga tegishli chizmalar alohida topshiriqlar bajarish namunasi va variantlari bilan , berilgan.

АННОТАЦИЯ

Учебное пособие основан на типовой учебной программе «Инженерная и компьютерная графика» по 5150900 –Дизайн (дизайн обуви и аксессуаров). Пособие посвящено важным вопросам обучения основам инженерной графики будущих инженеров и состоит из четырех разделов: начертательная геометрия, геометрическое черчение, проекционное черчение и компьютерная графика. Темы излогаются от простых до сложных, что помогает учащимся улучшить пространственное восприятие. Для оформления текста пособия ключевые геометрические слова курса и ключевые фразы, которые необходимы выделено отдельным цветом. Рисунки по каждой теме выполнены отдельным цветом и имеют желтую рамку.

ANNOTATION

The textbook is based on the standard curriculum "Engineering and Computer Graphics" 5150900 – Design (design of shoes and accessories). The manual is devoted to important issues of teaching the basics of engineering graphics for future engineers and consists of four sections: descriptive geometry, geometric drawing, projection drawing and computer graphics. Topics range from simple to complex to help students improve spatial awareness. To design the text of the textbook, the key geometric words of the course and key phrases that are necessary are highlighted in a separate color. Figures for each topic are in a separate color and have a yellow border.

KIRISH

Ilm-fan va texnika sanoatning turli tarmoqlarini rivojlantirishning zamonaviy bosqichi, texnik bilimlarga ega bo'lgan yuqori malakali muhandis-texnik xodimlarni tayyorlashga bo'lgan talabni oshiradi. Bunday tayyorgarlikda "Muhandislik va kompiyuter grafikasi" fani muhim o'rin tutadi. Yangi texnologiyalarni ishlab chiqish, muhandis texnik mehnatni jadallashtirish bilan birga, ko'plab ahamiyatli konstruktorlik hujjatlarini bajarishni talab qiladi. Zamonaviy mutaxassis tomonidan bajarilgan chizma chuqur bilimga asoslangan holda, texnik fikrni to'g'ri namoyon eta olishi lozim.

Chizma texnik ma'lumotlarning asosiy tashuvchisidir, ularsiz hech qanday ishlab chiqarish bo'lmaydi. Shuning uchun chizmalarni o'qish qobiliyati va ularni amalga oshirish qoidalarini bilish texnik oliygohlarda mutaxassislarni tayyorlash uchun zarur shartdir.

Muhandislik grafikasini (tayyorgarlik kursini) o'rganib, siz geometrik, proektsion va texnik rasmlarning asosiy texnikalari va qoidalari bilan tanishasiz, shuningdek, chizmalarni o'qishda, ayniqsa institut va universitetda boshqa umumiy texnik fanlarni rivojlantirishda sizga foydali bo'lgan ko'plab tushuncha va atamalarni o'rganasiz.

So'nggi o'nyilliklar inson faoliyatining turli sohalariga kompyuter texnologiyalarining keng joriy etilganligi bilan tavsiflanadi. Yigirmanchi asrning oxiridan boshlab kompyuter texnikasi imkoniyatlari konstruktorlik ishlarida keng qo'llanilib kelinmoqda. Muhandislik grafikasidagi barcha yo'nalishlarini qamrab oladigan turli dasturlar yaratilib kelinmoqda.

Mavjud dasturlarning xilma-xilligi orasida AutoCAD dasturi eng keng tarqalgan bo'lib, ushbu va boshqa dasturlarni amalda va to'g'ri ishlatish qobiliyati har bir muhandis uchun zarurdir.

Ushbu kitobda geometric va proyektsion chizmachilik, chizma geometriya va kompyuter grafikasining asosiy elementlari ko'rib chiqiladi. Qo'llanma talabalar uchun ixcham va qulay shaklda yozilgan bo'lib, grafik ishlarni bajarishda zarur bo'lgan materialiarni o'z ichiga qamrab olgan.

CHIZMA HUJJATLARINI RASMIYLASHTIRISH

Texnik chizma va konstruktorlik hujjatlarini taxlash va rasmiylashtirishda ma'lum bir qoidalarga rioya qilinadi. Ushbu qoidalar O'zDST (O'zbekiston Davlat Standarti) tomonidan ishlab chiqiladi va ular xalqaro standartlashtirish tashkiloti ISO (International Standart Organization), Iqtisodiy hamkorlik kengashi СЭВ (Совет Экономической Взаимопомощи) va b normalaridan kelib chiqgan holda tadbiq qilingan.

KHYT (Konstruktorlik hujjatlatining yagona tizimi) xalqaro nomlanishi ЕСКД (Единая система конструкторской документации) O'zR DST ning bo'limi hisoblanib O'zR DST da unga – 2 raqami berilgan. KHYT (ЕСКД) to'liq klassifikasiyasi esa 10 ta guruxga bo'lingan va ular 0 dan 9 gacha klassifikasiyalanadi. Shuning uchun chizma standartш raqamlarida birinchi son 2 bilan boshlanadi. Misol: O'zR DST 2.305-96. Bunda 2 – O'zR DST da konstruktorlik hujjatlarining yagona tizimi bo'limiga tegishli ekanligini, 305 – shu bo'limdagi klassifikatsion guruxni va 96 – tasdiqlangan yilini bildiradi.

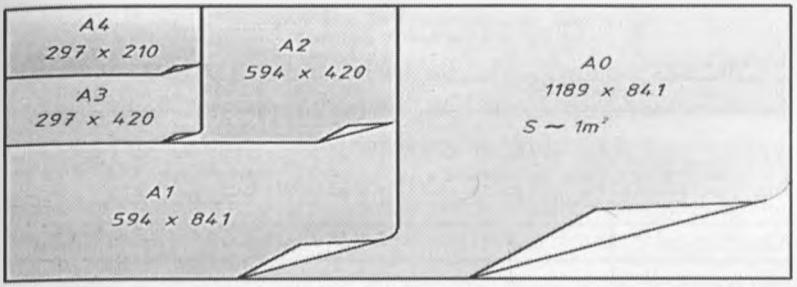
❖ **O'quv kursida bajariladigan barcha chizma topshiriqlari O'zR DST talablari asosida bajarilishi shart. Aks holda topshiriqlar xatoga yo'l qo'yilgan deb baholanadi.**

1. O'zDST 2. 301 – 2003 (Formatlar).

Barcha chizma formatlari A0 formatini teng bo'laklarga bo'linishidan hosil qilinadi va ular asosiy hisoblanadi. A0 formati 1189×841mm o'lchamga ega va u 1m² yzaga teng. Quyidagi jadvalda asosiy formatlar o'lchamlari keltirilgan.

Formatning belgilanishi	A0	A1	A2	A3	A4
Format tomonlari o'lchamlari, mm	841×1189	594×841	420×594	297×420	210×297

Izoh: A1 formati "Vatman" qog'ozi hisoblanib o'rtasidan to'rt bo'lakka bo'linsa 4 ta A3 formati hosil qilinadi (594/2=297 va 841/2=420).**O'quv kursida bajariladigan chizma topshiriqlari A3 formatida bajariladi.**

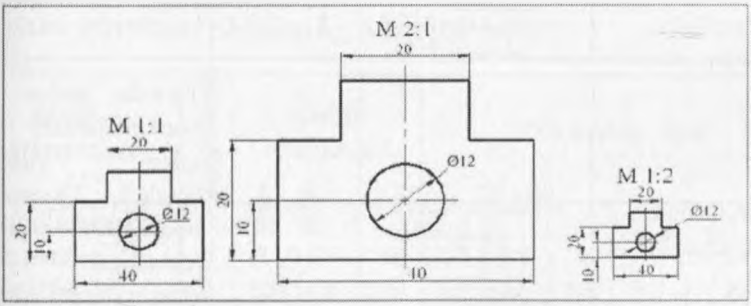


Asosiy formatlar

2. O'zDST 2.302 – 2003 (Masshtablar)

Detal va detallar birikmasi (uzel) haqiqiy o'lchamlari bo'yicha formatga chizilayotganda uning o'lchamlari katta bo'lib format qog'oziga sig'masa yoki detal va uzellar o'lchamlari kichik bo'lib chizmani ushbu o'lchamlar bo'yicha chizishni qiyinlashtirsa haqiqiy o'lchamlar marta kichraytiriladi yoki marta kattalashtiriladi. Haqiqiy – real o'lchamni necha marta kichraytirish yoki kattalashtirishni O'zR DST 2.302 – 96 belgilab beradi.

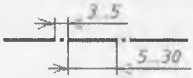
Kichraytirish masshtabi	1:2, 1:2.5, 1:4, 1:5, 1:10, 1:15, 1:20, 1:25, 1:40, 1:50, 1:75, 1:100, 1:200, 1:400, 1:500, 1:800, 1:1000
Natural kattalik	1:1
Kattalashtirish masshtabi	2:1, 2.5:1, 4:1, 5:1, 10:1, 20:1, 40:1, 50:1, 100:1

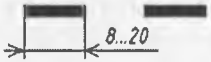
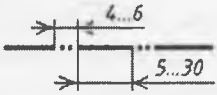


Izoh: Kichraytirish masshtabi 1:2.5 va kattalashtirish masshtabi 2.5:1 imkon qadar qo'llanmaydi.

3. O'zDST 2.303 – 2003 (Chiziqlar)

Chizma topshiriqlarni bajarishda chiziq turlari va chiziq qalinliklari qat'iyan O'zR DST talablariga mos kelishi shart. Quyidagi jadvalda chizma chiziqlarining turlari, ko'rinishi va nisbiy o'lchamlari O'zR DST 2.303 ga asosan berilgan.

Nomlanishi	Tuzilishi	Yo'g'onligi	Qo'llanilishi
Yo'g'on tutash chiziq - Asosiy		S (S = 0.5 ... 1.5 mm)	Ko'rinadigan kontur-lar, kesim konturlarini tasvirlovchi chiziq
Ingichka tutash chiziq		$\frac{S}{2} - \frac{S}{3}$	O'lcham va chiqarish chiziqlari, shtrixlash chiziqlari, joyida qirqim konturlari va h.
Tutash to'lqinsimon		$\frac{S}{2} - \frac{S}{3}$	Uzilish joylarini belgilovchi, ko'rinish va qirqimlarni chekjlovchi chiziq
Shtrix chiziq		$\frac{S}{2} - \frac{S}{3}$	Ko'rinmas konturlarni tasvirlovchi chizig'i
Ingichka shtrixpunktir		$\frac{S}{2} - \frac{S}{3}$	Markaz va o'qlarni belgilovchi chiziq
Qalinlashgan shtrixpunktir		$\frac{S}{2} - \frac{S}{3}$	Termik ishlov va qoplamalanishi lozim yuzalar chizig'i. Qirquvchi tekislikdan oldinda joylashgan elementlarni tasvirlovchi chiziq (Ustida proeksiyalash)

Uzuq chiziq		$S-1\frac{1}{2}S$	Qirqim chizig'i
Tutash ingichka siniq chiziq		$\frac{S}{2}-\frac{S}{3}$	Uzun uzilish joylarini belgilovchi chiziq
Ingichka ikki nuqtali shtrixpunktir		$\frac{S}{2}-\frac{S}{3}$	Yoyilmalarda bukish chizig'ini belgilash, buyumlarning eng chekka va oraliq vaziyatlarini belgilash chizig'i

4. O'zDST 2.304 – 2003 (Shriftlar)

Konstruktorlik hujjatlarida barcha yozuvlar qat'iy standart talablarida yozilishi kerak. Shriftlarning o'lcham va tuzilishini O'zR DST 2.304 – 96 belgilab beradi. Ushbu standartga shriftlarning ikki turi A va B turlari kiritilgan. Ular asosan shrift chiziqlari qalinligining harf balanligiga nisbati bilan farqlanadi.

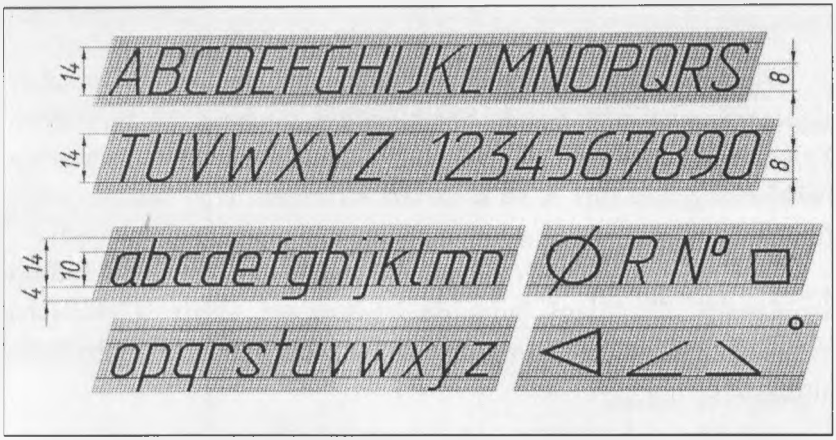
Shriftlarning asosiy o'lchami bu bosh harflarning balandligi hisoblanadi. Quyidagi jadvalda A turdagi shrift o'lchamlari berilgan. Chizma topshiriqlarida shriftning B turini ham qo'llash mumkin.

Shriftning A turi (d=h/14)

Shrift parametrlari	Belgilanishi	Nisbiy o'lchamlari		O'lchamlar, mm						
Shrift o'lchami:										
Bosh harflar	h	(14/14)h	14d	2,5	**3,5**	**5**	7	10	**14**	20
balandligi	c	(10/14)h	10d	1,8	**2,5**	**3,5**	5	7	**10**	14
Kichik harflar	a	(2/14)h	2d	0,35	**0,5**	**0,7**	1	1,4	**2**	2,8
balandligi	b	(22/14)h	22d	4	**5,5**	**8**	11	16	**22**	31

Harflar orasidagi masofa	e	(6/14)h	6d	1,1	**1,5**	**2,1**	3	4,2	**6**	8,4
Qatorlar minimal qadami	d	(1/14)h	d	0,18	**0,25**	**0,35**	0,5	0,7	**1**	1,4
So'zlar orasidagi minimal masofa										
Shrift chiziqlari qalinligi										

Shrift standartlarida harf va sonlarning eni turlicha bo'lganligi uchun ular guruhlanib nisbiy o'lchamlarda beriladi. A turdagi shriftlar uchun harf va sonlarning eni quyidagi jadvalda berilgan:



Harf va sonlarning eni (kenglik o'lchamlari). Shriftning A turi uchun

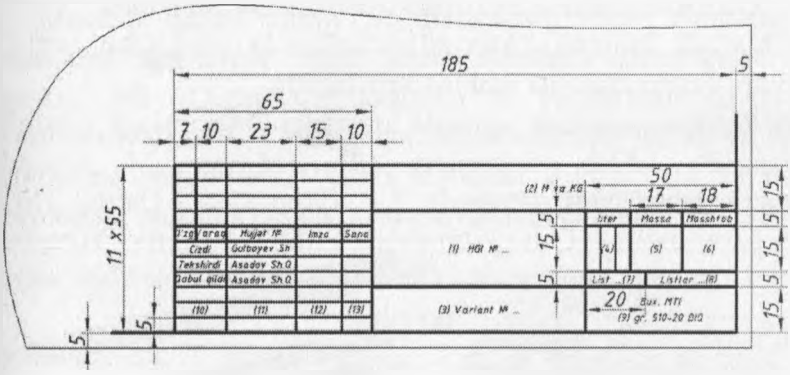
Harf va sonlar		Nisbiy o'lcham, h	h= ... mm				
			3,5	**5**	7	10	**14**
Bosh harflar	I	1/14	**≈0,3**	**≈0,4**	0,5	0,7	**1**
	C, E, F,	6/14	**1,5**	**≈2**	3	≈4,3	**6**
	B, D, G, H, K, N, O, P, Q, R, S, T, U, Z	7/14	**≈1,8**	**2,5**	3,5	5	**7**
	A, V, X, Y	8/14	**2**	**≈2,8**	4	≈5,7	**8**
	M	9/14	**≈2,2**	**≈3,2**	4,5	≈6,4	**9**
	W	12/14	**3**	**≈4,3**	6	≈8,6	**12**

Kichik harflar	i	1/14	≈0.3	≈0,4	0,5	0,7	1
	f, j, l, t	3/14	≈0,7	≈1	1,5	≈2.1	3
	c, r	5/14	≈1,2	≈1,8	2,5	≈3,6	5
	a, b, d, e, g, h, k, n, o, p, q, s, u, v, x, y, z,	6/14	1,5	≈2	3	≈4,3	6
	m	9/14	≈2,2	≈3,2	4,5	≈6,4	9
	w	10/14	2,5	3,6	5	≈7,1	10
Sonlar	1	4/14	1	≈1,4	2	≈2,8	4
	3, 5	6/14	1,5	≈2	3	≈4,3	6
	2, 4, 6, 7, 8, 9, 0	7/14	≈1,8	2,5	3,5	5	7

Izoh: Chizma topshiriqlarini bajarishda h=3,5 o'lchamli shriftda Asosiy yozuv; h=5 o'lchamli shriftda chizmadagi o'lcham va yozuvlar; h=14 o'lchamli shriftda Titul varag'i bajariladi.

5. O'zDST 2.104 – 2006 (Asosiy yozuv)

Oquv kursida bajariladigan barcha topshiriqlarda Asosiy yozuv bajarilishi shart. Uning asosiy vazifasi chizma haqida to'liq ma'lumotni o'z ichiga oladi. Asosiy yozuv O'zR DST 2.104 – 2006 talablari asosida bajarilishi kerak. Uning o'lchamlari va grafalar to'ldirish tartibini bilish lozim.



Asosiy yozuv grafa (katak) lari quyidagicha to'ldiriladi:

1-grafa. Detal yoki yig'ma birlik nomi (epyur);

2-grafa. Institutda qabul qilingan tizim bo'yicha xujjatning belgilanishi;

3-grafa. Detal materialining belgisi;

4-grafa. Chizma literi. O'quv chizmalarida «U» xarfi yoziladi;

5-grafa. Maxsulot massasi;

6-grafa. Masshtab;

7-grafa. Varaqning tartib raqami;

8-grafa. Xujjatdagi (albomdagi) varaqalar soni;

9-grafa. O'quv yurti nomi va gurux tartib raqami;

10-grafa. Xujjatni tasdiqlovchi shaxs bajaradigan ish xarakteri. Masalan: chizdi, qabul qildi, tekshirdi.

11-grafa. Xujjatda imzo chekuvchi shaxsning ismi-sharifi aniq yoziladi;

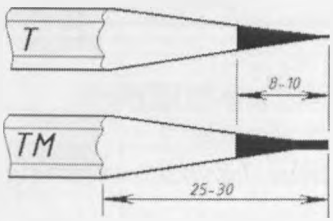
12-grafa. 11-grafada kursatilgan shaxslar imzosi;

13-grafa. Xujjatning tasdiqlanish sanasi.

CHIZMA TOPSHIRIQLARINI BAJARISH BO'YICHA AMALIY MASLASXATLAR

QALAM: Chizma chizishda qalam asosiy ish quroli hisoblanadi. Shuning uchun qalam tanlashda uning sifati, qattiq va yumshoqlik darajasi muhim o'rin tutadi.

Rossiya standarti asosida qalamlar 14 turdagi qattiqlik darajasida ishlab chiqariladi. T, TM va M toyifada klassifikatsiyalanadi. 1-rasmda T – «Твердый» - Qattiq, TM – «Твердомягкий» - Qattiq-yumshoq va M – «Мягкий» - Yumshoq degan ma'noni anglatadi. Ularning darajasi harfdan keyin qo'yiladi.



Misol uchun: T, T2, T3, T4 va M, M2, M3, M4.

Chizma topshiqiqlarini bajarishda T va TM qalamlaridan foydalanish tavsiya etiladi. T qalamda ingichka chiziqlar, TM da

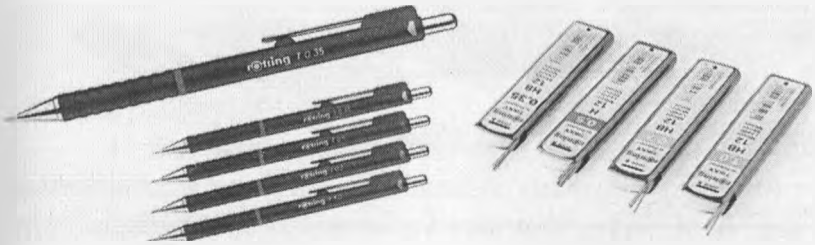
esa asosiy yo'g'on chiziqlar bajariladi. M – Yumshoq qalamlar chizma qog'ozini kir qilishi sabali tavsiya etilmaydi.

Bundan tashqari turli xorijiy mamlakatlarda ishlab chiqarilgan qalamlarni ham farqlay bilish lozim. Ular H (Qattiq), HB (Qattiq-yumshoq) va B (Yumshoq) toyifada klassifikatsiyalanadi va chizma chizishda ularning H va HB turlarini qo'llash mumkin (2-rasm):

1-rasm **2-rasm**

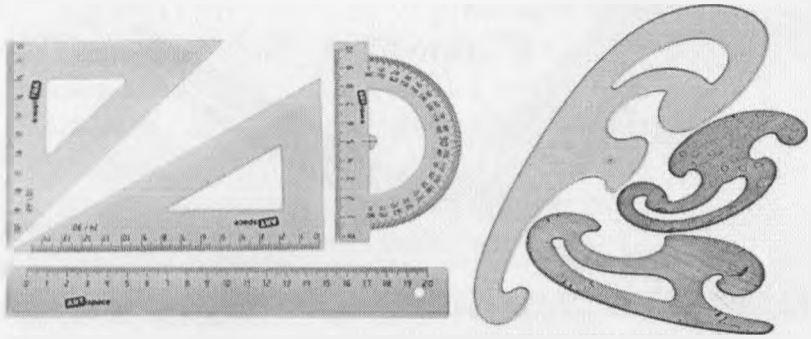
Qalam uchini to'g'ri yo'nish chizma chiziqlarining sifatiga ta'sir etadi. Ingichka chiziqlar uchun mo'ljallangan qalam uchini jilvir qog'ozda silliqlash tavsiya etiladi.

Mexanik qalam xorijiy mamlakatlarda ishlab chiqarilgan qalamlarni ham farqlay bilish lozim. 3-rasmda qalam grafiti H (Qattiq), HB (Qattiq-yumshoq) va B (Yumshoq) toyifada klassifikatsiyalanadi. Chizma chizishda ularning B, H va HB turlarini qo'llash mumkin. Grafit tayoqcha 0.35, 0.5, 0.7, 1.0 mm "стержень" mexanik qalam uchun urnatiladi (3-rasm):



3-rasm

CHIZG'ICHLAR: Chizma topshiriqlarni bajarish uchun togr'i chizg'ich (30 mm), uchburchak chizg'ich (20 mm li va burchaklari 30°, 60° va 90°) shuningdek turli lekalo chizg'ichlari, «транспортир» burchak chiqaruvchi transportyor chizg'ich bo'lishi kifoya 4-rasmda tasvirlari berilgan. Tog'ri va uchburchak chizg'ichlar yordamida parallel va perpendikular chiziqlar chizilishi mumkin.



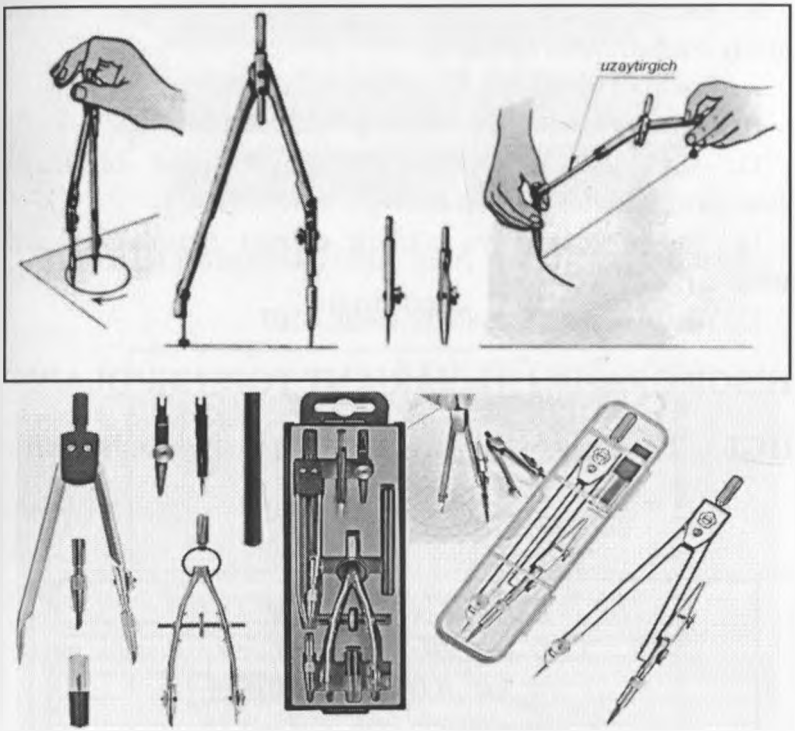
4-rasm. Chizg'ichlar, transportyor Lekalo chizg'ich

O'CHIRG'ICH: Chizmadagi yordamchi chiziqlarni, xato va noto'g'ri chiziqlarni o'chirish uchun o'chirgichning yumshoq turidan foydalanish tavsiya etiladi (5-rasm). Qattiq o'chirg'ichlar tush bilan ishlashda qo'llanadi.

5-rasm

SIRKUL: Chizmada aylana yoylarini bajarishda sirkuldan foydalaniladi. Sirkul sifat jixatdan temirdan bo'lishi, igna qismi boshqariladigan va qalam sterjeni mustaxkam o'rnatiladigan bo'lishi lozim (6-rasm): Plassmasa korpusli va o'rta maktab

geometriya, matematika kursiga mo'ljallangan sirkullar chizma uchun yaroqsiz.



6-rasm

Mustahkamlash ucun savol.

1. Qanday format turlari bor?
2. Qaysi asosiy formatlarni bilasiz?
3. Chizmalar yasashda ishlatiladigan chiziqlarning asosiy turlari qanday?
4. Siz nomlagan har bir satr nima uchun ishlatilishini tushuntiring?
5. Shrift o'lchami qanday?
6. Chizilgan shriftda harflar va raqamlarning qiyaligi qanday burchakka teng?

7. Format chegarasidan qancha masofada hoshiya chiziqlari chiziladi?

8. Asosiy yozuv chizmada qanday joylashgan? Uning umumiy o'lchamlarini nomlang.

9. Masshtab nima?

10.Yozuvlar nimani anglatadi: 1: 5; 1: 1; 10: 1?

11. Chizmalarda chiziqli o'lchamlar qaysi birliklarda ko'rsatilgan? Burchak o'lchamlari?

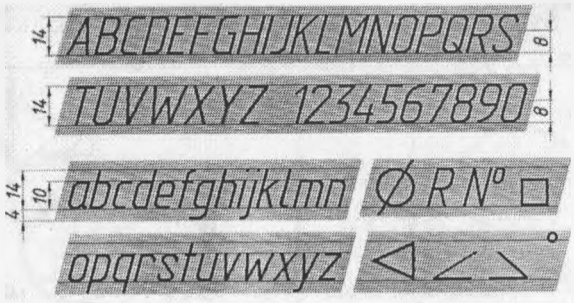
12. Tasvir konturi va o'lchov chizig'i orasidagi masofa qancha?

13. Yozuv nimani anglatadi: 4tesh. ⌀10?

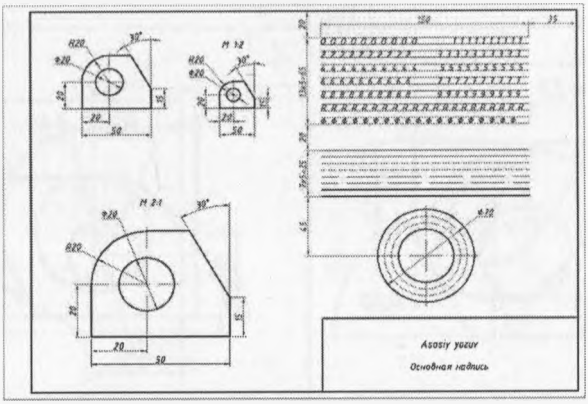
HISOB GRAFIK ISH, VARIANT TOPSHIRIQLARI

HGI-1. Titul varag'ini format A3 da rasmiylashtirish namunasi.

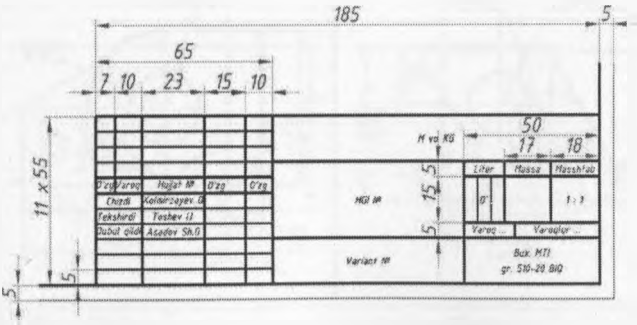
Topshiriqni bajarish uchun qo'shimcha materiallar.



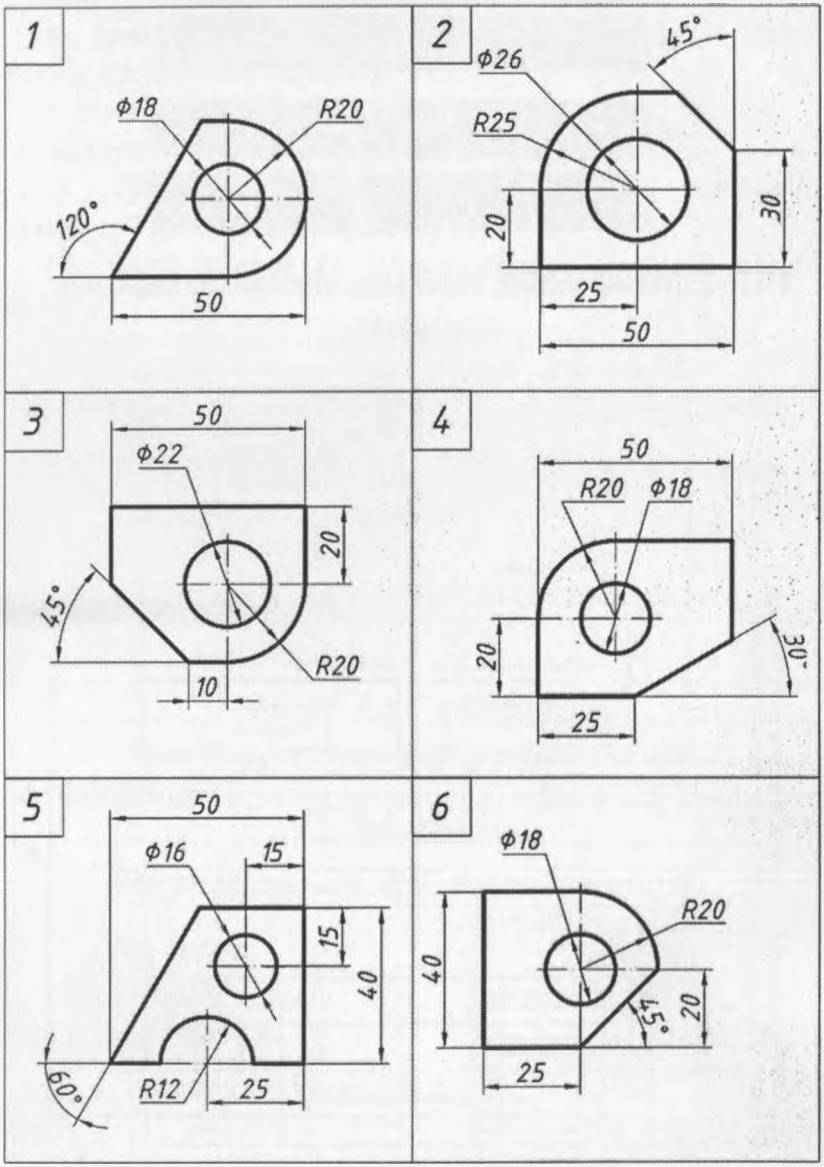
HGI-2. Masshtablar, chiziqlar, shriftlarni bajarish namunasi.

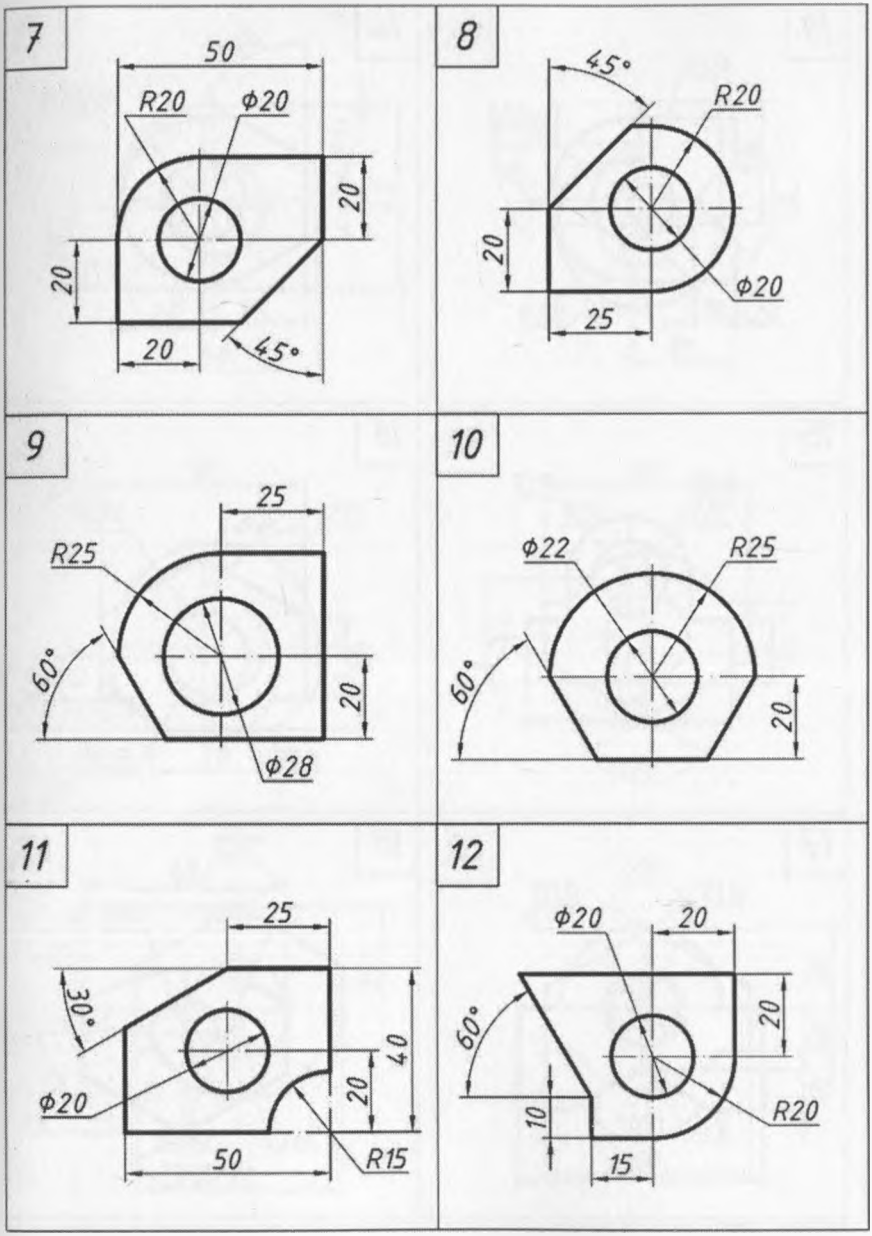


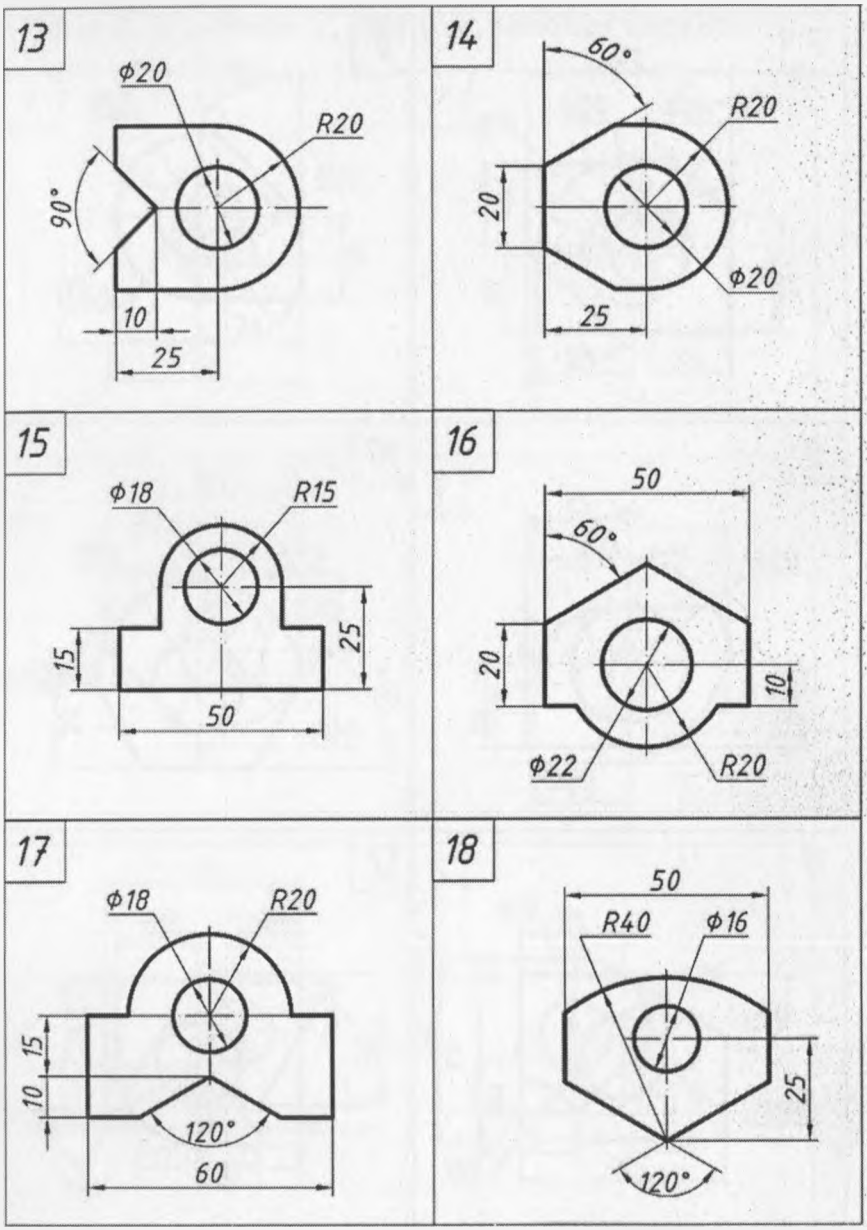
Barcha hisob grafik ishlar uchun asosiy yozuvni rasmiylashtirish namunasi.

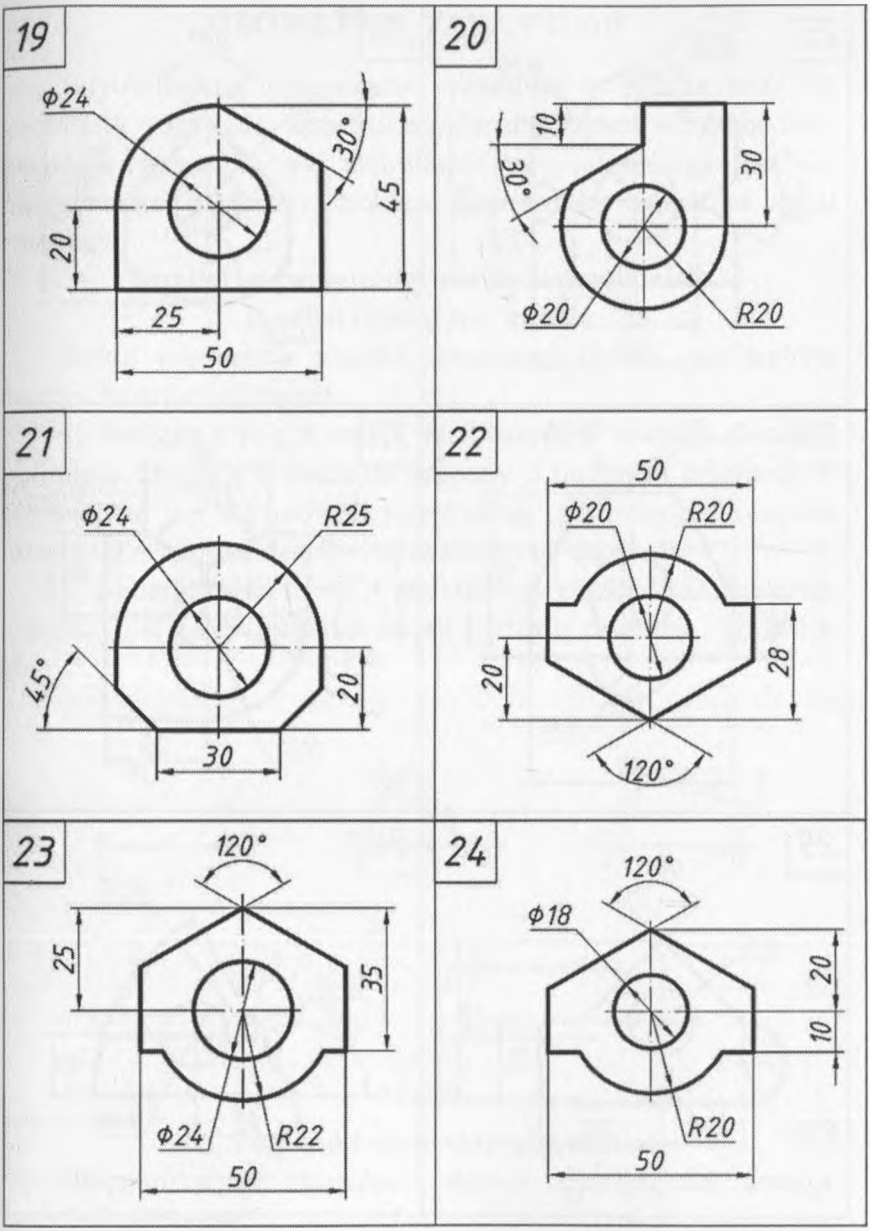


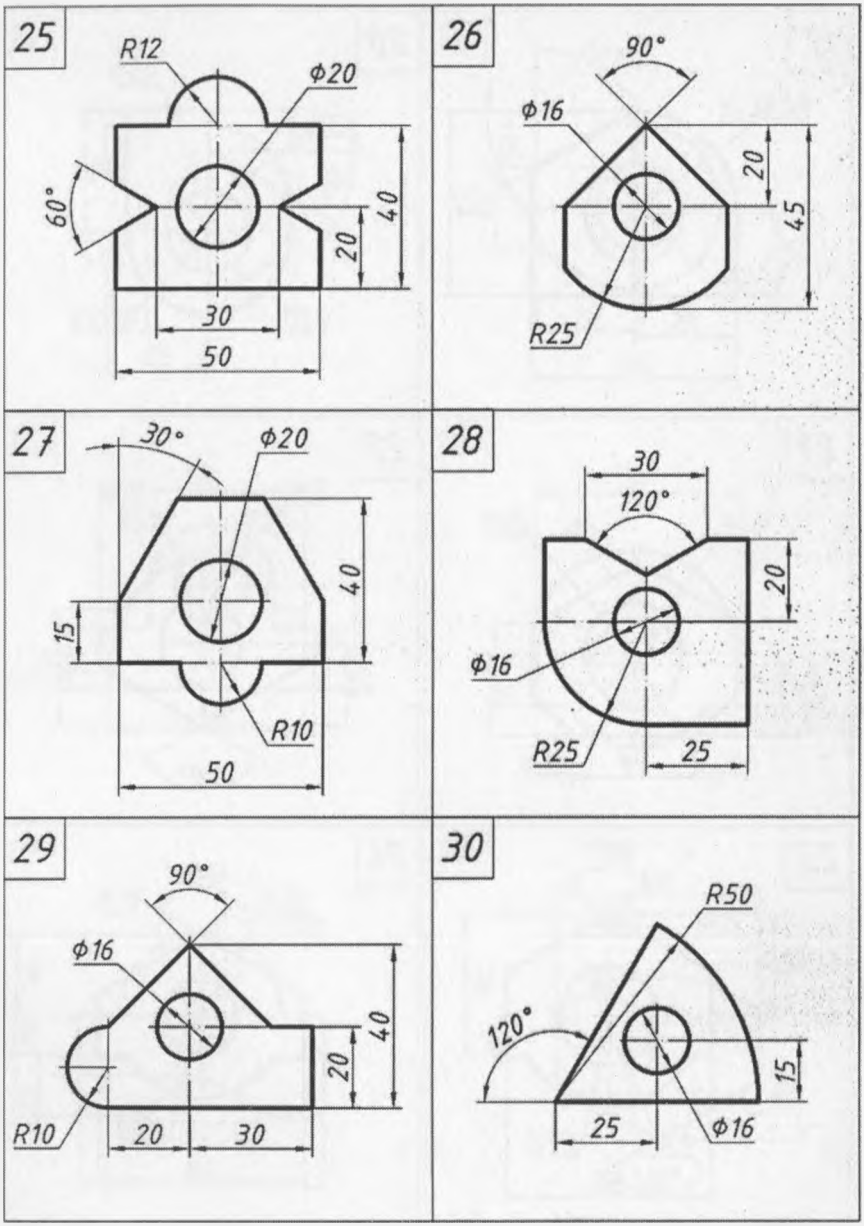
HGI-2. Masshtablar, chiziqlar, shriftlar variantlari.




7
50
R20
ϕ20
20
20
20
45°
8
45°
R20
20
ϕ20
25
9
25
R25
60°
20
ϕ28
10
ϕ22
R25
60°
20
11
25
30°
40
ϕ20
20
50
R15
12
ϕ20
20
60°
20
10
R20
15


13
ϕ20
R20
90°
10
25
14
60°
R20
20
ϕ20
25
15
ϕ18
R15
15
25
50
16
50
60°
20
10
ϕ22
R20
17
ϕ18
R20
15
10
120°
60
18
50
R40
ϕ16
25
120°


19
ϕ24
30°
45
20
25
50
20
10
10
30°
30
ϕ20
R20
21
ϕ24
R25
45°
20
30
22
50
ϕ20
R20
20
28
120°
23
120°
25
35
ϕ24
R22
50
24
120°
ϕ18
20
10
R20
50


25
R12
ϕ20
60°
40
20
30
50
26
90°
ϕ16
20
45
R25
27
30°
ϕ20
40
15
R10
50
28
30
120°
20
ϕ16
R25
25
29
90°
ϕ16
40
20
R10
20
30
30
R50
120°
15
25
ϕ16

GEOMETRIK YASASHLAR

Buyumlarning chizmalarini yasashda ko'pincha turli xil geometrik yasashlar, konstruktsiyalarni bajarish kerak bo'ladi, masalan, kesmalar va doiralarni teng qismlarga bo'lish, tutashmalarni bajarish va hokazo. Buni qanday bajarishni ko'rib chiqamiz.

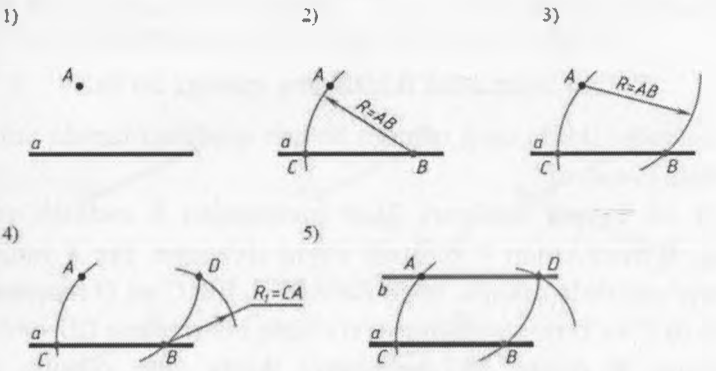
Parallel va perpendikulyar chiziqlar chizish

Parallel chiziqlarni qurish

Sirkul yordamida parallel chiziqlarni qurish quyidagicha amalga oshiriladi (7-rasm):

1) Berilgan *a* to`g`ri chiziq va *A* nuqta. A nuqta a chiziqda yotmaydi. 2) *a* to`g`ri chiziqda ixtiyoriy *B* nuqtasini belgilang. *B* markazidan *R* = *AB* radiusli yoyni oling. *A* chiziqda *C* nuqtani olamiz. 3) *A* markazidan *R* = *AB* radiusli yoy chiziladi.

4) B markazidan $R_1 = CA$ radiusli yoy chiziladi. *D* nuqtasini olamiz. 5) *A* va *D* nuqtalar orqali b chiziq chizamiz. Biz $b \parallel a$ olamiz.

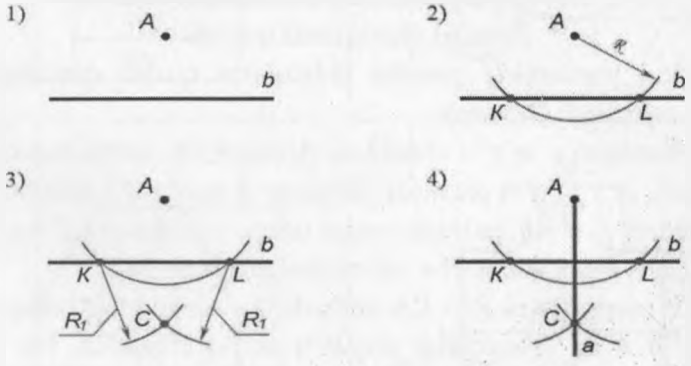


7-rasm

Perpendikulyar chiziqlar chizish

Perpendikulyar chiziqlarni qurish quyidagicha amalga oshiriladi (8-rasm):

1) berilgan b chiziq va A nuqta. A nuqta b chiziqda yotmaydi. 2) A markazidan biz R radiusli yoyni chizamiz Biz. R radiusni ixtiyoriy olamiz, lekin yoy b chiziqni ikki nuqtada kesib o'tishi kerak, masalan, K va L nuqtalarda 3) K va L markazlardan biz R_1 radiusli yoylarni chizamiz. Biz ixtiyoriy R_1 radiusini olamiz, lekin $R_1 > KL / 2$. Biz C nuqtasini olamiz 4) A va C nuqtalar orqali biz a to'g'ri chiziq chizamiz $a \perp b$ ni olamiz.



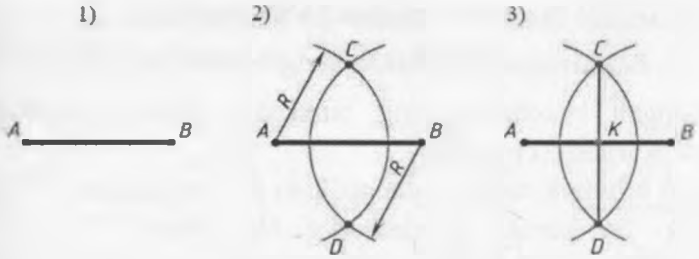
8-rasm

Chiziq kesmalarini teng qismlarga bo'lish

Chiziq kesmasini ikkita teng qismga bo'lish

Kesmani ikkita teng qismga bo'lish quyidagi tarzda amalga oshiriladi (9-rasm):

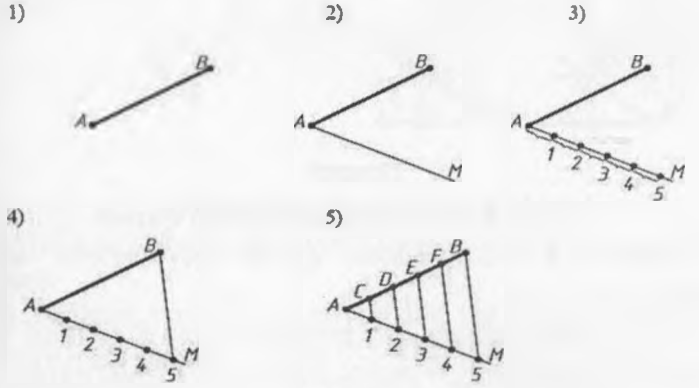
1) AB kesma berilgan. 2) A markazdan R radiusli yoyni torting. B markazdan R radiusli yoyni chizamiz. Biz R radiusni ixtiyoriy ravishda olamiz, lekin $R > AB / 2$. Biz C va D nuqtalarini olamiz 3) C va D nuqtalarini to'g'ri chiziq bilan ulang $CD \frown AB = K$ ni olamiz. K nuqta AB segmentini ikkita teng qismga yoki yarmiga bo'linadi, $AK = KB$.



9-rasm

To'g'ri chiziq kesmasini n teng qismga bo'lish

To'g'ri chiziq kesmasini beshta teng qismga bo'lish quyidagi tarzda amalga oshiriladi (10-rasm): 1) *AB* kesma berilgan. 2) *A* nuqtadan biz *AM* nurini o'tkazamiz. Nurni ixtiyoriy chizish. 3) *A* nuqtadan *AM* nurida beshta teng kesma yotar. Biz kesmaning uzunligini ixtiyoriy olamiz. Biz *1, 2, 3, 4, 5* nuqtalarni belgilaymiz. 4) *5*-nuqta *B* nuqtaga to'g'ri chiziq bilan bog'langan. 5) *1, 2, 3, 4* nuqtalar orqali biz *B5* to'g'ri chiziqqa *AB* kesma bilan kesishgan joyga parallel ravishda to'g'ri chiziqlar o'tkazamiz. *AB* segmentini beshta teng qismga ajratadigan *F, E, D, C* nuqtalarini olamiz, *AC = CD = DE = EF = FB*.



10-rasm

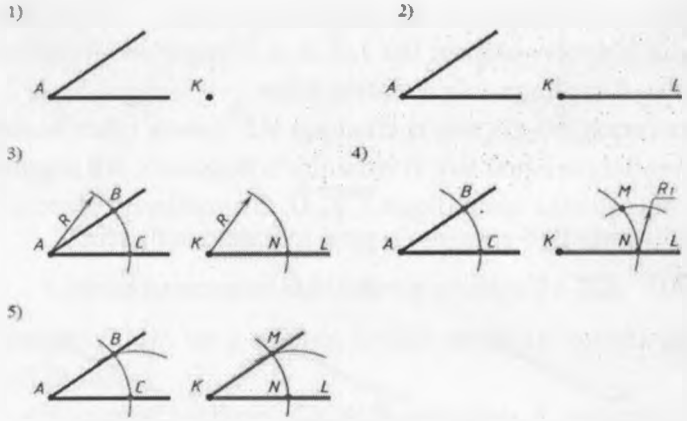
Shu tarzda, kesmani istalgan teng qismlarga bo'lish mumkin.

Burchaklarni chizish va ajratish

Belgilangan burchakka teng burchak yasash

Berilgan burchakka teng burchakni qurish quyidagicha amalga oshiriladi (11-rasm):

1) A burchak va *K* nuqta berilgan 2) *K* nuqtadan *KL* nurini chizamiz. Bu kerakli burchakning bir tomoni. 3) *A* va *K* markazlardan biz *R* radiusli yoylarni chizamiz. Biz ixtiyoriy *R* radiusni olamiz. *A* burchakning yon tomonlarida biz *B* va *C* nuqtalarni, *KL* nurida esa *N* nuqtani olamiz. 4) *N* markazdan biz $R_1 = BC$ radiusli yoyni chizamiz, va *M* nuqtani olamiz. 5) *K* va *M* nuqtalar orqali biz kerakli burchakning ikkinchi tomoni bo'lgan to'g'ri chiziqni chizamiz. ... $\angle MKN = \angle BAC$ ni olamiz.



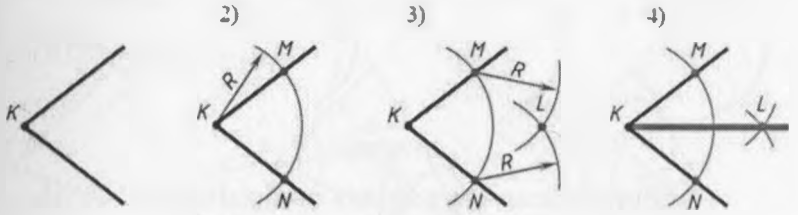
11-rasm

Burchakning bissektrisasini qurish

Burchakning bissektrisasini qurish quyidagicha amalga oshiriladi (rasm- 12):

1) K burchak berilgan.2) *K* markazdan biz *R* radiusli yoyni chizamiz Biz ixtiyoriy *R* radiusni olamiz. Yoy burchakning yon tomonlarini *M* va *N* nuqtalarda kesadi 3) *M* va *N* markazlardan *R* radiusli yoylarni chizamiz. Yoylar *L* nuqtada kesishadi 4) *K*

nuqtadan - burchak tepasi, *KL* nurini chizamiz. Kesma *KL* - *K* burchakning bissektrisasi va $\angle LKM = \angle LKN$.



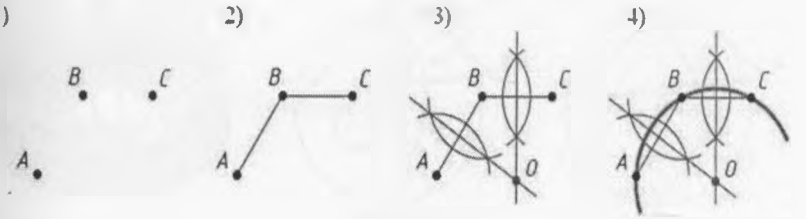
12-rasm

Aylanalar yasash

Uch nuqta orqali aylana yoyini chizish

Uch nuqta orqali aylana yoyni qurish quyidagicha amalga oshiriladi (13-rasm):

1) Berilgan *A, B, C* nuqtalar 2) A nuqtani *B* nuqta bilan *B* nuqtani *C* nuqtani to'g'ri chiziqlar bilan tutashtiramiz. *AB* va *BC* kesmalari yasaladi. 3) *AB* va *BC* kesmalarining o'rta nuqtalariga perpendikulyar chizish. Perpendikularlar *O* nuqtada kesishadi. 4) *O* nuqta *A, B, C* nuqtalardan o'tuvchi aylana yoyning markazidir.

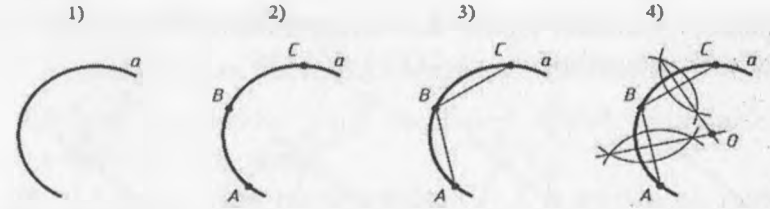


13-rasm

Aylana yoyning markazini chizish

Aylana yoyi markazini qurish quyidagicha amalga oshiriladi (14-rasm):

1) Berilgan yoy *a*. 2) *a* yoyda biz ixtiyoriy uchta *A, B, C* nuqtalarni belgilaymiz 3) *AB* va *BC* xordalarini chizamiz. 4) *AB* va *BC* kesmalarining o'rta nuqtalariga perpendikulyar chizish. Perpendikulyarlar *O* nuqtada to'qnashadi. *O* nuqta *a* yoyning markazi.

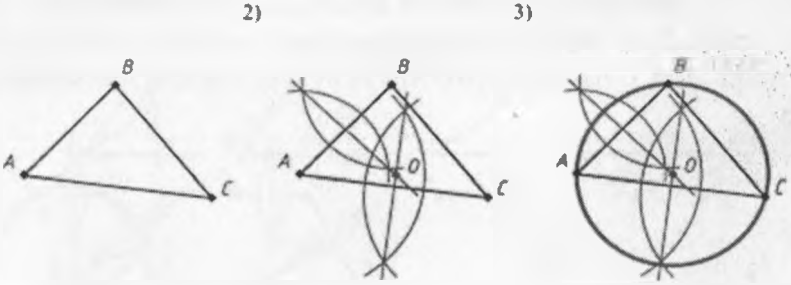


14-rasm

Uchburchak atrofida aylana markazini hosil qilish

Uchburchak atrofida aylananing markazini qurish quyidagi tarzda amalga oshiriladi (15-rasm):

1) Berilgan *ABC* uchburchagi. 2) uchburchak tomonlarining o'rta nuqtalariga, masalan *AB* va *BC* tomonlariga perpendikulyarlarni torting. Perpendikularlar *O* nuqtada kesishadi 3) *O* nuqta *ABC* uchburchagi atrofida yasalgan aylananing markazidir.



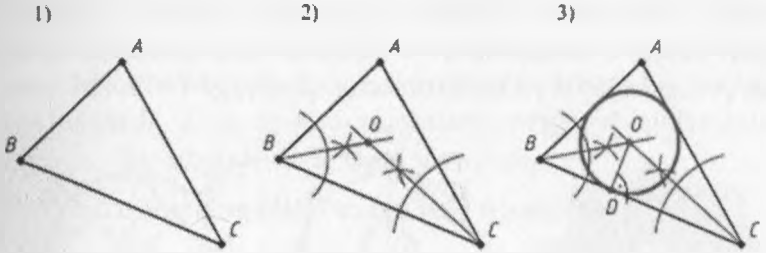
15-rasm

Uchburchak ichiga chizilgan aylana markazini hosil qilish

Uchburchakka ichki chizilgan aylana markazining qurilishi quyidagicha amalga oshiriladi (16-rasm):

1) Berilgan *ABC* uchburchagi. 2) Biz uchburchak burchaklari bissektrisalarini, masalan *A* va *B* burchaklarini yasaymiz, bissektrisalarning kesishish nuqtasi - *O* nuqta *ABC* uchburchak ichiga chizilgan aylananing markazidir. 3) *O* nuqtadan biz uchburchakning istalgan tomoniga, masalan *BC* tomoniga

perpendikulyar tushiramiz. Biz D nuqtasini olamiz. OD kesma - uchburchak ichiga chizilgan aylananing radiusi.



16-rasm

Aylananing teng qismlarga bo'linishi

Aylanani uchta teng qismga bo'lish

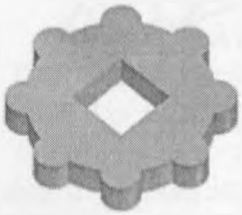
Rasm-17 murakkab teshikka ega jismni ko'rsatadi. Ushbu jismning rasmini (18-rasm) bajarish uchun dastlab aylanani uchta teng qismga bo'lish kerak. Aylananing uchta teng qismga bo'linishi (rasm- 19):

17-rasm **18-rasm** **19-rasm**

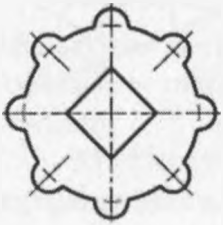
Aylana diametrining uchlari bo'lgan nuqtalarni belgilaymiz, masalan, *1* va *A* nuqtalar *A* markazidan $R = AO$ radiusli yoy chizamiz. Yoyning aylana bilan kesishishi ikkita *2* va *3* nuqtalarni beradi. *1, 2, 3* nuqtalar aylanani uchta teng qismga ajratadi. *1, 2, 3.* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz. Muntazam *teng tomonli uchburchakni* yasaymiz.

Aylanani to'rt va sakkizta teng qismlarga bo'linishi

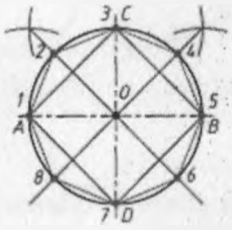
Rasm-20 kvadrat teshik va sakkizta dumaloq shakllarga ega buyumni ko'rsatadi. Ushbu buyumning rasmini (21-rasm) bajarish uchun aylanani to'rt va sakkizta teng qismlarga bo'lish kerak. Aylanara to'rt va sakkizta teng qismlarga bo'linishi (rasm-22):



20-rasm



21-rasm



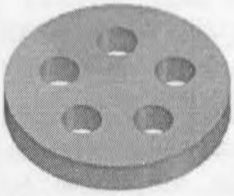
22-rasm

O'zaro perpendikulyar diametrlar aylanani to'rtta teng qismga ajratadi, masalan, *AB* va *CD* diametrlari. Biz *A, B, C, D* nuqtalarini to'g'ri chiziqlar bilan bog'laymiz *kvadrat* hosil qilamiz.

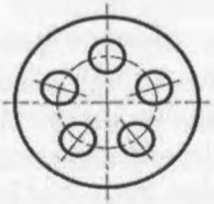
AOC va *BOC* burchaklarining bissektrisalarini chizing. Biz aylana sakkizta teng qismga bo'linadigan *1, 2, 3, 4, 5, 6, 7, 8* nuqtalarini olamiz. *1, 2, 3, 4, 5, 6, 7, 8* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz, *muntazam sakkiz burchakni* yasaymiz.

Aylanani beshta teng qismga bo'lish

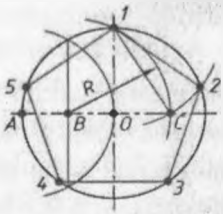
Rasm-23 beshta teshikka ega bo'lgan jismni ko'rsatadi. Ushbu buyumning rasmini (24-rasm) yakunlash uchun aylanani beshta teng qismga bo'lish kerak. Aylananing beshta teng qismga bo'linishi (rasm-25):



23-rasm



24-rasm

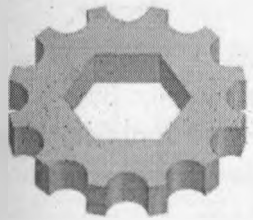


25-rasm

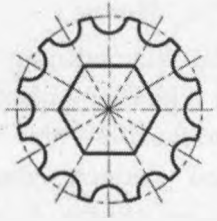
Aylananing vertikal diametrining oxiri bo'lgan *1*-bandni belgilang. *OA* radiusini ikkita teng qismga ajratamiz. *B* nuqtasini olamiz, *B* markazidan *R* = *B1* radiusli yoy chizamiz. Yassi aylananing gorizontal diametrini *C* nuqtada kesib o'tadi. Biz *2, 3, 4, 5.* nuqtalarni olamiz. *1, 2, 3, 4, 5*-bandlar aylanani beshta teng qismga ajratadi. *1, 2, 3, 4, 5* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz. *Muntazam beshburchakni* yasaymiz.

Aylananing teng oltita va o'n ikki qismga bo'linishi

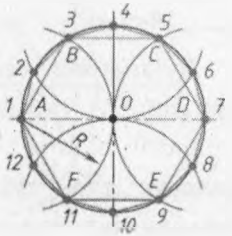
Rasm-26 da teshik olti burchakli prizma va o'n ikkita bir xil elementlar shaklida shakllangan detal ko'rsatilgan. Ushbu buyumning chizilgan rasmini (27-rasm) bajarish uchun aylanani oltita va o'n ikki teng qismga bo'lish kerak. Aylananing oltita va o'n ikkita teng qismlarga bo'linishi (rasm-28):



26-rasm



27-rasm



28-rasm

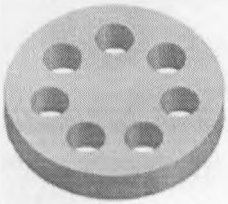
Aylananing gorizontal diametrining uchlari bo'lgan *A* va *D* nuqtalarini belgilang. *A* va *D* nuqtalarning markazlaridan *R* radiusli yoylarni chizamiz Radius *R* bu aylananing radiusiga teng. *B, F, C, E.* nuqtalarni olamiz *A, B, C, D, E, F* nuqtalar aylanani oltita teng qismga ajratamiz. *A, B, C, D, E, F.* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz. *Muntazam olti burchakni* yasaymiz.

Aylananing ikki o'zaro perpendikulyar diametrining uchlari bo'lgan *1, 4, 7* va *10* markazlardan *R.* radiusli yoylarni chizamiz. Radius *R* bu aylananing radiusiga teng. Biz aylanani o'n ikkita teng qismga ajratadigan *1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12* punktlarini

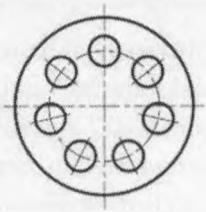
olamiz. *1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz, biz oddiy *muntazam o'n ikki burchakni* yasaymiz.

Aylanani teng ettita qismga bo'lish

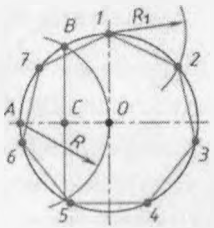
Rasm-29 da etti teshikka ega bo'lgan buyum ko'rsatilgan. Ushbu buyumning rasmini (30-rasm) bajarish uchun aylanani ettita teng qismga bo'lish kerak. Aylananing ettita teng qismga bo'linishi (rasm-31):



29-rasm



30-rasm



31-rasm

Aylananing vertikal diametrining oxiri bo'lgan *1*-bandni belgilang. *OA* `radiusini ikkita teng qismga ajratamiz. Biz *B* va *C* nuqtalarni olamiz *1* markazdan biz $R_1 = BC$ radiusli yoyni chizamiz. Yoy aylanani ikkinchi nuqtada kesadi. Ikkinchi nuqtadan biz ma'lum bir aylana bo'ylab *BC* kesmaga teng bo'laklarni yotqizamiz. Biz *3, 4, 5, 6, 7.* nuqtalarni olamiz. *1, 2, 3, 4, 5, 6, 7*-bandlar aylanani ettita teng qismga ajratadi. *1, 2, 3, 4, 5, 6, 7* nuqtalarni to'g'ri chiziqlar bilan bog'laymiz. *Muntazam yetti burchaklini* yasaymiz.

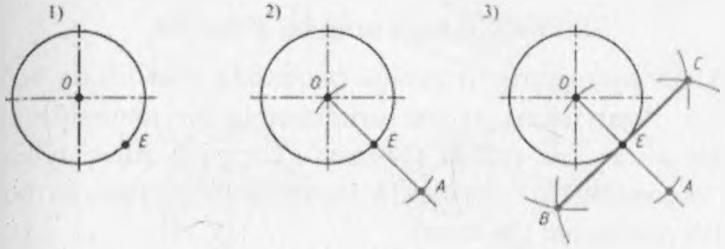
Urunmani qurish

Aylanaga urunma o'tkazish

Aylana bo'ylab yotgan nuqta orqali aylanaga urunma quyidagicha amalga oshiriladi (32-rasm):

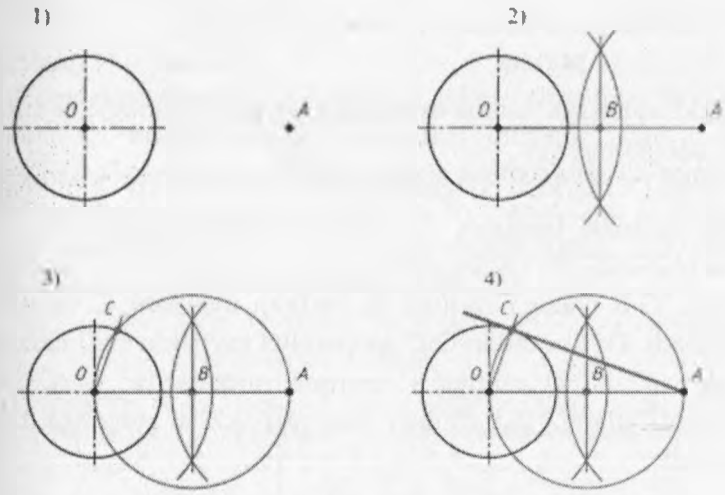
Markazi *O* va aylana ustida joylashgan *E* nuqtasi bo'lgan *R* radiusli aylana berilgan. 2) *O* doira markazidan *E* nuqta orqali *OA* kesmani chizamiz, *EA = OE.* 3) E nuqta orqali biz *OA*

kesmaga *BC* perpendikulyar chizamiz. Berilgan aylanaga *E* nuqta tegishlidir *BC* kesma urunma.



32-rasm

Aylanada yotmagan nuqtadan aylanaga urunma qurilishi quyidagicha amalga oshiriladi (33-rasm):



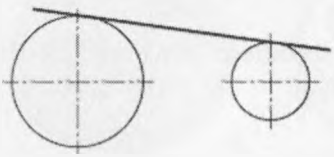
33-rasm

Aylanada yotmaydigan, markazi *O* va *A* nuqtasi bo'lgan aylana berilgan. 2) *O* aylananing markazini *A* nuqtasi bilan ulang, to'g'ri chiziq bilan *OA* kesmani olamiz. *OA* kesmani ikkita teng qismga ajrating. Biz *B* nuqtasini olamiz 3) *B* markazidan radiusi *R* = *BO* bo'lgan aylana chizamiz. Biz aylanada *C* nuqtasini olamiz.4)

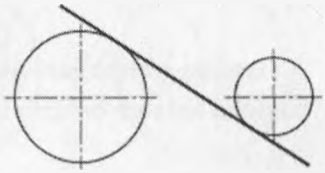
A va C nuqtalarni to'g'ri chiziq bilan bog'laymiz AC kesma aylanaga urunma yasaymiz.

Ikkita aylanaga urunma o'tkazish

Ikkala aylananing urunmasi tashqarida yoki ichida bo'lishi mumkin. Agar ikkala aylana urunmaning bir tomonida yotsa Urunma *tashqi* deb ataladi (34-rasm). Urunma chiziq aylanalar ichki tomonning qarama-qarshi tomonlarida joylashgan bo'lsa, *ichki* deb nomlanadi (35-rasm)



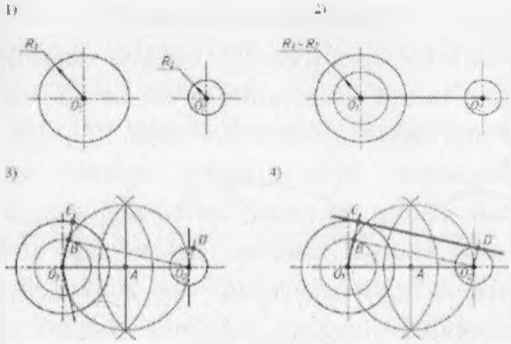
34-rasm



35-rasm

Ikki aylanaga tashqi urunmani qurish quyidagicha amalga oshiriladi (36-rasm):

Sizga O_1 markazi bo'lgan R_1 radiusi va markazi O_2 bo'lgan R_2 radiusi aylanasi berilgan. 2) O_1 markazidan radiusi $(R_1 - R_2)$ aylana chiziladi. 3) Ushbu aylanaga O_2 nuqtadan O_2B kesmasini quramiz. O_1B chizig'i radiusi R_1 bo'lgan aylanani C nuqtasida kesib o'tadi. O_2 nuqtadan O_1C ga parallel ravishda O_2D chizig'ini chizamiz. C va D nuqtalari urunma nuqtalardir. 4) C va D nuqtalarini ulang, CD chizig'i berilgan ikkita aylanaga tashqi urunmadir.

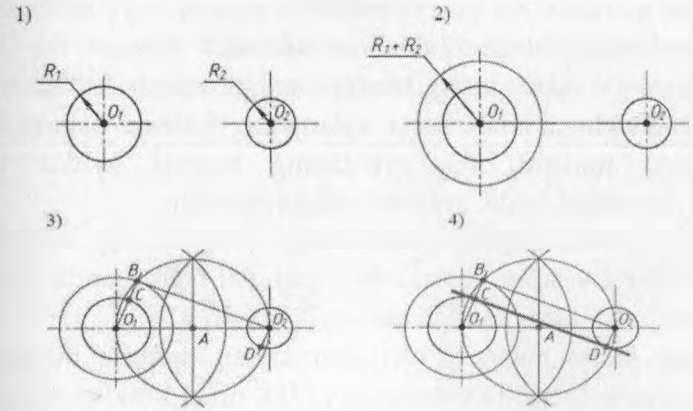


36-rasm

Ikki aylanaga ichki urunmani qurish quyidagicha amalga oshiriladi (37-rasm):

Markazi O_1 bo'lgan R_1 radiusi va radiusi R_2 aylana markazi O_2 berilgan.

O_1 markazidan $R_1 + R_2$ radiusli aylana chizamiz. 3) Ushbu aylanaga O_2 nuqtadan O_2B kecmasini quramiz. O_1B chizig'i radiusi R_1 bo'lgan aylanani C nuqtasida kesib o'tadi. O_2 nuqtadan O_1C ga parallel ravishda O_2D chizig'ini chizamiz. C va D nuqtalari urunma nuqtalardir. 4) C va D nuqtalarini ulang, CD chizig'i berilgan ikkita aylanaga ichki urunmadir.

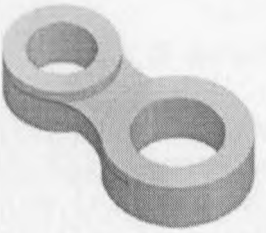


37-rasm

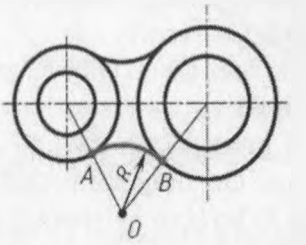
Tutashmalar yasash

Rasm-38 da tekis konturga ega bo'lgan detalni tasvirlaydi, ya'ni bitta chiziq ikkinchisiga silliq o'tib ketadi. Bir chiziqdan ikkinchisiga silliq o'tish *tutashma* deb ataladi.

Uyg'unlashganda, bitta chiziq aylana yoyi bo'ylab boshqasiga o'tadi. Ushbu *yoy tutashtiruvchi aylana yoyi* deb ataladi. Ushbu aylananing radiusi *tutashma radiusi* deb ataladi. Ushbu aylananing markazi *tutashma markazi* deb ataladi. Bir chiziqning ikkinchisiga qo'shilish nuqtasi *tutashma nuqtasi* deb ataladi. Tutashma qurish bu tutashmaning o'rtasi va tutashmaning nuqtalarini topish demakdir.



38-rasm



39-rasm

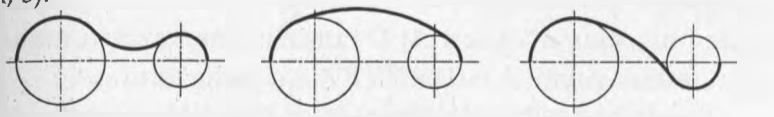
Rasm-39 da *A* nuqta va *B* nuqta tutashma nuqtalari, *O* nuqta tutashma markazi, *AB* yoy tutashuvchi aylana yoyi, tutashuvchi aylana yoyining *R* radiusi tutashma radiusi.

Bir to'g'ri chiziqning boshqa to'g'ri chiziq bilan, to'g'ri chiziqning aylana bilan, bitta aylananing boshqa aylana bilan tutashmasi mavjud. Bir aylananing boshqa aylana bilan tutashmasi tashqi, ichki, aralash bo'lishi mumkin.

Agar ikkita aylanani birlashtirganda ularning markazlari tutashma aylanasidan tashqarida yotadigan bo'lsa, unda bunday tutashma *tashqi tutashma* deb ataladi (40-rasm, *a*).

Agar ikkita aylanani birlashtirganda, ularning markazlari tutashma aylana ichida yotadigan bo'lsa, unda bunday tutashma *ichki tutashma* deb ataladi (40-rasm, *b*).

Agar ikkita aylanani birlashtirganda, bitta aylananing markazi tutashma aylana tashqarisida yotgan bo'lsa, boshqa aylananing markazi tutashma aylananing ichida joylashgan bo'lsa, unda bunday tutashma *aralash tutashma* deb ataladi (40-rasm, *c*).



a b c

40-rasm

Burchak tomonlariga tutashmalar yasash

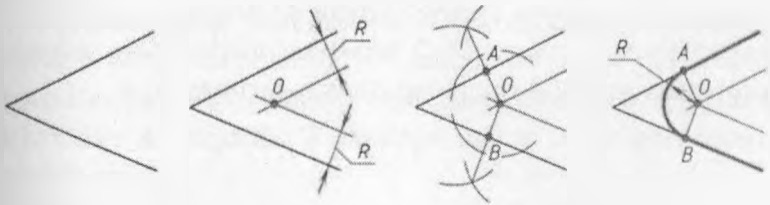
Rasmda ko'rsatilgan buyumlarning tutashma elementlarini qurishda. (41-rasm), o'tkir burchak (41-rasm, *a*), o'tmas burchak (41-rasm, *b*) va to'g'ri burchak (41-rasm, *c*) tomonlarning tutashmasini ma'lum bir radiusli aylana yoyini yarating.

a *b* *c*

41-rasm

O'tkir burchak tomonlarining ma'lum radiusli aylana yoyi bilan tutashmasi quyidagi tarzda amalga oshiriladi (42-rasm):

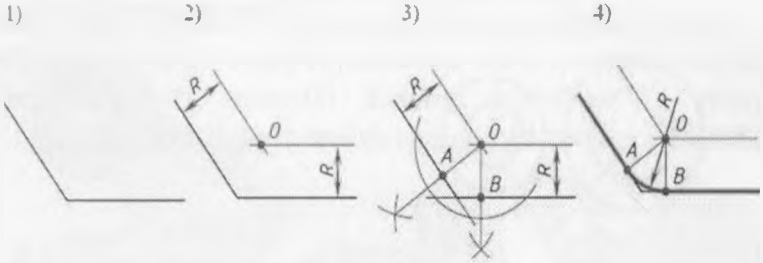
1) 2) 3) 4)



42-rasm

1) Tutashmaning o'tkir burchagi va radiusi *R*. berilgan. 2) Ushbu burchakning yonlariga parallel ravishda *R* masofada ikkita yordamchi to'g'ri chiziqlar torting. Chiziqlar *O*. nuqtasida kesishadi, *O* nuqta tutashma markazi. 3) *O* nuqtadan burchak tomonlariga perpendikulyar chizamiz. Biz *A* va *B* nuqtalarni olamiz - tutashuv nuqtalari. 4) *O* tutashma markazidan radiusi *R* ning tutashuv yoyini *A* nuqtadan *B* nuqtagacha torting.

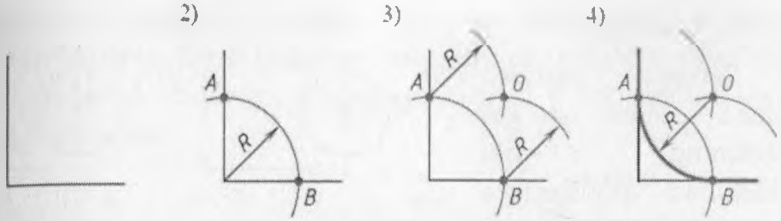
O'tmas burchak tomonlarining ma'lum bir radiusli aylana yoyi bilan tutashmasi xuddi shu tarzda amalga oshiriladi (43-rasm).



43-rasm

To'g'ri burchakli tomonlarning ma'lum radiusdagi aylana yoyi bilan tutashmasi quyidagi tarzda amalga oshiriladi (44-rasm):

1) To'g'ri burchak va tutashma radiusi berilgan *R*. 2) To'g'ri burchakning *A* tepasidan, *R* radiusli yoyni chizamiz. Biz *A* va *B* nuqtalarni - tutashma nuqtalarini olamiz. 3) *A* va *B* markazlardan *R* radiusli ikkita yoyni torting. Yoylar *O* nuqtada kesishadi, *O* nuqta tutashma markazi. 4) *O* tutashma markazidan radiusi *R* ning tutashuv yoyini *A* nuqtadan *B* nuqtagacha torting.



44-rasm

Aylana va to'g'ri chiziqni tutashmasini qurish

45- Rasmda ko'rsatilgan qismlarning rasmlarini qurishda., berilgan radiusli aylananing tashqi (45-rasm, *a*) va ichki (45-rasm, *b*) tutashma va aylananing tutashmasi amalga oshiriladi.

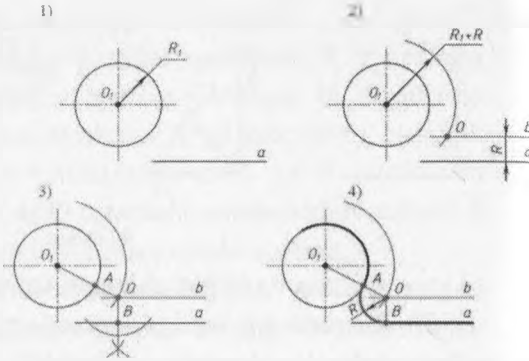
a **b**

45-rasm

Berilgan radiusli aylana bilan to'g'ri chiziqning tashqi tutashmasi quyidagicha amalga oshiriladi (46-rasm):

1) Markazi O_1 va *a* to'g'ri chiziqli R_1 radiusli aylana berilgan. 2) O_1 markazidan radiusi ($R + R_1$) bo'lgan yordamchi yoyni torting. 3) *R* masofada *a* to`g`ri chiziqqa parallel ravishda yordamchi *б* chiziqni torting. Chiziq va yoy *O* nuqtada kesishadi. *O* nuqta tutashma markazi. 4) OO_1 chizig'ini chizamiz, *A* tutashuv nuqtasini olamiz *O* nuqtadan a to'g'ri chiziqqa perpendikulyar. Biz *B* tutashuv nuqtasini olamiz. 5) *O* tutashma markazidan *A* nuqtadan *B* nuqtaga radiusi *R* bo'lgan tutashuv yoyini chizamiz.

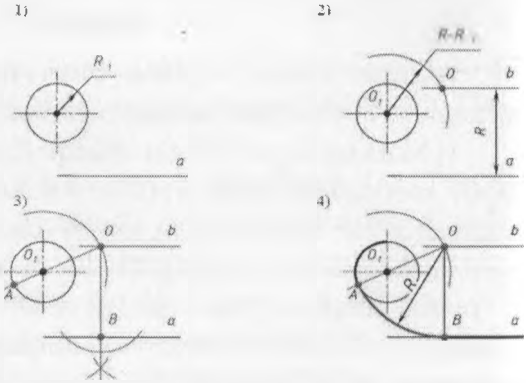
46-rasm



Berilgan radiusli aylana bilan to'g'ri chiziqning ichki tutashmasi quyidagicha amalga oshiriladi (47-rasm):

1) Markazi O_1 va *a* to'g'ri chiziqli R_1 radiusli aylana berilgan. 2) O_1 markazidan radiusi $(R - R_1)$ bo'lgan yordamchi yoyni torting. 3) *R* masofada *a* to`g`ri chiziqqa parallel ravishda yordamchi *б* chiziqni torting. Chiziq va yoy *O* nuqtada kesishadi. *O* nuqta tutashma markazi. 4) OO_1 chizig'ini chizamiz, *A* tutashuv nuqtasini olamiz *O* nuqtadan *a* chiziqqa perpendikulyar. Biz *B* tutashuv nuqtasini olamiz. 5) *O* tutashma markazidan *A* nuqtadan *B* nuqtaga radiusi *R* bo'lgan tutashuv yoyini chizamiz.

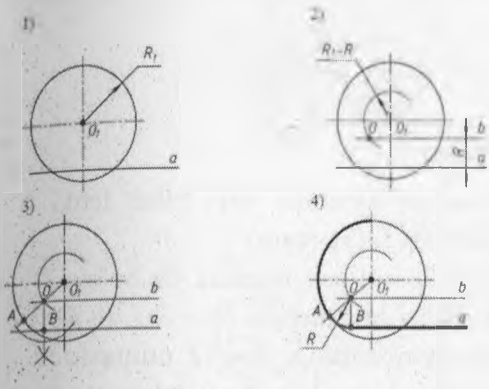
47-rasm



To'g'ri chiziq aylanani kesib o'tganda aylana va to'g'ri chiziqni tutashmasi quyidagicha amalga oshiriladi (48-rasm):

1) Markazi O_1 va *a* to'g'ri chiziqli R_1 radiusli aylana berilgan. 2) O_1 markazidan radiusi $(R_1 - R)$ bo'lgan yordamchi yoyni torting. 3) *R* masofada *a* to`g`ri chiziqqa parallel ravishda yordamchi *б* chiziqni torting. Chiziq va yoy *O* nuqtada kesishadi. *O* nuqta tutashma markazi. 4) OO_1 chizig'ini chizamiz, *A*

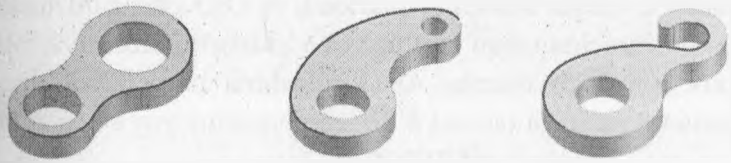
tutashuv nuqtasini olamiz O nuqtadan a chiziqqa perpendikulyar. Biz B tutashuv nuqtasini olamiz. 5) O tutashma markazidan A nuqtadan B nuqtaga radiusi R bo'lgan tutashuv yoyini chizamiz.



48-rasm

Ikkita aylanaga tutashma yasash

49- Rasmda ko'rsatilgan buyumlarning ko'rinishini qurishda, ular tashqi (49-rasm, *a*), ichki (49-rasm, *b*) va aralash (49-rasm, *c*) berilgan aylanadagi aylana yoyi bilan ikki aylananing tutashmasini quradilar.

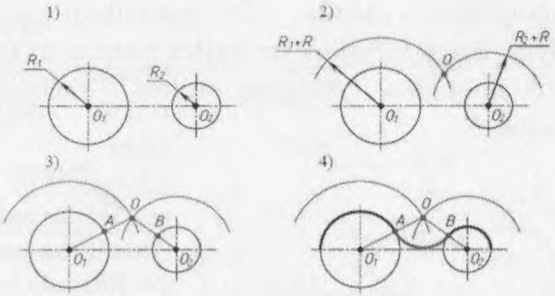


a b c

49-rasm

Ikki aylananing berilgan radius aylanasi yoyi bilan tashqi tutashma quyidagicha amalga oshiriladi (50-rasm):

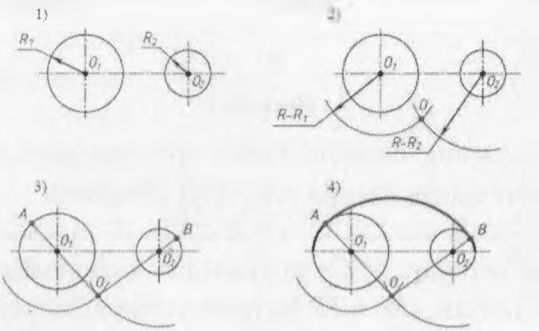
1) R_1 radiusli markaz O_1 va R_2 radiusli markaz O_2 bo'lgan ikkita aylana berilgan. 2) O_1 markazidan radiusi $(R_1 + R)$ va O_2 markazidan radiusi $(R_2 + R)$ bo'lgan yordamchi yoyini torting. Yoy O. nuqtasida kesishadi, O nuqta tutashma markazi. 3) OO_1 chizig'ini tortamiz, A tutashuv nuqtasini olamiz OO_2 chiziqni chizamiz, B tutashuv nuqtasini olamiz. 4) O tutashma markazidan A nuqtadan B nuqtaga radiusi R bo'lgan tutashuv yoyini chizamiz.



50-rasm

Ikki aylananing berilgan radius aylanasi yoyi bilan ichki tutashma quyidagicha amalga oshiriladi (51-rasm)

1) R_1 radiusli markaz O_1 va R_2 radiusli markaz O_2 bo'lgan ikkita aylana berilgan. 2) O_1 markazidan radiusi $(R - R_1)$ va O_2 markazidan $(R - R_2)$ yordamchi yoyini torting. Yoy O. nuqtasida kesishadi, O nuqta tutashma markazi. 3) O_1O chizig'ini torting, biz A tutashuv nuqtasini olamiz, OO_2 chizig'ini chizamiz, biz B tutashuv nuqtasini olamiz. 4) O tutashma markazidan biz A radiusidan B nuqtaga radiusi R bo'lgan tutashuv yoyini chizamiz.

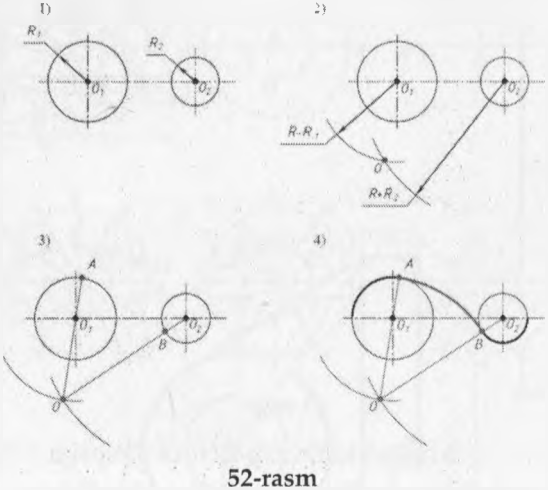


51-rasm

Ikki aylananing berilgan radius aylanasi yoyi bilan aralash tutashma quyidagicha amalga oshiriladi (52-rasm)

1) R_1 radiusli markaz O_1 va R_2 radiusli markaz O_2 bo'lgan ikkita aylana berilgan. 2) O_1 markazidan radiusi $(R - R_1)$ va O_2

markazidan $(R + R_2)$ yordamchi yoyini torting. Yoy O. nuqtasida kesishadi, O nuqta tutashma markazi. 3) O_1O chizig'ini torting, biz A tutashuv nuqtasini olamiz, OO_2 chizig'ini chizamiz, biz B tutashuv nuqtasini olamiz. 4) O tutashma markazidan biz A radiusidan B nuqtaga radiusi R bo'lgan tutashuv yoyini chizamiz.



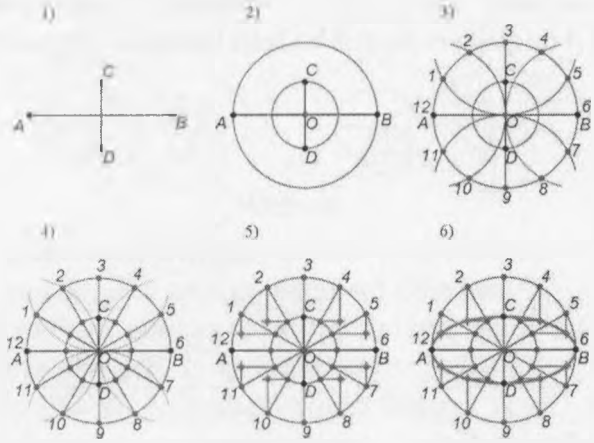
52-rasm

Ellips qurish

Katta va kichik o'qlar bo'ylab ellips qurilishi quyidagicha amalga oshiriladi (53-rasm):

1) AB ellipsining katta o'qi va CD ellipsining kichik o'qi berilgan. 2) Ellips o'qlari kesishish nuqtasini - O nuqtasini belgilang. O markazidan OA radiusli va OC radiusli aylana chizilgan. 3) Katta doirani o'n ikki teng qismga ajrating. Biz *1, 2, 3, ..., 12.* nuqtalarni olamiz. 4) *1, 2, 3,..., 12* aylananing bo'linish nuqtalari aylana markazi O bilan to'g'ri chiziqlar bilan bog'lanadi, shu bilan birga *1 - 7, 2 - 8, ..., 6 -12* to'g'ri chiziqlar kichik doirani o'n ikki teng qismga bo'ling. 5) Katta aylananing bo'linish nuqtalaridan, CD ga parallel ravishda to'g'ri chiziqlar torting. Kichik aylananing bo'linish nuqtalaridan AB ga parallel ravishda to'g'ri chiziqlar torting. Vertikal va gorizontal chiziqlarning

kesishish nuqtalari ellipsning kerakli nuqtalari. 6) Ellipsning olingan nuqtalarini parcha yordamida silliq egri chiziq bilan bog'laymiz. Biz ellipsni yasaymiz.



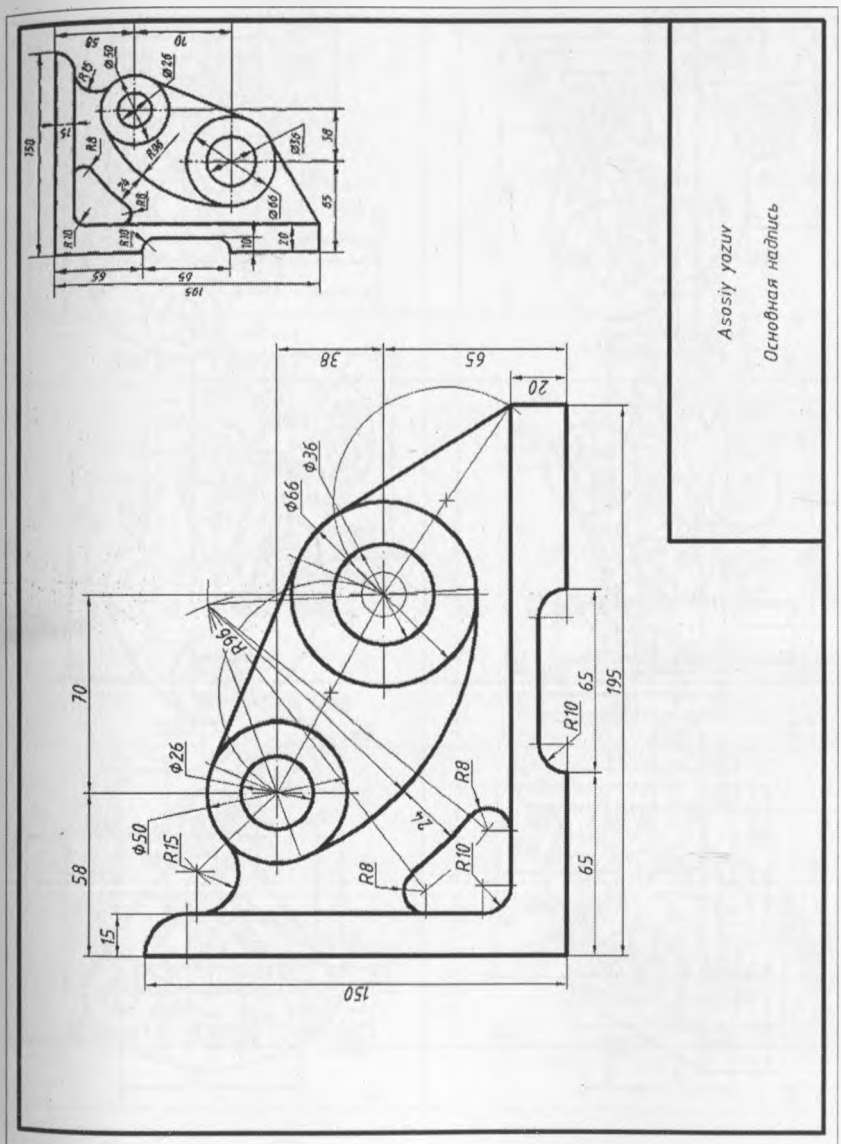
53-rasm

Mustahkamlash uchun savollar

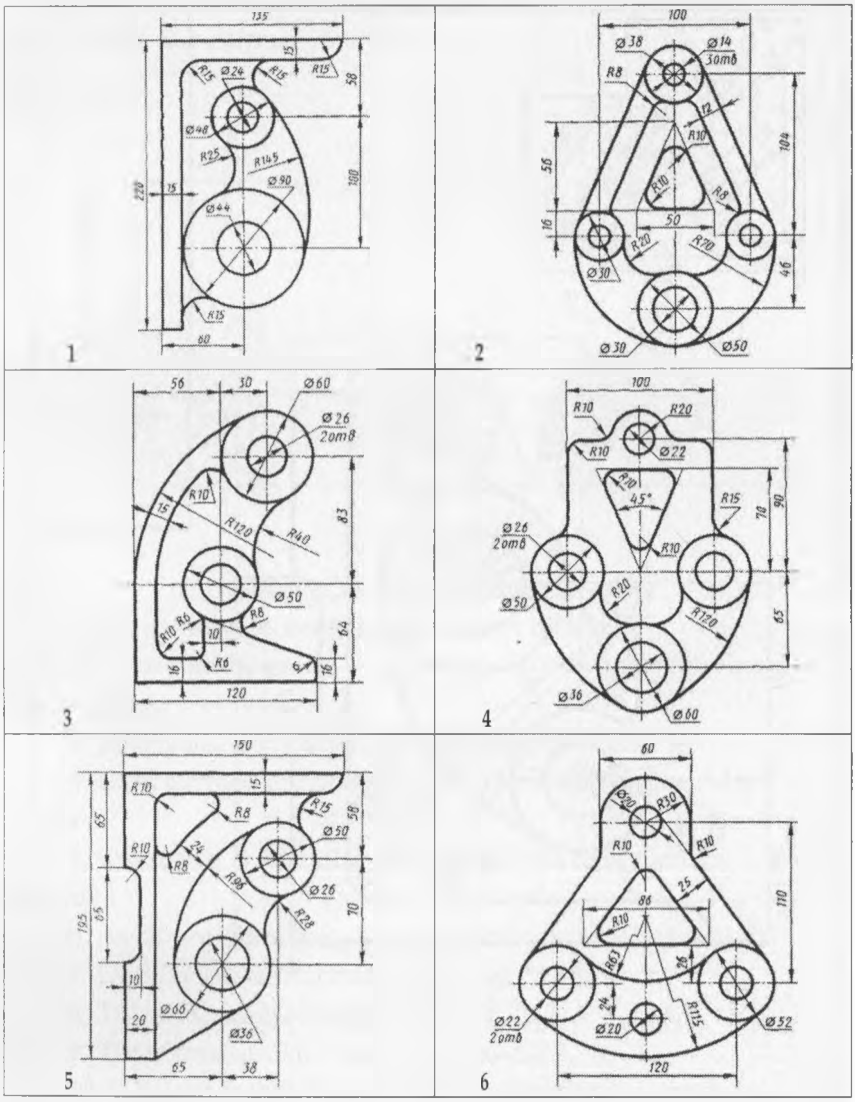
1. Siz qanday geometrik yasashlarni bilasiz?
2. Chiziq kesmasini n teng qismga bo'lish bosqichlarini sanab o'ting.
3. Burchakni ikkiga qanday ajratish mumkin?
4. Uchburchak ichiga chizilgan aylana markazi qanday quriladi?
5. Qaysi to'g'ri chiziqlar aylanani to'rtta teng qismga ajratadi?
6. Aylanani oltita teng qismga qanday ajratish mumkin?
7. Qanday tutashma tashqi deyiladi? Ichki?
8. Tutashma deb nimaga aytiladi?
9. Tutashma qurish nimani anglatadi?
10. To'g'ri burchakli tomonlarning tutashmasi qanday yaratiladi?

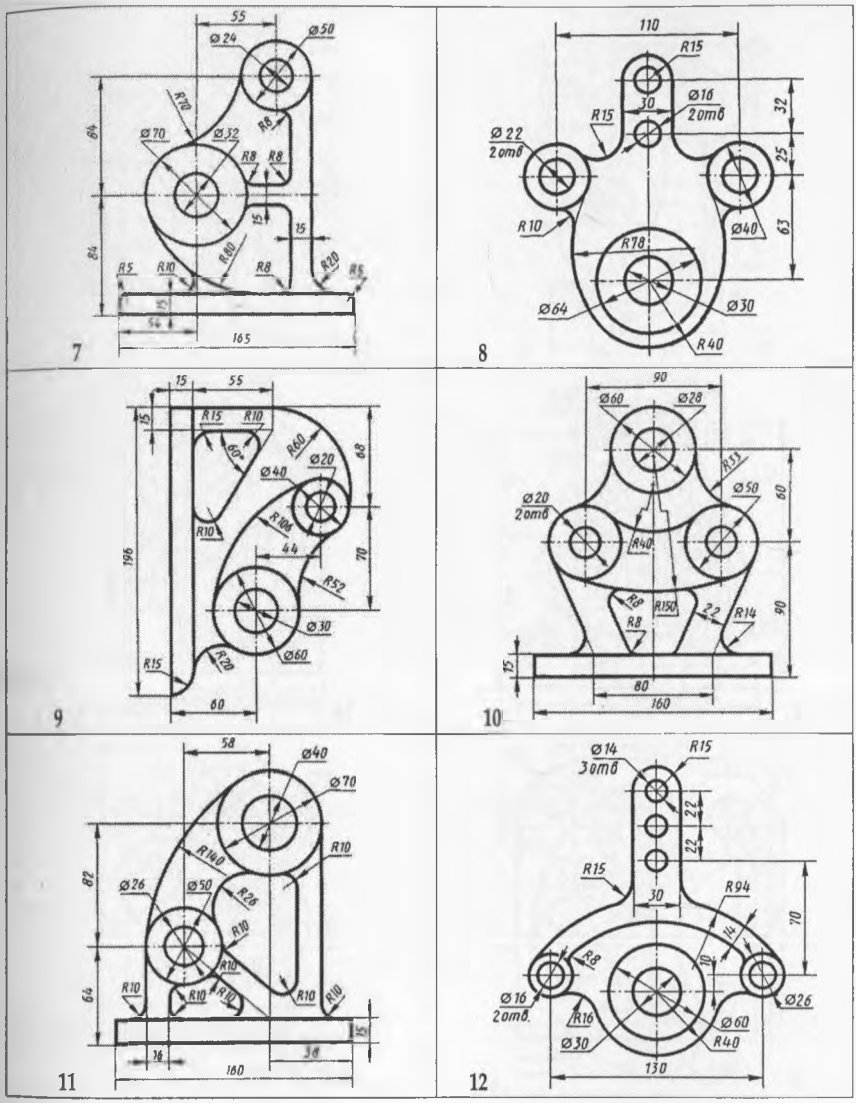
Hisob grafik ish, variant topshiriqlari

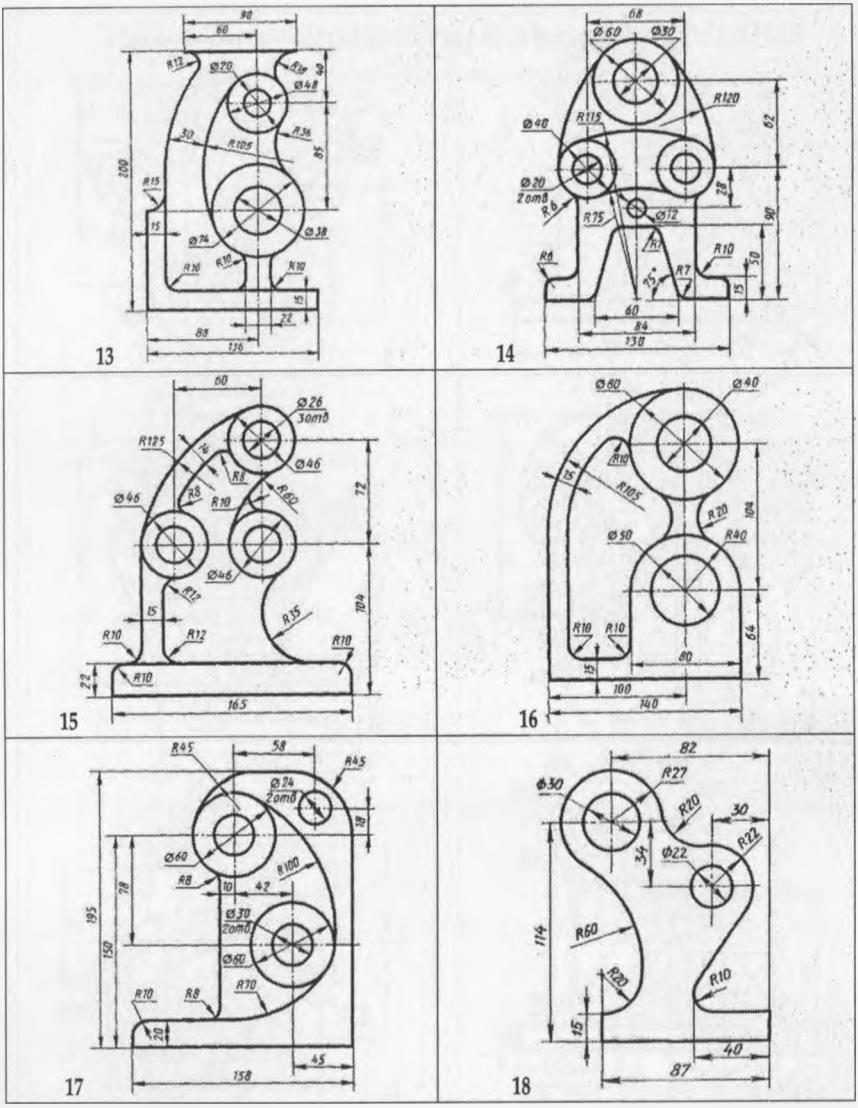
HGI-3. Tutashmalarni bajarish namunasi.



HGI-3 Tutashmalarni bajarish uchun variantlar




7
55
Ø24
Ø50
R70
R8
Ø70
Ø32
R8
R8
84
84
15
15
R5
R10
R80
R8
R20
R5
15
54
165
8
110
R15
Ø16
2отв
30
R15
32
25
63
Ø22
2отв
R10
R78
Ø40
Ø64
Ø30
R40
9
15
55
15
R15
R10
60°
R60
Ø20
Ø40
68
R10
R100
44
70
196
R52
Ø30
Ø60
R15
R20
60
10
90
Ø60
Ø28
R33
Ø50
60
Ø20
2отв
R40
R8
R150
22
R14
90
R8
15
80
160
11
58
Ø40
Ø70
R140
R10
82
Ø26
Ø50
R28
R10
R10
R10
64
R10
R10
R10
R10
R10
15
16
30
160
12
Ø14
3отв
R15
22
22
R15
30
R94
70
14
10
R8
Ø16
2отв.
R16
Ø26
Ø60
Ø30
R40
130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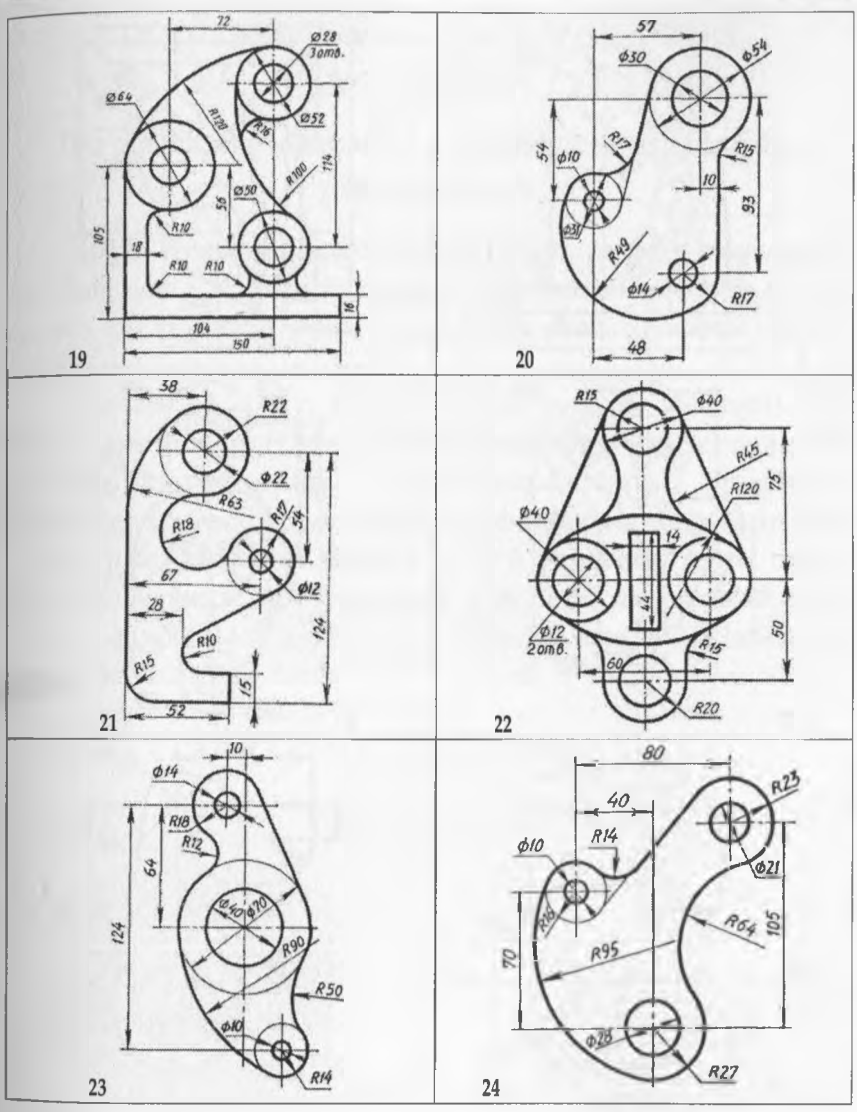
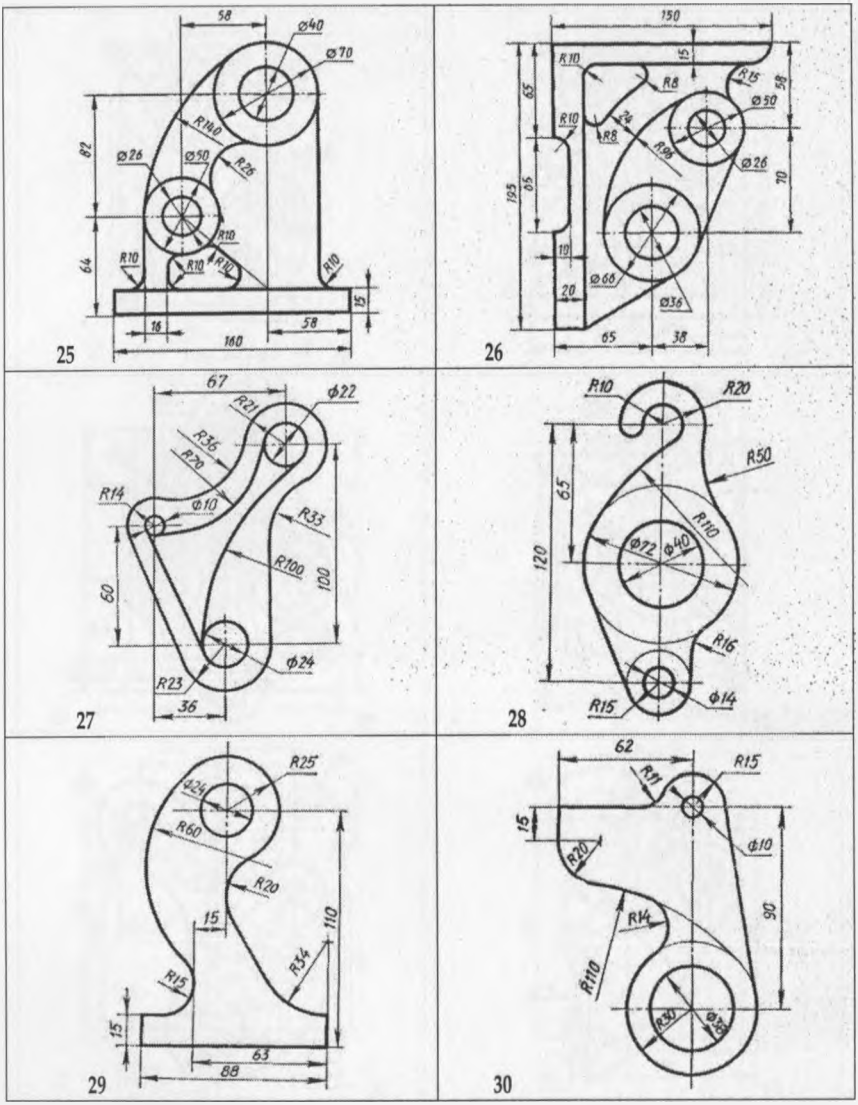
18


19
72
Ø28
3отв.
Ø64
R120
R16
Ø52
114
R100
Ø50
55
105
18
R10
R10
R10
16
104
150
20
57
Ø30
Ø54
54
Ø10
R17
R15
10
93
Ø31
R49
Ø14
R17
48
21
38
R22
Ø22
R63
R17
56
R18
67
Ø12
28
124
R10
R15
15
52
22
R15
Ø40
R45
R120
75
Ø40
14
44
Ø12
2отв.
R15
50
60
R20
23
10
Ø14
R18
R12
64
124
Ø40
Ø70
R90
R50
Ø10
R14
24
80
40
R23
Ø10
R14
Ø21
R12
R64
105
70
R95
Ø26
R27


25
58
⌀40
⌀70
R140
⌀26
⌀50
R26
82
R10
R10
R10
R10
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64
16
160
58
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26
150
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R10
R8
R15
65
58
⌀50
R10
24
R8
R10
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⌀68
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⌀36
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67
R21
⌀22
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R100
100
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⌀24
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65
120
R110
⌀72
⌀40
R16
R15
⌀14
29
R25
⌀24
R60
R20
15
110
R34
R15
15
63
88
30
62
R11
R15
15
R20
⌀10
R14
90
R110
R30
⌀20

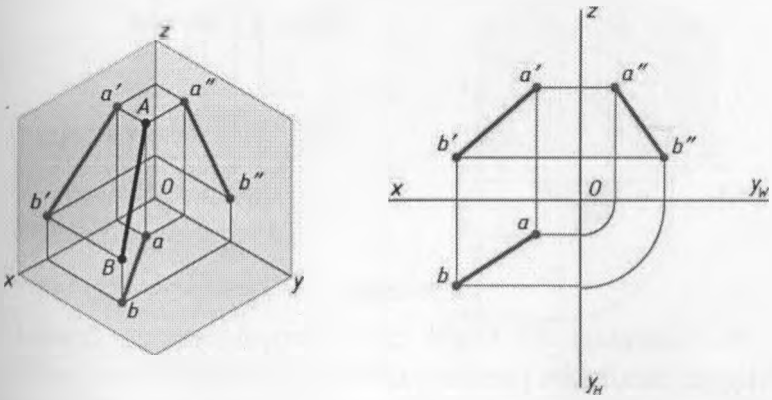
To'g'ri chiziq kesmasining to'g'riburchakli proektsiyalari

To'g'ri chiziq kesmasini proektsiya tekisliklarida proektsiyalash

To'g'ri chiziqning fazodagi o'rni ikki nuqta bilan belgilanadi. Shuning uchun, to'g'ri chiziqning to'g'riburchakli proektsiyalarini qurish uchun uning ikkita nuqtasining proektsiyalarini qurish kifoya.

Fazoda AB to`g`ri chiziqli kesma berilgan (54-rasm). AB chiziq kesimining H proyeksiya tekisligidagi proyeksiyalarini topamiz, buning uchun A va B nuqtalardan H proyeksiya tekisligiga perpendikulyar chizamiz, shu nuqtalarning gorizontal a va b proyeksiyalarini olamiz. A va b nuqtalarni to'g'ri chiziq bilan bog'laymiz, AB kesmaning gorizontal ab proyeksiyasini olamiz. Xuddi shunday, biz V va W proyeksiya tekisliklarida AB chiziq kesmasining frontal $a'b'$ va profil $a''b''$ proyeksiyalarini topamiz.

$|ab| < |AB|, |a'b'| < |AB|, |a''b''| < |AB|.$



54-rasm

To'g'ri chiziqning proektsiya tekisliklariga nisbatan joylashishi

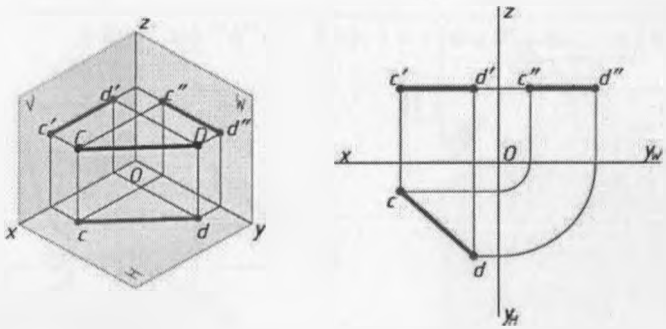
Uchta proektsiya tekislikning hech biriga parallel bo'lmagan (ya'ni to'g'ri chiziqdan tashqari barcha proektsiya tekisliklarga qiya bo'lgan) to'g'ri chiziq *umumiy vaziyatdagi to'g'ri chiziq* deb ataladi (54-rasm). Umumiy vaziyatdagi to'g'ri chiziq kesmasining barcha proektsiyalari kesmaning tabiiy (haqiqiy) kattaligidan kichik.

Bir yoki ikkita proektsiya tekislikka parallel chiziqlar *xususiy vaziyatdagi chiziqlar* deyiladi. Bitta proyeksiya tekisligiga parallel chiziq *sath chizig'i* deyiladi. Sath chizig'ining bitta proektsiyasi to'g'ri chiziq kesmasining haqiqiy kattaligiga teng.

Uchta to'g'ri sath mavjud 55-Rasmdagi *CD* to'g'ri chiziq proektsiyalarning gorizontal *H* tekisligiga parallel va proektsiyalarning frontal *V* va profil *W* tekisliklariga qiya bo'ladi. Ushbu chiziq *gorizontal chiziq* deb ataladi.

c'd' proyeksiyasi *x* o'qiga va *c''d''* proektsiyasi *y* o'qiga parallel. *cd* proektsiyasi *CD* kesmasining haqiqiy kattaligiga teng.

$| cd | = | CD |, | c'd' | < | CD |, | c''d'' | < | CD |.$

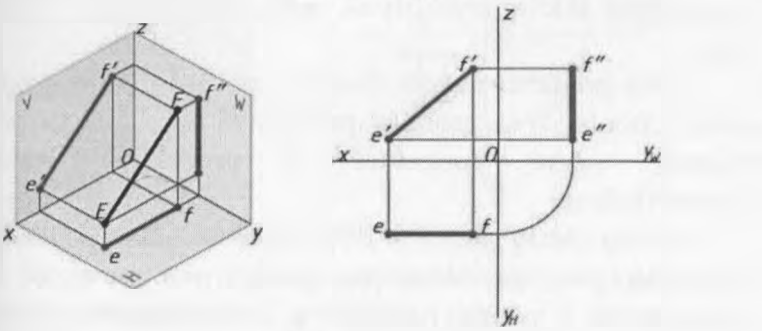


55-rasm

56- Rasmdagi *EF* to'g'ri chiziq proyeksiyaning frontal *V* tekisligiga parallel va proektsiyalarning gorizontal *H* va profil *W* tekisliklariga qiya bo'ladi. Bunday to'g'ri chiziq *frontal chiziq* deb ataladi. *ef* proektsiyasi *x* o'qiga, *e''f ''* proektsiyasi z o'qiga

parallel. $e'f'$ proektsiyasi EF kesmasining haqiqiy kattaligiga teng.

$|ef| < |EF|, |e'f'| = |EF|, |e''f''| < |EF|$

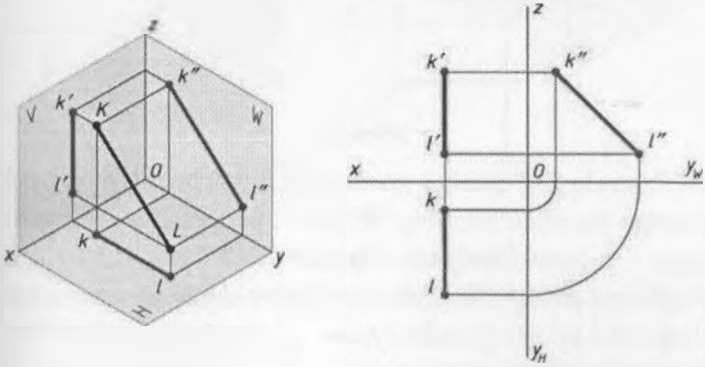


56-rasm

57- Rasmdagi KL chizig'i proektsiyalarning profil W tekisligiga parallel va proektsiyalarning gorizontal H va frontal V tekisliklariga qiya bo'ladi.

Bunday to'g'ri chiziq *profil chiziq* deb ataladi. kl proyeksiyasi y o'qiga parallel, k' l' proyeksiyasi z o'qiga parallel. $k''l''$ proektsiyasi KL kesmasining haqiqiy kattaligiga teng.

$|kl| < |KL|, |k'l'| < |KL|, |k''l''| = |KL|.$



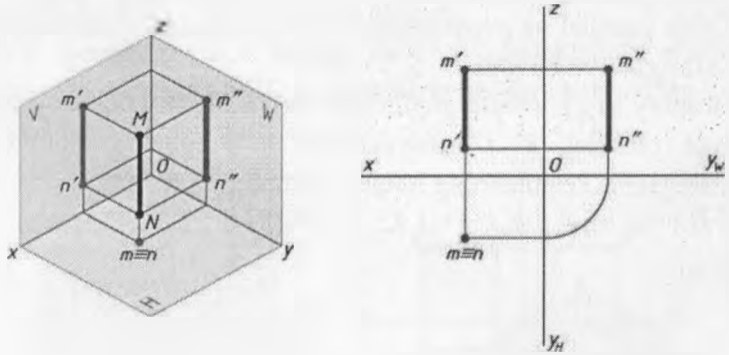
57-rasm

Proyeksiyalarning bir tekisligiga perpendikulyar bo'lgan chiziqlar *proektsiyalovchi chiziqlar* deyiladi. Ular boshqa ikkita proektsiyalar tekisliklariga parallel. Proektsiyalovchi chiziq kesmasining ikkita proektsiyasi kesmaning haqiqiy kattaligiga teng.

Uchta proektsiyalovchi chiziqlar mavjud (58- Rasm)da *MN* chizig'i. frontal *V* va profil *W* proyeksiya tekisliklariga parallel, shuning uchun gorizontal *H* proyeksiya tekisligiga perpendikulyar.

Bunday chiziq *gorizontal proyeksiyalovchi chiziq* deyiladi. *MN* chiziqning proyeksiyasi nuqta, chunki $m \equiv n$. $m'n'$ va $m''n''$ proektsiyalar z o'qiga parallel va *MN* kesmasining haqiqiy kattaligiga teng.

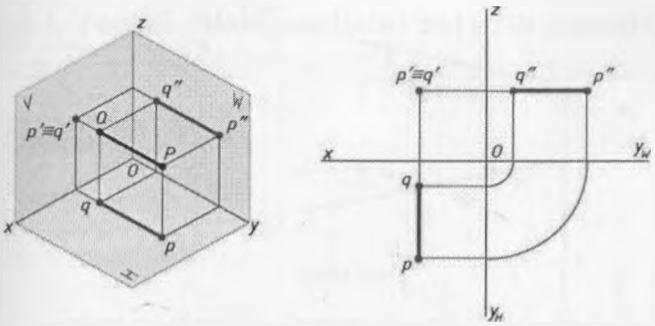
$| m \equiv n |, | m'n' | = | m''n'' | = | MN |.$



58-rasm

59- Rasmda *PQ* chizig'i gorizontal *H* va profil *W* proyeksiya tekisliklariga parallel, shuning uchun *V*. proektsiyalarning frontal tekisligiga perpendikulyar. Bunday to'g'ri chiziq *frontal proyeksiyalovchi chiziq* deb ataladi. *PQ* proektsiyasi nuqta, chunki $p' \equiv q'$. pq va $p''q''$ proektsiyalar *y* o'qiga parallel va *PQ* kesmasining haqiqiy kattaligiga teng.

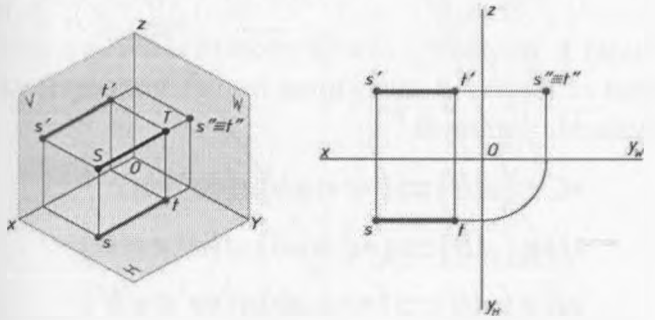
$| p' \equiv q' |, | pq | = | p''q'' | = | PQ |.$



59-rasm

60- Rasmdagi to'g'ri *ST*. proektsiyalarning gorizontal *H* va frontal *V* tekisliklariga parallel, shuning uchun *W*. proyeksiyalarning profil tekisligiga perpendikulyar. Bunday to'g'ri chiziq *profil proyeksiyalovchi chiziq* deyiladi. *ST* to'g'ri chiziq proektsiyasi nuqta $s''\equiv t''$. *St* va $s't'$ proektsiyalar *x* o'qiga parallel va *ST* kesmasining haqiqiy kattaligiga teng.

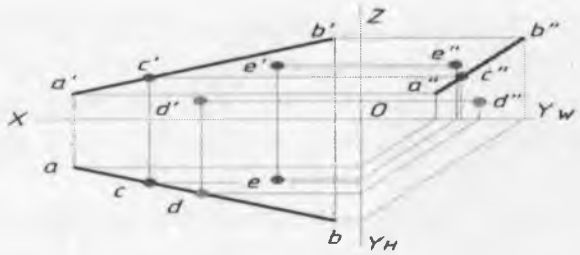
$|s''\equiv t''|, |s't'| = |st| = |ST|.$



60-rasm

To'g'ri chiziqdagi nuqta

Agar nuqta to'g'ri chiziqqa tegishli bo'lsa, unda nuqta proektsiyalari ushbu to'g'ri chiziqning mos proektsiyalarida yotadi. 61- Rasmda *AB* to'g'ri chiziq va uning proektsiyalari berilgan.



61-rasm

AB chiziqda biz ixtiyoriy nuqtani olamiz, masalan, C nuqta. C nuqtadan gorizontal proyeksiya AB chiziqning gorizontal ab proyeksiyasida yotadi. c' nuqtaning frontal proektsiyasi *AB* chiziqning *a'b'* frontal proyeksiyasida yotadi. *C* nuqtaning profil proyeksiyasi *AB* chiziqning *a''b''* profil proyeksiyasida yotadi. *C* nuqta *AB* chiziqqa tegishli deyiladi. "Nuqta chiziqqa tegishli" iborasi quyidagicha yoziladi: $C \in AB$.

D nuqta (62-rasm) *AB* chiziqqa tegishli emas, chunki *D* nuqtaning *d'* frontal proyeksiyasi *AB* chiziqning *a'b'* frontal proyeksiyasida yotmaydi. *E* nuqta (63-rasm) *AB* chizig'iga tegishli emas, chunki *E* nuqtaning frontal proektsiyasi *e'* va gorizontal proektsiyasi *e.e* nuqta *AB* chizig'ining frontal, gorizontal va profil proyeksiyalarida yotmaydi.

$$\bullet C \in (AB) \Rightarrow (\bullet c \in ab) u (\bullet c' \in a'b')$$

$$\bullet D \notin (AB) \Rightarrow (\bullet d \in ab), a(d' \notin a'b')$$

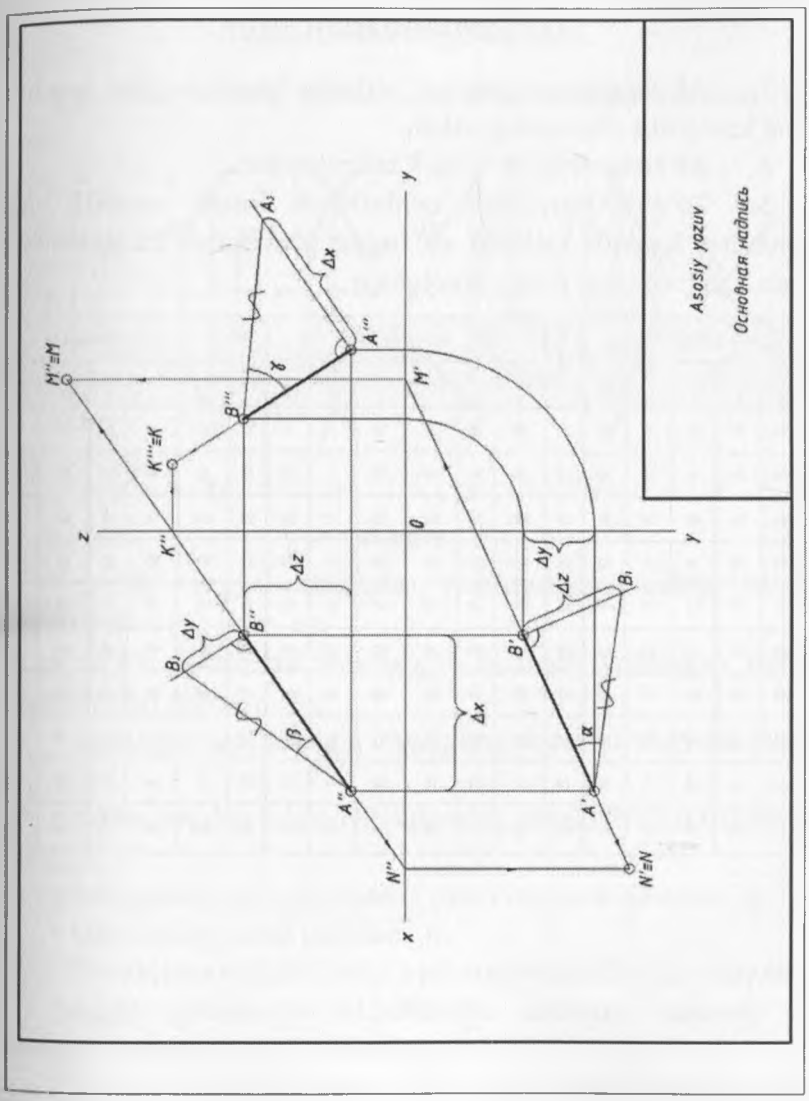
$$\bullet E \notin (AB) \Rightarrow (\bullet e \notin ab) u (\bullet e' \notin a'b')$$

Mustahkamlash uchun savollar

1. Chizilgan rasmda tekis shaklni qanday aniqlash mumkin?
2. Umumiy vaziyatdagi chiziq qanday chiziq deyiladi?
3. Qaysi chiziq proektsiyalovchi deb ataladi?
4. Qaysi chiziq sath chizig'i deb ataladi?

Hisob grafik ish, variant topshiriqlari

HGI-4. To'g'ri chiziq analizini bajarish namunasi



HGI-4. To'g'ri chiziq analizini bajarish shartlari va variantlari

1. *AB* kesma uchlarining berilgan koordinatalari asosida uning kompleks chizmasi qurilsin.

2. *AB kesmaning M, N* va *K* izlari topilsin.

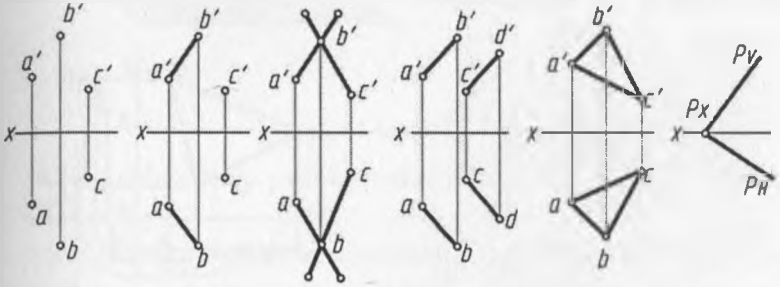
3. To'g'ri burchakli uchburchak usuli asosida *AB* kesmaning haqiqiy kattaligi va uning proyeksiya tekisliklariga og'ish burchaklari α, β va γ aniqlansin.

Bar. №	Koordinatalar						Bar. №	Koordinatalar						Bar. №	Koordinatalar					
	A			B				A			B				A			B		
	x	y	z	x	y	z		x	y	z	x	y	z		x	y	z	x	y	z
1	90	26	12	34	6	48	11	90	28	16	36	8	60	21	92	28	16	34	8	60
2	80	40	20	30	10	60	12	96	36	20	32	8	80	22	82	34	18	34	8	78
3	96	40	16	40	58	56	13	112	52	16	40	12	56	23	114	54	16	42	14	54
4	80	36	18	24	8	58	14	96	32	18	30	8	64	24	100	32	20	32	10	60
5	102	48	24	42	12	64	15	100	40	14	40	8	40	25	52	42	18	44	14	58
6	80	40	16	30	12	44	16	96	44	20	44	12	60	26	100	44	18	44	14	56
7	84	44	20	30	12	60	17	58	46	22	46	14	62	27	84	36	20	32	8	80
8	88	52	16	30	12	56	18	102	50	22	44	14	62	28	94	34	18	30	8	60
9	92	44	24	28	8	56	19	82	42	18	32	14	58	29	94	44	20	44	12	60
10	96	40	20	34	8	56	20	94	42	26	34	10	54	30	100	40	12	38	8	18

To'g'riburchakli tekislik proektsiyalari

Tekisliklarning berilishi

Chizmada tekislik bir necha usulda berilishi mumkin (62-rasm).



62-rasm

- bitta to'g'ri chiziqda yotmaydigan uchta nuqta proektsiyalari (62-rasm, *a*);
- to'g'ri chiziq va shu to'g'ri chiziqda yotmagan nuqta proektsiyalari (62-rasm, *b*);
- kesishgan ikkita to'g'ri chiziqning proektsiyalari (62-rasm, *c*);
- ikkita parallel to'g'ri chiziqlarning proektsiyalari (62-rasm, *d*);
- har qanday tekis figuraning proektsiyalari (62-rasm, *e*);
- tekislikning izlari (62-rasm, *f*).

Proektsiya tekisliklariga nisbatan tekislikning vaziyati

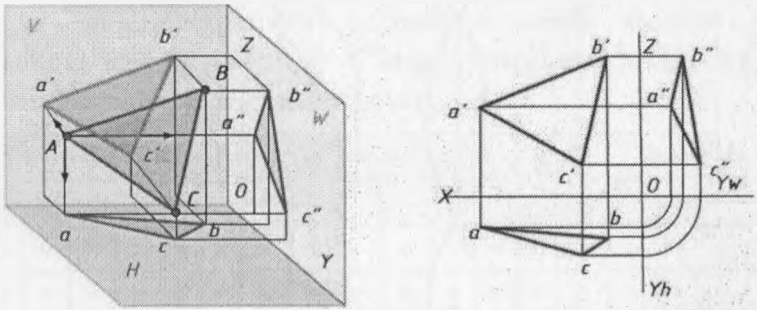
Tekislik proektsiya tekisliklariga nisbatan umumiy va xususiy vaziyatlarni egallashi mumkin.

Proektsiya tekisliklarning hech biriga perpendikulyar yoki parallel bo'lmagan tekislik (ya'ni 90^0 ga teng bo'lmagan

burchakdagi barcha proektsiya tekisliklarga qiya) *umumiy vaziyatdagi tekislik* deyiladi.

Umumiy vaziyatdagi tekislikda yotgan figura proektsiya tekisliklarining hech biriga o'z kattaligida proektsiyalanmaydi.

Rasm-63. *ABC* uchburchagi bilan berilgan umumiy vaziyatdagi *Q* tekisligi berilgan.



63-rasm

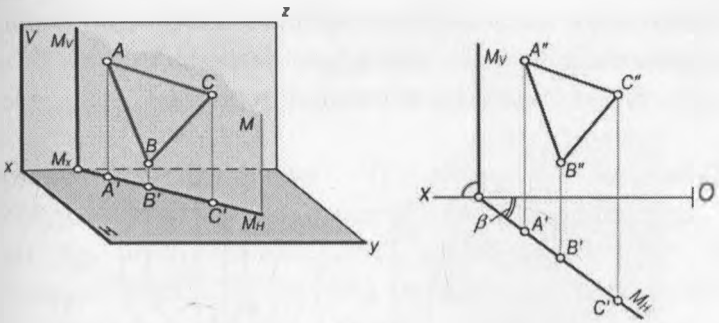
Proyeksiya tekisliklariga perpendikulyar yoki parallel bo'lgan tekisliklar *xususiy vaziyatdagi tekisliklar* deyiladi.

Bitta proyeksiya tekisligiga perpendikulyar bo'lgan tekislikka *proyeksiyalovchi* deyiladi.

Poroyeksiyalovchi tekislikka yotgan geometric shakl, bu tekislik qaysi proyeksiya tekisligiga perpendikulyar bo'lsa, shu poroyeksiya tekisligiga kesma bo'lib proyeksiyalanadi.

Uchta proyeksiyalovchi tekislik mavjud: gorizontal, frontal va profil-proyeksiyalovchi.

Rasm-64 rasmda *ABC* uchburchagi bilan aniqlangan *T* tekislik proyeksiyalarning gorizontal tekisligiga perpendikulyar. Bunday tekislik *gorizontal proyeksiyalovchi* deyiladi.

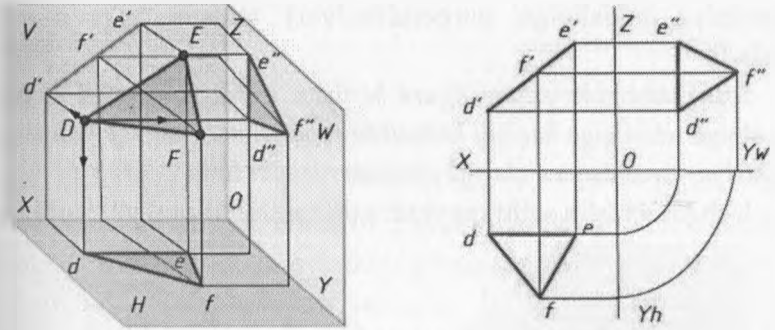


64-rasm

ABC uchburchagi proektsiyalar tekisligi bo'yicha *H* - kesma *ab*

(*abc* chizig'i). *ABC* uchburchagining *V* va *W* proyeksiya tekisliklariga proektsiyalari *ABC* uchburchakning haqiqiy kattaligiga teng bo'lmagan *a'b'c'* va *a''b''c''* uchburchaklar.

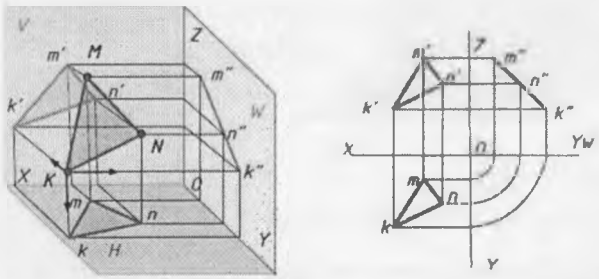
Rasm-65 da *DEF* uchburchagi bilan aniqlangan *R* tekislik frontal proyeksiya tekisligiga perpendikulyar. Ushbu tekislik *frontal proyeksiyalovchi* deb ataladi.



65-rasm

V proektsion tekislikdagi *DEF* uchburchagi proektsiyasi d'f' kesmasidir. *DEF* uchburchagining *H* va *W* proyeksiyalar tekisliklari bo'yicha proektsiyalari *def* va *d'e'f'* uchburchaklar bo'lib, *ABC* uchburchakning haqiqiy kattaligiga teng emas.

Rasm-66 da *KMN* uchburchagi bilan aniqlangan *P* tekislik proektsiyalarning profil tekisligiga perpendikulyar. Bunday tekislik *profil-proektsiyalovchi* deb ataladi.



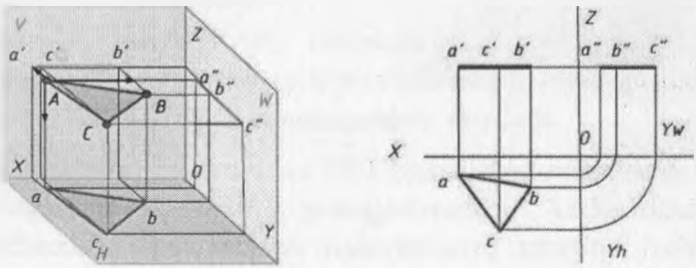
66-rasm

KMN uchburchakning *W* proyeksiyalovchi tekislikdagi proektsiyasi *k''m''* kesmasidir. *KMN* uchburchakning *H* va *V* proyeksiyalar tekisliklaridagi proektsiyalari *KMN* uchburchakning haqiqiy kattaligiga teng bo'lmagan *kmn* va *k'm'n'* uchburchaklardir.

Bir proyeksiya tekisligiga parallel (va boshqa ikki proyeksiya tekisligiga perpendikulyar) tekislik *sath tekisligi* deyiladi.

Sath tekisligida yotgan figura berilgan tekislikka parallel bo'lgan proyeksiya tekisligiga haqiqiy kattalikda proektsiyalanadi. Qolgan ikkita proektsiya - proektsiya o'qlariga parallel chiziqlardir.

Uch xil tekislik sathi mavjud: gorizontal, frontal va profil.



67-rasm

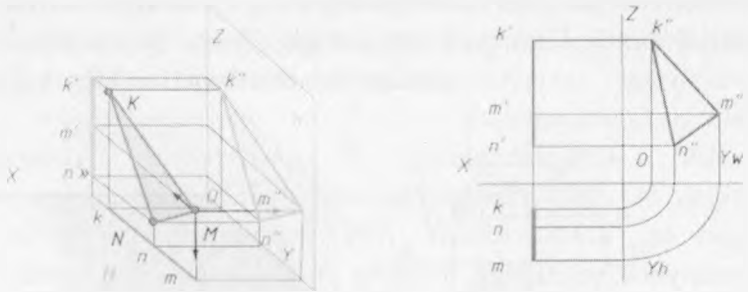
Rasm-67 da *ABC* uchburchagi orqali berilgan *T* tekislik proektsiyalarning gorizontal tekisligiga parallel va *V* va *W* proyeksiyalar tekisliklariga perpendikulyar bo'lib, bunday tekislik *gorizontal* deyiladi.

ABC uchburchagining *H* proyeksiya tekisligidagi proektsiyasi *ABC* uchburchagining haqiqiy kattaligiga teng bo'lgan *abc* uchburchakdir. *ABC* uchburchagining *V* va *W* proyeksiyalar tekisliklari bo'yicha proektsiyalari mos ravishda *x* va *y* proyeksiya o'qlariga parallel ravishda *a'b'* va *a''b''* kesmalardir.

Rasm-68 da *DEF* uchburchagi bilan aniqlangan *R* tekislik proektsiyalarning frontal tekisligiga parallel va *H* va *W* proyeksiyalar tekisliklariga perpendikulyar. Bunday tekislik *frontal tekislik* deb ataladi.

68-rasm

DEF uchburchakning proyeksiyalovchi tekislikdagi proektsiyasi - *DEF* uchburchakning haqiqiy kattaligiga teng *d'e'f'* uchburchak. *DEF* uchburchagining *H* va *W* proyeksiyalar tekisliklari bo'yicha proektsiyalari mos ravishda *x* va *z* proyeksiya o'qlariga parallel ravishda *df* (*chiziq def*) va *f''e''* (*d''e''f''* *chiziq*) kesmalaridir.



69-rasm

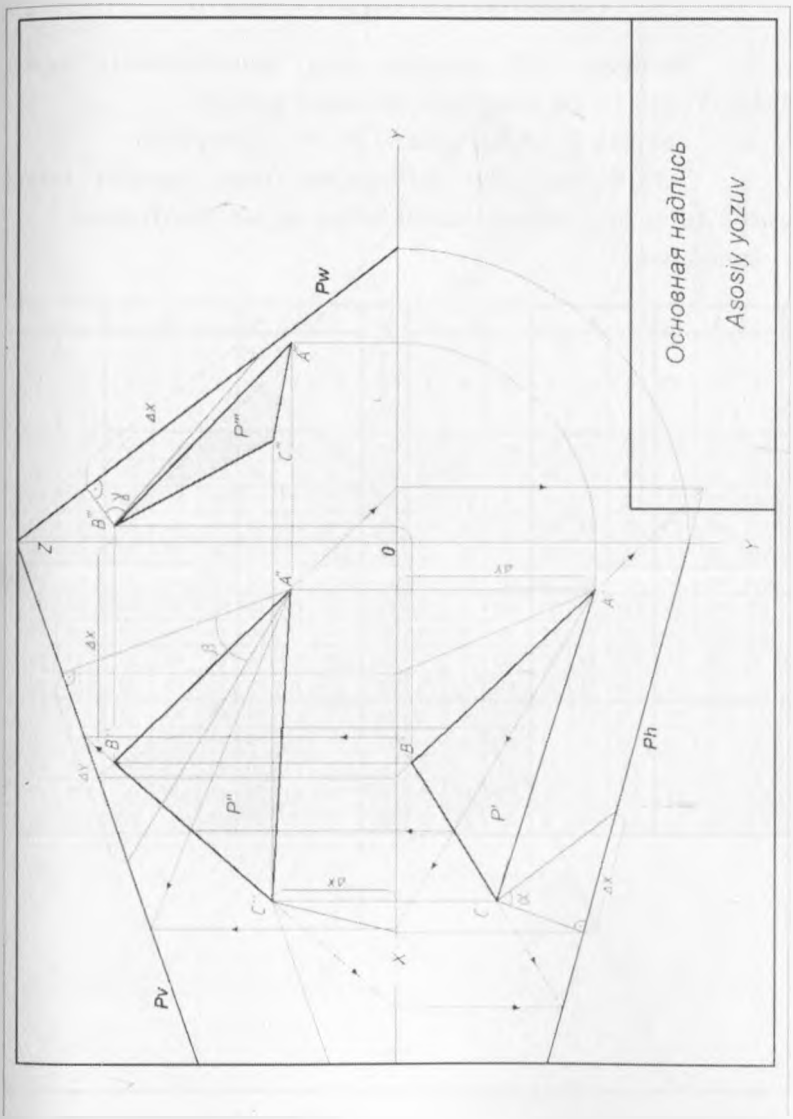
Rasm-69 da *KMN* uchburchagi bilan aniqlangan *P* tekislik proyeksiyalarning profil tekisligiga parallel va *H* va *V* proyeksiyalar tekisliklariga perpendikulyar bo'lib, bunday tekislik *profil tekisligi* deyiladi.

Mustahkamlash uchun savollar

1. Qaysi chiziq sath chizig'i deb ataladi?
2. Qanday tekislik umumiy vaziyatdagi tekislik deb ataladi?
3. Qanday tekislik proyeksiyalovchi deb ataladi?
4. Qaysi tekislik sath tekislik deb ataladi?
5. Nuqta qanday vaziyatda yuzaga tegishlidir?

Hisob grafik ish, variant topshiriqlari

HGI-5. Tekislik analizini bajarish namunasi (to'liq bo'lmagan).



HGI-5. Tekislik analizinini bajarish shartlari va variantlari (to'liq bo'lmagan)

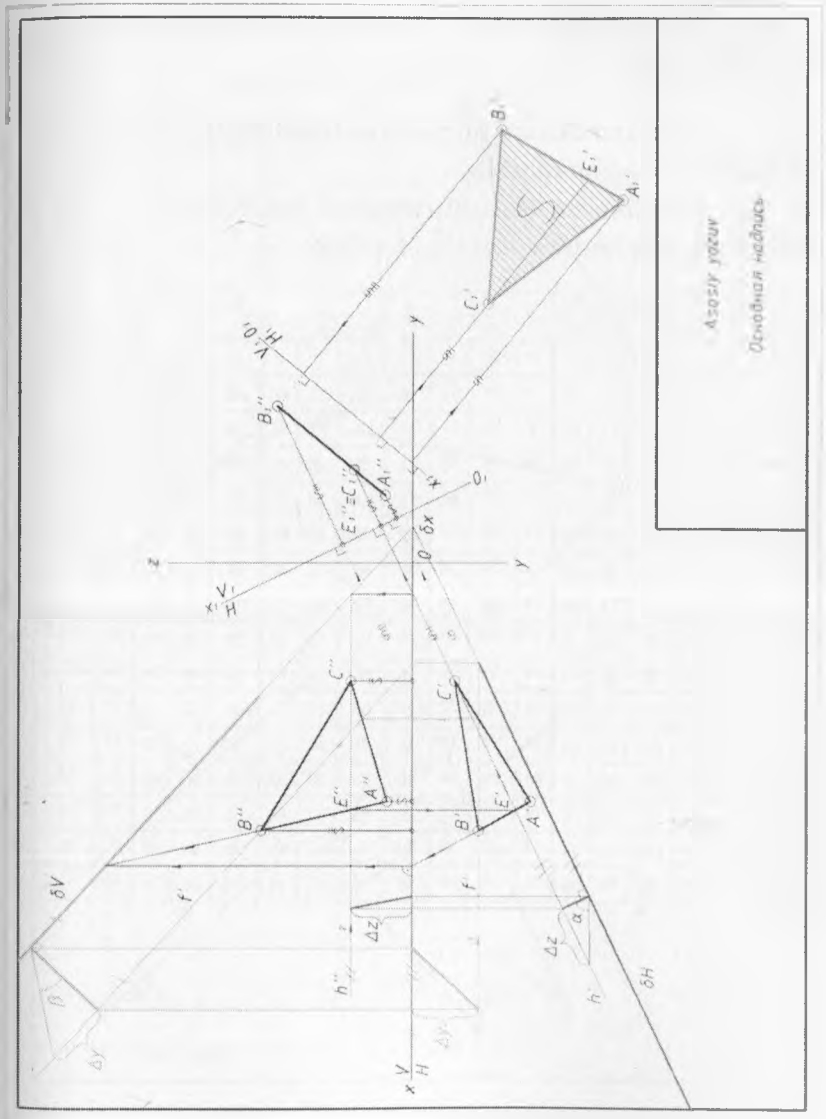
1. Berilgan ABC nuqtalarining koordinatalari asosida tekislik $P(\triangle ABC)$ning kompleks chizmasi qurilsin.

2. Tekislik $P(\triangle ABC)$ izlari – Ph, Pv, Pw topilsin.

3. To'g'ri burchakli uchburchak usuli asosida tekislik $P(\triangle ABC)$ning proyeksiya tekisliklariga og'ish burchaklari – α, β va γ aniqlansin.

Variant №	A			B			C			Variant №	A			B			C		
	X	Y	Z	X	Y	Z	X	Y	Z		X	Y	Z	X	Y	Z	X	Y	Z
1.	115	92	10	52	20	80	10	84	50	**16.**	124	66	54	16	87	6	70	15	78
2.	117	91	9	48	22	75	5	86	48	**17.**	117	9	90	52	79	25	0	48	83
3.	114	90	11	50	21	81	9	82	51	**18.**	115	7	85	50	80	25	0	50	85
4.	112	89	12	55	23	82	6	80	52	**19.**	120	10	90	48	82	20	0	52	82
5.	116	94	13	46	25	78	7	88	53	**20.**	116	8	88	50	78	25	0	46	80
6.	120	95	5	51	18	77	8	85	47	**21.**	115	10	92	50	80	25	0	50	85
7.	22	57	35	130	76	10	100	6	70	**22.**	117	75	40	52	6	107	0	38	47
8.	24	55	36	129	76	11	98	5	75	**23.**	18	10	90	83	79	25	135	48	82
9.	26	54	34	132	74	8	102	4	72	**24.**	20	12	92	85	89	25	135	50	85
10.	22	57	36	128	78	6	95	0	74	**25.**	15	10	85	80	80	20	130	50	80
11.	23	56	33	131	77	9	99	6	73	**26.**	16	12	88	85	80	25	130	50	80
12.	26	56	36	132	76	12	100	6	70	**27.**	18	12	85	85	80	25	135	50	80
13.	123	65	55	15	90	10	74	10	75	**28.**	18	90	10	83	25	79	135	83	48
14.	120	68	52	17	88	8	75	12	76	**29.**	18	40	75	83	117	6	135	47	38
15.	125	64	50	14	92	5	72	14	77	**30.**	18	75	40	83	6	107	135	38	47

HGI-6. Tekislik analizini bajarish namunasi (to'liq)



IIGI-6. Tekislik analizini bajarish namunasi (to'liq).

1. Berilgan ABC uchlarining koordinatalari asosida uchburchakning kompleks chizmasi qurilsin.

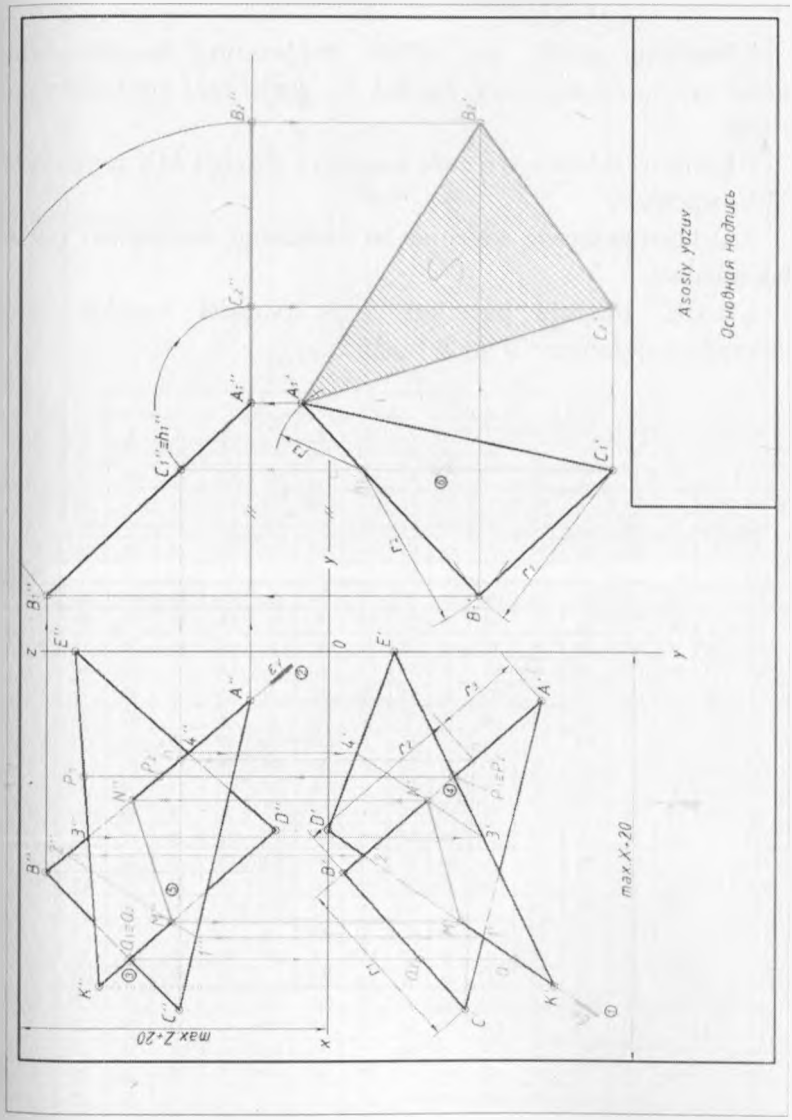
2. Uchburcak ABC izlari δH va δV topilsin.

3. Uchburchakning proyeksiya tekisliklariga og'ish burchaklari α va β aniqlansin.

4. Tekisliklarni almashtirish usuli yordamida uchburchakning haqiqiy kattaligi topilsin.

Var. №	Koordinatalar									Var. №	Koordinatalar								
	A			B			C				A			B			C		
	x	y	z	x	y	z	x	y	z		x	y	z	x	y	z	x	y	z
1	94	70	30	30	16	70	10	36	12	16	90	32	80	60	80	24	12	50	30
2	70	40	12	110	16	70	10	52	36	17	94	72	30	32	18	68	12	34	12
3	106	32	34	20	16	80	56	100	20	18	70	38	12	108	16	68	14	50	36
4	90	40	80	64	70	22	10	10	14	19	106	30	32	20	18	80	54	96	20
5	94	70	30	30	18	72	12	36	12	20	86	40	80	60	66	20	12	10	10
6	70	42	14	110	18	72	12	52	34	21	92	72	32	34	14	70	10	40	10
7	104	30	32	20	16	80	54	96	18	22	72	40	16	106	14	72	12	52	30
8	92	40	84	60	66	20	12	12	16	23	104	30	30	20	18	80	50	116	24
9	92	70	32	30	16	72	14	38	10	24	84	36	76	60	60	20	12	12	12
10	72	44	16	112	14	74	12	54	32	25	90	70	30	30	20	70	8	40	10
11	104	30	36	20	18	84	50	92	18	26	70	40	16	110	12	72	12	50	32
12	88	38	78	60	68	20	14	14	14	27	104	28	32	16	20	80	50	90	20
13	90	72	32	32	16	72	14	38	10	28	92	40	80	66	70	30	30	10	10
14	72	40	16	112	14	74	12	52	30	29	94	70	30	30	18	70	8	36	12
15	108	32	32	20	18	80	52	96	18	30	70	42	14	110	16	70	16	52	34

HGI-7.Tekisliklarni o'zaro kesishuvini bajarish namunasi.



HGI-7. Tekisliklarni o'zaro kesishuvini bajarish shartlari va variantlari

1. Berilgan ΔABC va ΔDEK uchlarining koordinatalari asosida uchburchaklarning frontal va gorizontal proyeksiyalari qurilsin.

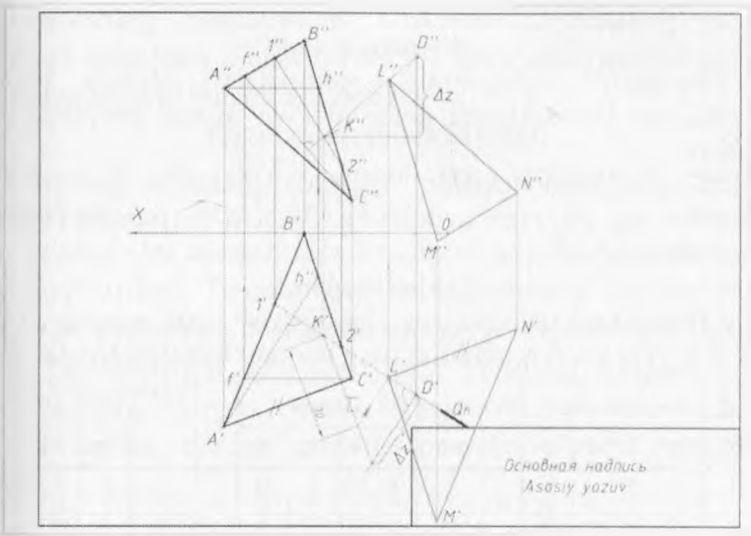
2. Uchburcaklarning o'zaro kesishuv chizig'i *MN* topilsin (① va ② bosqichlar).

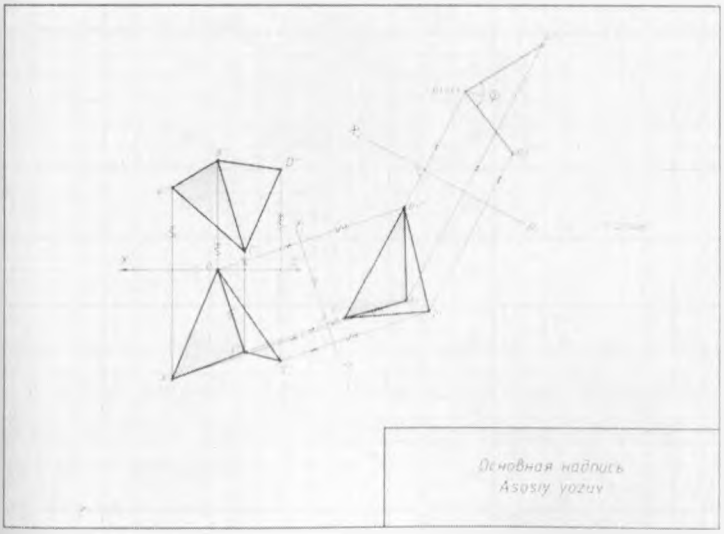
3. Uchburchakning ko'rinar-ko'rinmasligi aniqlansin (③ va ④ bosqichlar).

4. ΔABC haqiqiy kattaligi tekis parallel harakat usuli yordamida aniqlansin (⑤ va ⑥ bosqichlar).

Var. №	*A*			*B*			*C*			*D*			*E*			*K*		
	x	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*
1	115	92	10	52	20	80	10	84	50	70	100	84	130	20	35	16	50	5
2	117	91	9	48	22	75	5	86	48	68	102	80	132	25	36	14	52	10
3	114	90	11	50	21	81	9	82	51	71	100	85	131	24	32	15	51	6
4	112	89	12	55	23	82	6	80	52	75	105	88	135	23	37	10	53	11
5	116	94	13	46	25	78	7	88	53	74	107	90	133	22	40	12	55	12
6	120	95	5	51	18	77	8	85	47	73	106	92	135	26	38	17	56	8
7	22	57	35	130	76	10	100	6	70	72	10	5	135	50	40	35	80	60
8	24	55	36	129	76	11	98	5	75	68	9	4	130	48	35	30	78	55
9	26	54	34	132	74	8	102	4	72	72	8	6	132	47	36	32	82	56
10	22	57	36	128	78	6	95	0	74	75	10	4	134	52	38	34	79	58
11	23	56	33	131	77	9	99	6	73	72	12	8	137	53	42	36	80	59
12	26	56	36	132	76	12	100	6	70	72	11	6	133	51	41	36	78	58
13	123	65	55	15	90	10	74	10	75	5	55	35	40	15	83	118	100	5
14	120	68	52	17	88	8	75	12	76	7	57	36	38	12	85	115	98	6
15	125	64	50	14	92	5	72	14	77	6	58	38	42	13	84	114	97	4
16	124	66	54	16	87	6	70	15	78	9	56	37	36	14	86	116	96	7
17	117	9	90	52	79	25	0	48	83	68	85	110	135	36	19	14	0	52
18	115	7	85	50	80	25	0	50	85	70	85	110	135	20	20	15	0	50
19	120	10	90	48	82	20	0	52	82	65	80	110	130	38	20	15	0	52
20	116	8	88	50	78	25	0	46	80	70	85	108	135	36	20	15	0	52
21	115	10	92	50	80	25	0	50	85	70	85	110	135	35	20	15	0	50
22	117	75	40	52	6	107	0	38	47	135	0	20	86	48	111	15	68	78
23	18	10	90	83	79	25	135	48	82	68	85	110	0	36	19	121	0	52
24	20	12	92	85	89	25	135	50	85	70	85	110	0	35	20	120	0	52
25	15	10	85	80	80	20	130	50	80	70	80	108	0	35	20	120	0	50
26	16	12	88	85	80	25	130	50	80	75	85	110	0	30	15	120	0	50
27	18	12	85	85	80	25	135	50	80	70	85	110	0	35	20	120	0	50
28	18	90	10	83	25	79	135	83	48	67	110	85	0	19	36	121	52	0
29	18	40	75	83	117	6	135	47	38	67	20	0	0	111	48	121	78	86
30	18	75	40	83	6	107	135	38	47	67	0	20	0	48	111	121	86	78

HGI-8. Pozitsion va metrik masalalarni bajarish namunasi.





HGI-8 Pozitsion va metrik masalalarni bajarish shartlari va variantlari

(Birinchi qism)

1. Berilgan nuqtalarning koordinatalari asosida tekislik $P(\triangle ABC)$ va D nuqtaning gorizontal va frontal proyeksiyalari qurilsin.

2. D nuqtadan tekislik $P(\triangle ABC)$ gacha bo'lgan masofa aniqlansin va 30 mm uzoqlikda $Q(\triangle LMN)$ parallel tekislik o'tkazilsin..

(Ikkinchi qism)

3. Proyeksiya tekisliklarini almashtirish usuli asosida $\triangle ABC$ va $\triangle DBC$ ikki yoqli burchak ϕ ning haqiqiy kattaligi aniqlansin.

Var. №	Koordinatalar	Nuqtalar				Var. №	Koordinatalar	Nuqtalar				Var. №	Koordinatalar	Nuqtalar			
		A	B	C	D			A	B	C	D			A	B	C	D
1.	X	55	40	0	60	11.	X	70	40	0	65	21.	X	80	0	30	70
	Y	20	0	25	60		Y	60	0	45	15		Y	0	20	45	75
	Z	10	60	20	25		Z	45	55	10	0		Z	40	70	0	65
2.	X	60	40	0	65	12.	X	65	40	0	70	22.	X	65	10	0	35
	Y	65	5	50	25		Y	20	5	50	65		Y	20	0	60	5
	Z	50	55	10	0		Z	0	55	5	55		Z	10	20	60	75
3.	X	75	75	45	5	13.	X	60	45	0	10	23.	X	70	40	0	65
	Y	30	65	15	55		Y	60	15	5	45		Y	45	55	10	0
	Z	55	15	0	10		Z	10	55	25	50		Z	60	0	45	15
4.	X	85	25	15	65	14.	X	30	45	5	70	24.	X	65	40	0	70
	Y	0	55	25	55		Y	65	50	10	20		Y	0	55	5	55
	Z	65	50	15	15		Z	20	50	10	10		Z	20	5	50	65
5.	X	65	50	10	10	15.	X	65	40	0	50	25.	X	55	30	10	60
	Y	15	55	35	70		Y	15	0	40	60		Y	70	50	20	55
	Z	35	70	65	25		Z	0	55	10	55		Z	20	5	60	55
6.	X	65	75	55	5	16.	X	60	45	5	75	26.	X	80	45	0	10
	Y	85	70	0	15		Y	65	0	10	15		Y	10	70	40	15
	Z	85	0	20	0		Z	30	60	20	10		Z	20	0	45	0
7.	X	75	60	40	0	17.	X	75	30	10	60	27.	X	65	25	0	60
	Y	30	60	0	65		Y	25	5	60	55		Y	55	5	25	10
	Z	0	70	60	20		Z	0	50	20	55		Z	20	5	50	55
8.	X	65	60	45	0	18.	X	80	45	0	10	28.	X	75	35	0	65
	Y	10	60	65	25		Y	20	0	45	0		Y	25	65	0	0
	Z	45	80	15	50		Z	10	70	40	15		Z	5	55	25	65
9.	X	65	10	0	35	19.	X	65	25	0	60	29.	X	55	75	0	45
	Y	10	20	60	70		Y	20	5	50	55		Y	20	70	45	50
	Z	20	0	60	5		Z	55	5	25	10		Z	30	0	40	50
10.	X	70	45	0	20	20.	X	75	35	0	65	30.	X	70	45	30	10
	Y	0	50	20	50		Y	5	55	25	55		Y	60	0	45	50
	Z	60	10	10	55		Z	25	65	0	0		Z	45	60	10	55

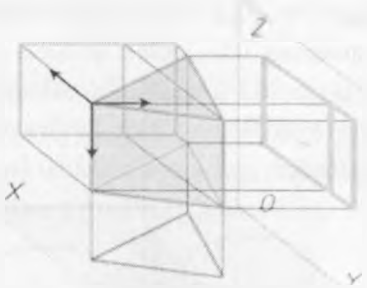
Geometrik jismlarning to'g'riburchakli proektsiyalari

Aksariyat narsalarning shakli har xil geometrik jismlarning yoki ularning qismlarining birikmasidir. Shuning uchun, chizilgan rasmlarni o'qish uchun siz geometrik jismlar qanday tasvirlanganligini bilishingiz kerak.

Prizmaning proektsiyalari

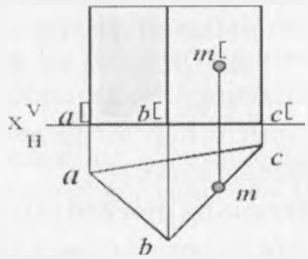
Rasm-70 da to'g'ri muntazam uchburchak prizma ko'rsatilgan.

Prizma - bu asoslari mos keladigan parallel tomonlari bilan teng ko'pburchak. Prizma - parallelogrammning yon tomonlari. Agar yon yuzlarning chekkalari asosga perpendikulyar bo'lsa, u holda prizma to'g'ri deb nomlanadi. Prizmani aniqlash uchun uning asosini va yon chetini birini ko'rsatish kifoya. To'g'ri prizma uchun barcha qirralar proyeksiyalovchi tekisliklari bo'ladi.



70-rasm

Agar nuqta sirtga tegishli har qanday chiziqqa tegishli bo'lsa, u sirtga tegishli. Agar chiziq sirtga tegishli nuqtalardan o'tib ketsa, u sirtga tegishli. 71-rasmda to'g'ri prizmaning ikkita proektsiyasi ko'rsatilgan.

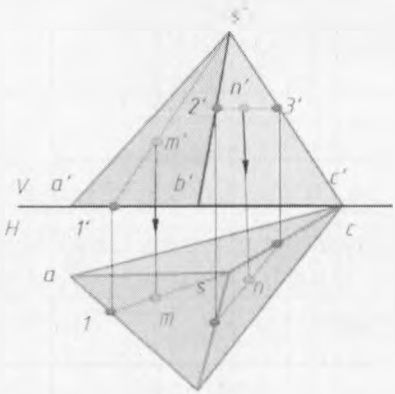


71-rasm

M' proyeksiya bilan berilgan M nuqta prizma yuzasiga tegishli. M nuqtaning gorizontal proyeksiyasini topish talab etiladi. BC yoq proyeksiyalovchi bo'lganligi sababli, ushbu yoqda joylashgan barcha nuqtalarning proyeksiyalari ushbu yoq asosida bo'ladi 71-rasmda.

Piramidaning proektsiyalari

Piramida - bu bitta yuzi asosli ko'pburchak (ixtiyoriy *ABCD* ko'pburchak). Qolgan (yon yoqlar) yuzlar piramidaning tepasi deb ataladigan umumiy *S* uchi bo'lgan uchburchaklardir. Chizilgan rasmda piramidani aniqlash uchun uning asosini va tepasini ko'rsatish kifoya. Rasm-72 da to'g'ri piramidaning ikkita proektsiyasini ko'rsatadi.



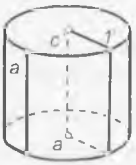
72-rasm

Piramidaning yuzasida nuqta proektsiyasini qurish uchun shu nuqta orqali to'g'ri chiziq chizish kerak. Masalan, agar *SAB* yuziga tegishli *M* nuqtaning frontal proyeksiyasi ko'rsatilgan bo'lsa, u holda gorizontal proektsiyani qurish uchun shu nuqta orqali *S1* to'g'ri chiziq chizish kerak. Shuningdek, frontal proyeksiyada berilgan *N* nuqta orqali *BC* piramida asosining uchburchagi tomoniga parallel ravishda *2-3* to'g'ri chiziq chizamiz. *2-3* to'g'ri chiziqning gorizontal proektsiyasini toping, so'ngra *N* nuqtaning gorizontal proektsiyasini aniqlang.

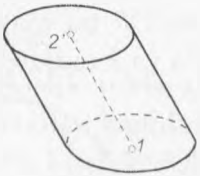
Silindr proektsiyalari

Silindr - bu ikkita aylanadan iborat bo'lib, parallel to'g'ri chiziqlar bilan birlashtirilgan va bu doiralarning tegishli nuqtalarini birlashtiruvchi barcha kesmalar. Aylanalar silindrning , aylanalarning mos keladigan nuqtalarini bog'laydigan chiziq kesmalari silindrning deyiladi.

Rasm-73 silindrni ko'rsatadi. *O* va *O1* markazlari bo'lgan doiralar uning asoslari, *AA1*, *BB1*, *CC1* uning yasovchilari. Agar uning yasovchilari asoslar tekisliklariga perpendikulyar bo'lsa, silindr to'g'ri deb nomlanadi. Rasm-74 da qiya silindr ko'rsatilgan. Silindrning - bu uning asosining radiusi. Silindrning *balandligi* bu asos tekisliklari orasidagi masofa. Silindrning bu asoslar markazidan o'tuvchi to'g'ri chiziq.



73-rasm

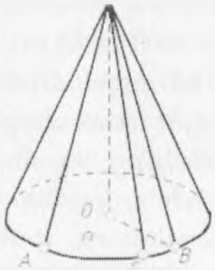


74-rasm

Konusning proektsiyalari

Konus deganda aylana - konusning *asosi*, bu aylana tekisligida yotmaydigan nuqta - konusning ustki qismi va konusning yuqori qismini asos nuqtalari bilan bog'laydigan

barcha kesmalardan iborat yon yoqni aytamiz. Konusning yuqori qismini asos atrofi nuqtalari bilan bog'laydigan kesmalar deyiladi. Konus yuzasi asos va yon sirtdan iborat. Rasm-75 da dumaloq konusni tasvirlaydi. *S* - konusning yuqori uchi (qismi), O nuqtada markazlashgan aylana - konusning asosi, *SA, SB, SC* - konusning yasovchilari.

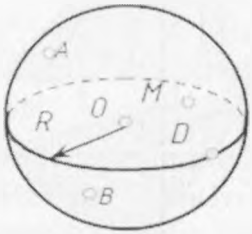


75-rasm

Agar konusning yuqori qismini asos markazi bilan bog'laydigan to'g'ri chiziq asos tekisligiga perpendikulyar bo'lsa, konus to'g'ri deb nomlanadi.

Sharning proektsiyalari

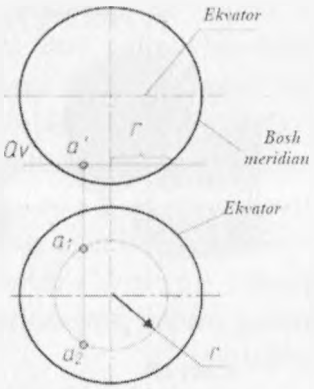
Shar - bu ma'lum bir nuqtadan ma'lum masofada joylashgan fazodagi barcha nuqtalardan iborat sirtdir. Ushbu *O* nuqta va *OR* bu masofa deb ataladi. Rasm-76 *O* nuqtada va *R* radiusda joylashgan shar ko'rsatilgan.



76-rasm

A, B, M va *O* nuqtalari ushbu sharga tegishli. Sharning chegarasi sharsimon sirt yoki *sfera* deb ataladi. Shar sirtining ikki nuqtasini birlashtiruvchi va sharning o'rtasidan o'tuvchi kesma diametr deyiladi. Har qanday diametrning uchlari sharning qarama-qarshi diametrli nuqtalari deyiladi.

Shar yarim yoyni uning diametri atrofida aylantirish orqali hosil bo'ladi. Aylana sirtining o'qidan o'tadigan tekislik *meridional* deb ataladi. Uning sirt bilan kesishish chizig'i *meridian*. Proektsiyalarning frontal tekisligiga parallel bo'lgan meridian *asosiy meridian* deb ataladi (78-rasm). Aylanish o'qiga perpendikulyar bo'lgan tekislikda yotgan eng katta aylana *ekvator* deb ataladi.



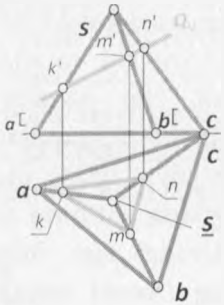
78-rasm

Geometrik jismlarning tekisliklar bilan kesishuvi

Geometrik jismlarning kesimlari haqida tushuncha. Piramidaning tekislik bilan kesishuvi

Jismning tekislik bilan kesishuvidan hosil bo'lgan shakl *kesim* deb ataladi. Tekislik yordamida hosil bo'lgan kesma *kesuvchi tekislik* deb ataladi.

Rasm-79 piramidaning kesishuvi frontal proyeksiyalovchi Q tekisligi orqali ko'rsatiladi.



79-rasm

Kesim shakli *KMN* uchburchagi. Uchburchakning uchlari piramida qirralarining *Q* kesuvchi tekislik bilan kesishish nuqtalari. Masalan, *M* nuqta *SB* qirraning *Q* tekislik bilan kesishish nuqtasidir. Uchburchakning yon tomonlari piramida yuzlarining *Q* kesuvchi tekislik bilan kesishish chizig'i *Q*. Masalan, *MN* tomoni *CSB* yuzining tekislik bilan kesishish chizig'i. *Q* .Kesim ko'rinishini tasvirlash usullari.

Kesish tekisligi *Q* frontal proyeksiya bo'lgani uchun, u to'g'ri chiziq bilan frontal proyeksiya tekisligiga proyeksiyalanadi. *K', m', n'* nuqtalarni belgilaymiz - piramida qirralarining *Q* tekislik bilan kesishish nuqtalarining frontal proyeksiyalari. Qismi *k'm'n'* - kesmaning frontal proyeksiyasi.

Keyin, *k', m', n'* nuqtalardan bog'lovchi chiziqlarini qirralarning tegishli gorizontal proektsiyalari bilan tutashguncha torting. *K, m, n* nuqtalarni belgilang va ularni to'g'ri chiziqlar bilan ulang. Uchburchak *kmn* - kesmaning gorizontal proektsiyasi.

Piramidani tekislik bilan kesganda quyidagi shakllar hosil bo'lishi mumkin:

- kesish tekisligi piramida asosiga parallel bo'lsa, asosga o'xshash ko'pburchak;

• agar kesish tekisligi piramida asosiga qiya bo'lsa, asosga o'xshamaydigan ko'pburchak;

• agar kesish tekisligi piramidaning uchidan o'tib, asosga perpendikulyar o'tsa uchburchar

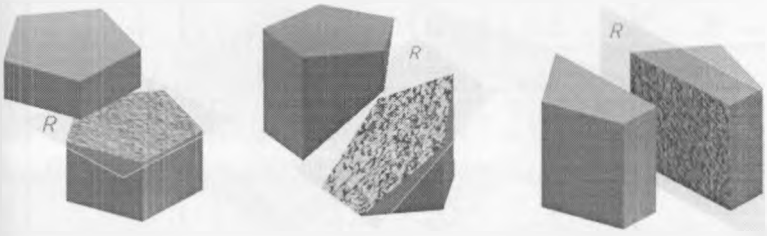
Prizmaning tekislik bilan kesishuvi

Prizmani tekislik bilan kesganda quyidagi shakllar hosil bo'lishi mumkin:

• agar kesish tekisligi prizma asosiga parallel bo'lsa, asosga teng ko'pburchak (80-rasm, *a*);

• agar kesuvchi tekislik prizmaning qirralariga qiya bo'lsa, asosga teng bo'lmagan ko'pburchak (80-rasm, *b*);

• agar kesuvchi tekislik prizmaning yon qirralariga parallel bo'lsa, to'rtburchak (80-rasm, *c*).

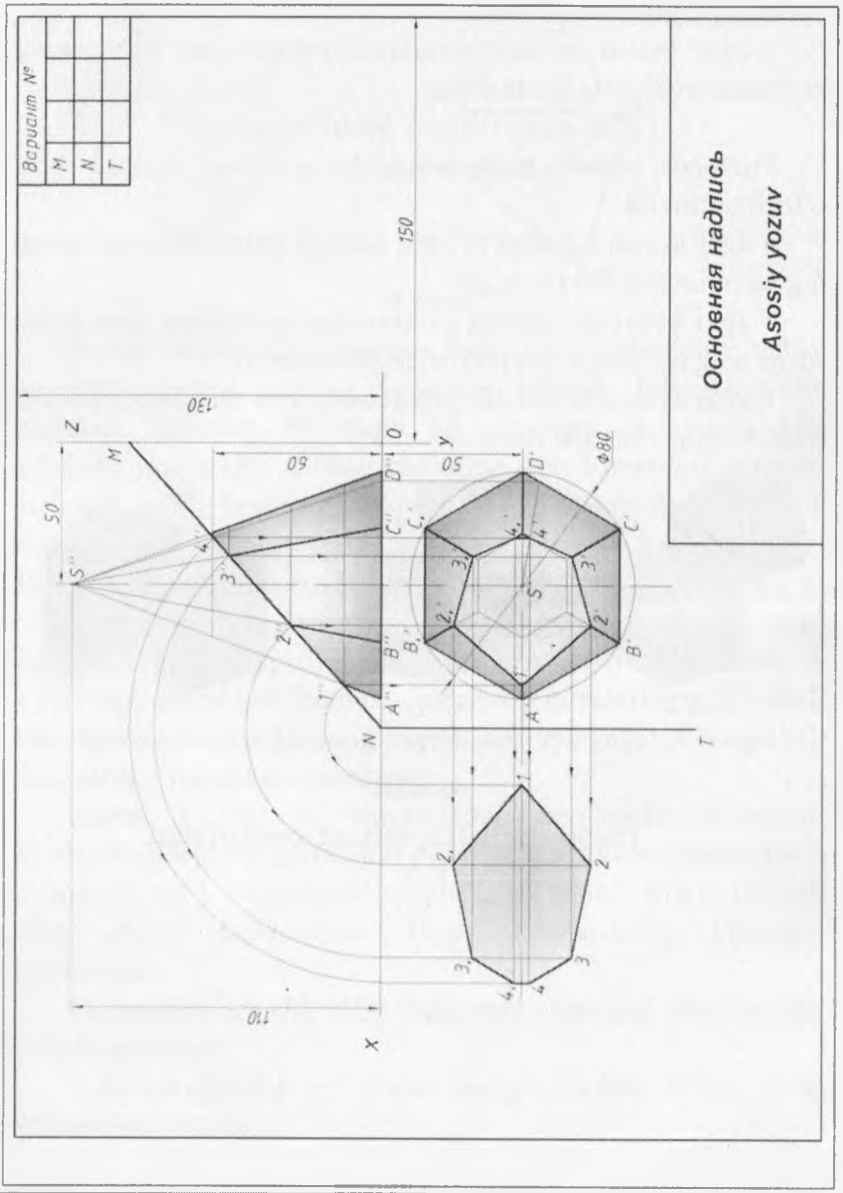


a b c

80-rasm

Hisob grafik ish, variant topshiriqlari.

HGI-9. Piramida va tekislikni bajarish namunasi.



HGI-9. Piramida va tekislikni bajarish shartlari va variantlari

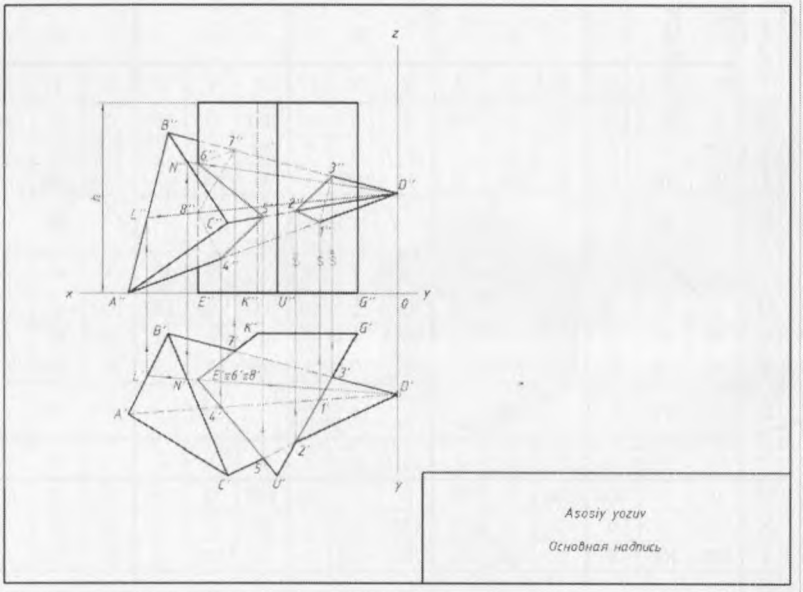
1. Kesik piramidani proyeksiyalovchi tekislik bilan kesishuv chizig'i topilsin. Proyeksiyalovchi tekislikni variant asosida M, N, T nuqtalardan o'tkazilsin.

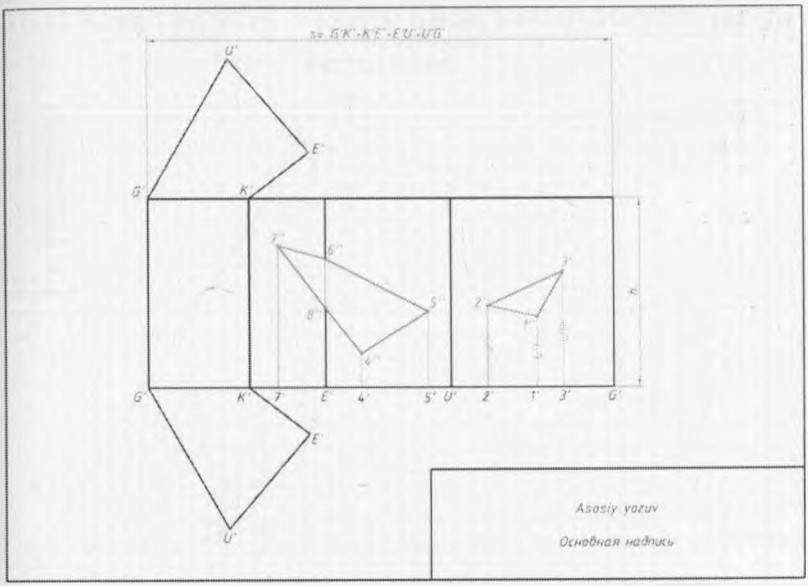
2. Kesim yuzasi haqiqiy kattaligi jipslashtirish usuli bilan aniqlansin.

Var.№	1			2			3			4			5		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	100	100	0	100	0	0	80	100	0	120	0	0	70
N	80	0	0	0	0	0	80	0	0	20	0	0	110	0	0
T	80	100	0	0	100	0	80	100	0	20	100	0	110	100	0
Var.№	6			7			8			9			10		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	100	100	0	80	0	0	80	100	0	130	100	0	50
N	90	0	0	0	0	0	90	0	0	40	0	0	40	0	0
T	90	100	0	0	100	0	90	100	0	40	100	0	40	100	0
Var.№	11			12			13			14			15		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	100	100	0	70	0	0	80	100	0	100	0	0	60
N	100	0	0	0	0	0	100	0	0	40	0	0	80	0	0
T	100	100	0	0	100	0	100	100	0	40	100	0	80	100	0
Var.№	16			17			18			19			20		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	90	100	0	60	0	0	80	100	0	80	0	0	60
N	100	0	0	0	0	0	110	0	0	40	0	0	110	0	0
T	100	100	0	0	100	0	110	100	0	40	100	0	110	100	0
Var.№	21			22			23			24			25		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	90	100	0	50	0	0	70	100	0	60	100	0	100
N	90	0	0	0	0	0	70	0	0	40	0	0	60	0	0
T	90	100	0	0	100	0	70	100	0	40	100	0	60	100	0

Var.№	26			27			28			29			30		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
M	0	0	90	100	0	40	0	0	70	100	0	60	80	0	120
N	80	0	0	0	0	0	80	0	0	60	0	0	60	0	0
T	80	100	0	0	100	0	80	100	0	60	100	0	60	100	0

HGI-10. Piramida va prizma (yoyilma) ni bajarish namunasi.





HGI-10. Piramida va prizma (yoyilma) ni bajarish shartlari va variantlari:

1. Berilgan piramida uchlarining koordinatalari *ABCD* va to'g'ri prizma asosining uchlari koordinatalari *EKGU* hamda uning *h* balandligi asosida ko'pyoqliklarning frontal va gorizontal proyeksiyalari qurilsin.

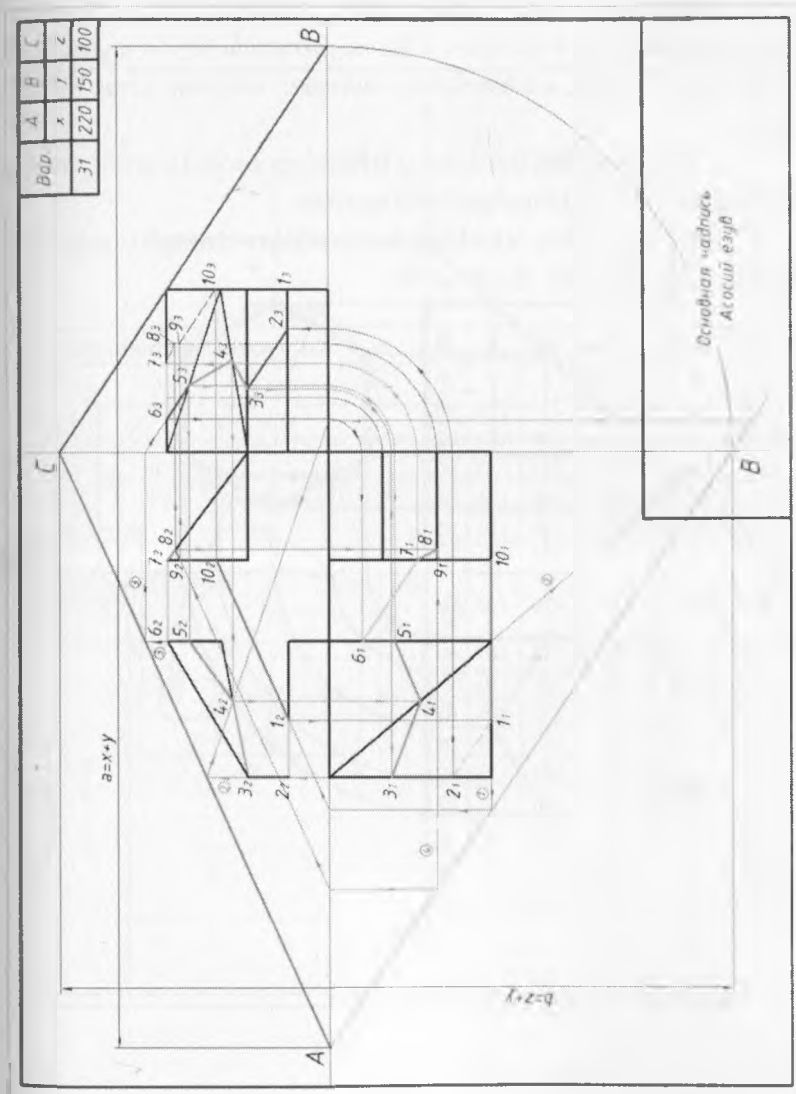
1. Ko'pyoqliklarning o'zaro kesishuv chizig'i topilsin (1, 2,..., 8).

2. Ko'pyoqliklarning ko'rinar-ko'rinmasligi aniqlansin.

3. To'g'ri prizmaning yoyilmasi kesishuv o'yiqlari bilan qurilsin.p

Var. №	Piramida												Prizma												h
	A			B			C			D			E			K			G			U			
	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	14	7	0	12	1	7	8	10	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
2	0	7	0	20	9	7	5	95	4	14	4	4	40	5	0	6	2	0	12	2	0	8	9	0	8
3	0	8	0	20	1	7	5	11	4	14	5	4	40	5	0	6	2	0	12	2	0	8	9	0	8
4	0	6	0	20	7	7	5	93	4	14	4	4	40	5	0	6	2	0	12	2	0	8	9	0	8
5	0	7	0	20	1	7	5	10	4	14	5	4	40	5	0	6	2	0	12	2	0	8	9	0	8
6	0	8	0	20	2	7	5	11	4	14	5	4	40	5	0	6	2	0	12	2	0	8	9	0	8
7	0	8	0	20	2	7	5	11	4	14	6	4	40	5	0	6	2	0	12	2	0	8	9	0	8
8	0	9	0	20	2	7	5	12	4	14	6	4	40	5	0	6	2	0	12	2	0	8	9	0	8
9	0	8	0	15	3	8	5	12	4	14	6	4	40	5	0	6	2	0	12	2	0	8	9	0	8
10	14	7	0	12	9	7	8	95	4	0	4	4	10	5	0	7	2	0	16	2	0	5	9	0	8
11	14	8	0	12	1	7	8	11	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
12	14	6	0	12	7	7	8	93	4	0	4	4	10	5	0	7	2	0	16	2	0	5	9	0	8
13	14	8	0	12	2	7	8	11	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
14	14	8	0	12	2	7	8	11	4	0	6	4	13	5	0	7	2	0	16	2	0	5	9	0	8
15	14	9	0	12	2	7	8	12	4	0	6	4	10	5	0	7	2	0	16	2	0	5	9	0	8
16	13	7	0	11	1	7	8	10	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
17	14	7	0	12	1	7	9	10	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
18	14	9	0	12	3	7	8	12	4	0	7	6	10	5	0	7	2	0	16	2	0	5	9	0	8
19	14	7	0	12	1	8	9	95	4	0	7	4	10	5	0	7	2	0	16	2	0	5	9	0	8
20	14	6	0	12	2	7	8	10	4	0	6	4	10	5	0	7	2	0	16	2	0	5	9	0	8
21	12	1	7	14	7	0	8	10	4	0	5	4	10	5	0	8	1	0	20	2	0	5	9	0	8
22	12	1	8	14	7	0	8	10	4	0	5	4	10	5	0	8	1	0	20	2	0	5	9	0	8
23	12	2	8	14	7	0	8	10	4	0	5	4	98	5	0	7	2	0	18	2	0	5	9	0	8
24	14	7	0	12	1	8	8	95	5	0	5	4	10	5	0	7	2	0	20	2	0	6	9	0	8
25	14	6	0	11	2	7	8	90	4	0	5	4	10	4	0	7	1	0	22	2	0	6	9	0	8
26	13	6	0	12	2	7	8	90	4	0	5	4	10	4	0	7	1	0	20	2	0	6	9	0	8
27	13	6	0	11	2	8	8	90	4	0	5	4	10	4	0	7	2	0	20	2	0	6	9	0	8
28	13	7	5	11	1	7	8	10	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8
29	14	7	5	12	9	7	8	95	4	0	4	4	10	5	0	7	2	0	16	2	0	5	9	0	8
30	14	7	5	12	1	7	9	10	4	0	5	4	10	5	0	7	2	0	16	2	0	5	9	0	8

HGI-11 Ko'pyoqlikni tekislik bilan kesishuvini bajarish namunasi.



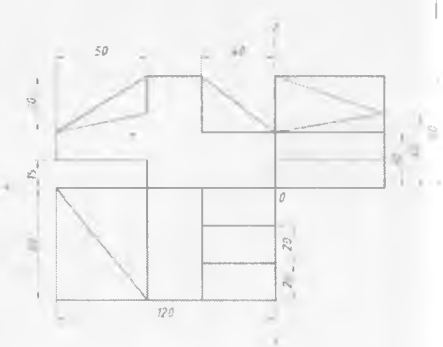
HGI-11. Ko'pyoqlikni tekislik bilan kesishuvini bajarish shartlari va variantlari:

1. Berilgan *ABC* uchlarining o'qlardagi koordinatalari asosida tekislik izlari qurilsin. *Chizma formatida to'g'ri joylashtirish uchun epyur gabarit o'lchamlarini oldindan aniqlash kerak (a=x+y; b=z+y).*

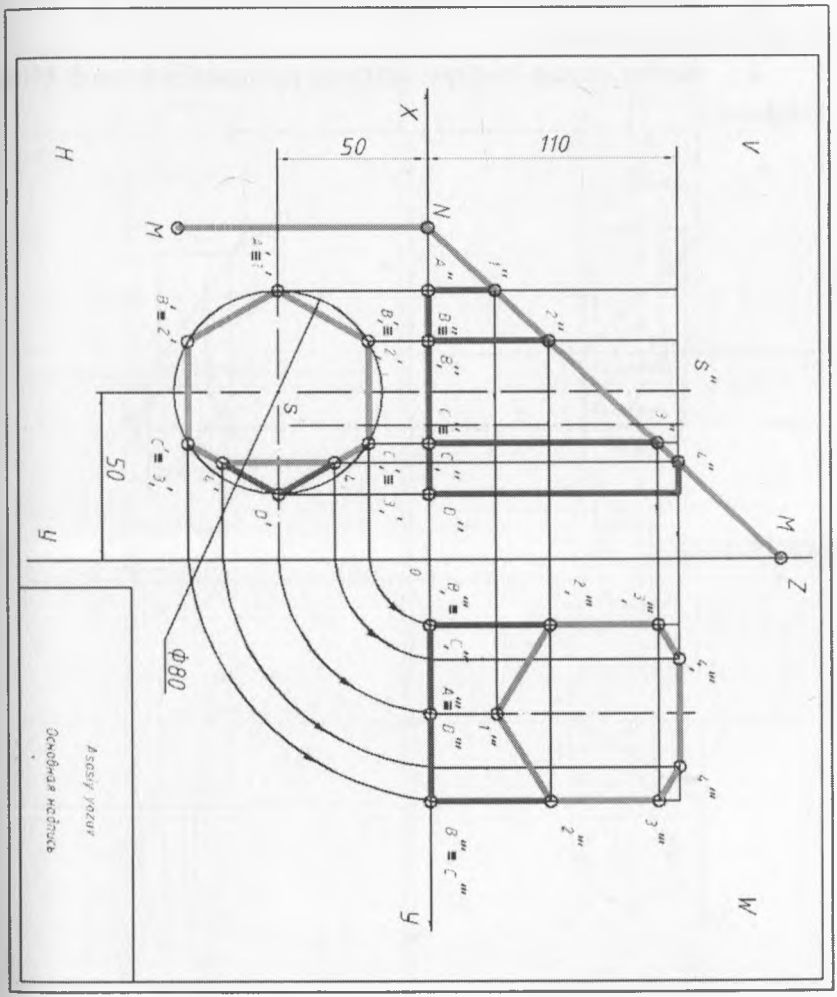
2. Ko'pyoqlikni berilgan o'lchamlari asosida uning asosini koordinatalar boshida joylashtirib qurilsin.

3. Ko'pyoqlikni tekislik bilan kesishuv chizig'i bosqichma-bosqich aniqlansin (①, ②, ③ va ④).

Var. №	A	B	C	Var. №	A	B	C	Ko'pyoqlik o'lchamlari.
	x	*y*	*z*		*x*	*y*	*z*	
1.	210	140	95	16.	210	130	80	
2.	190	140	95	17.	210	120	80	
3.	170	140	95	18.	210	110	80	
4.	210	130	95	19.	190	130	80	
5.	210	110	95	20.	190	120	80	
6.	210	120	95	21.	190	110	80	
7.	190	130	95	22.	170	130	80	
8.	190	120	95	23.	170	120	80	
9.	190	110	95	24.	170	110	80	
10.	170	130	95	25.	200	125	85	
11.	170	120	95	26.	195	115	90	
12.	170	110	95	27.	180	135	90	
13.	210	140	80	28.	200	120	85	
14.	190	140	80	29.	215	110	90	
15.	170	140	80	30.	200	135	85	



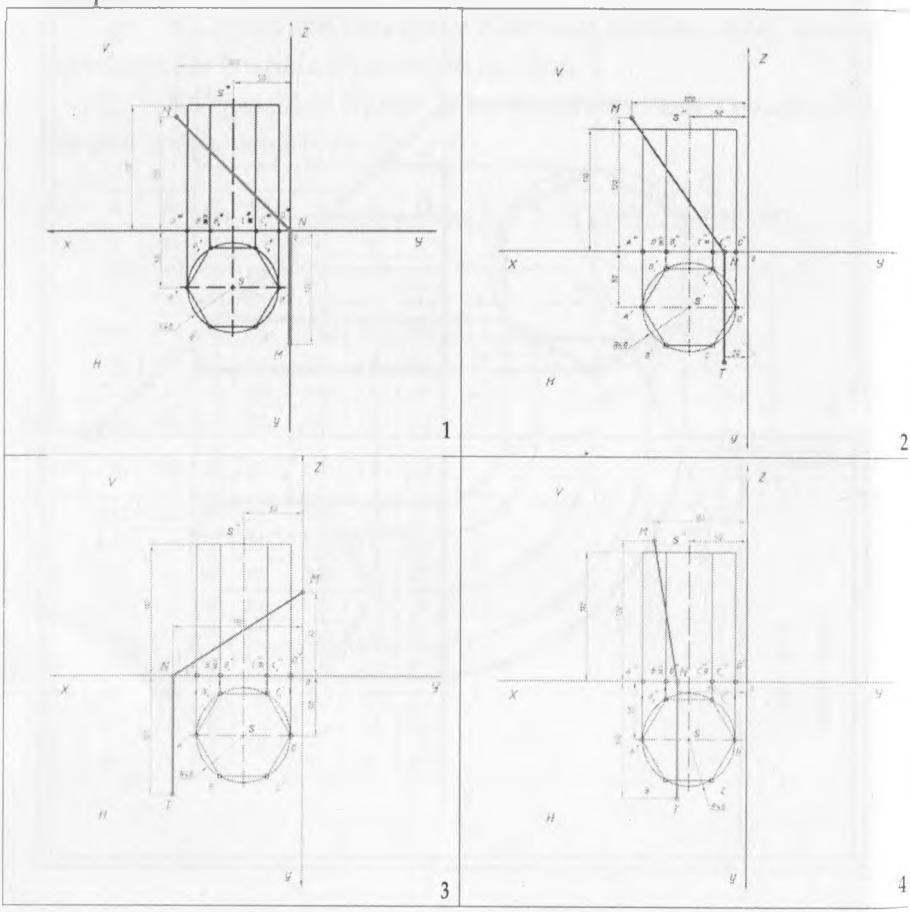
HGI-12. Prizmani tekislik bilan kesishuvini bajarish namunasi.

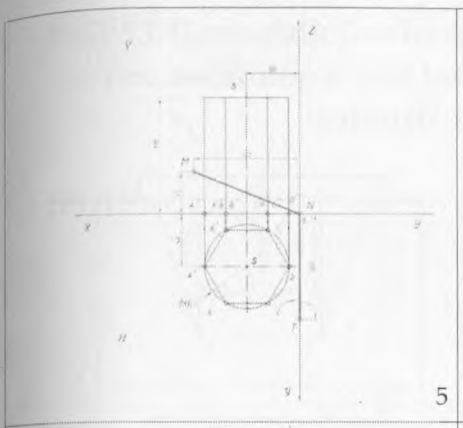


12-HGI. Prizmani tekislik bilan kesishuviga doir variantlari

3. Proyeksiyalovchi tekislikni variant asosida M, N, T nuqtalardan o'tkazilsin.

4. Kesim yuzasi haqiqiy kattaligi jipslashtirish usuli bilan aniqlansin.

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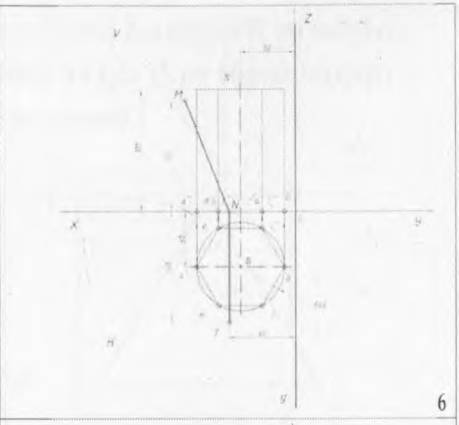
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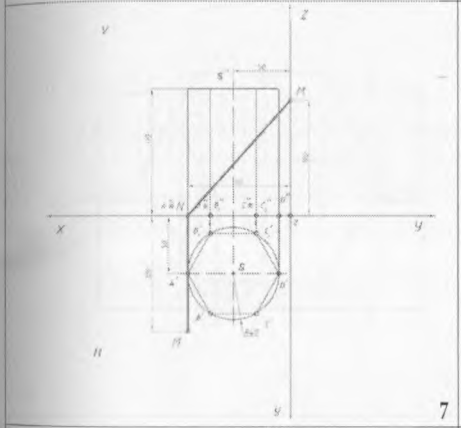
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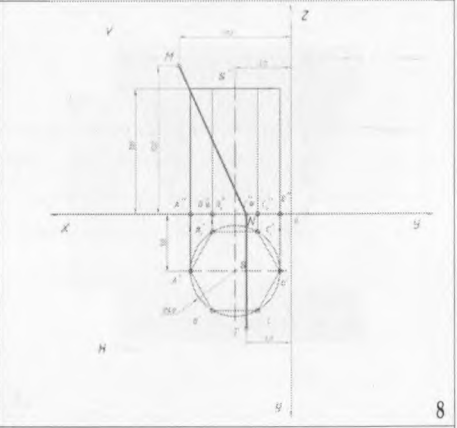
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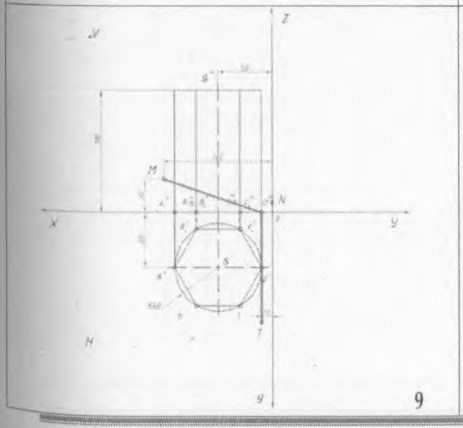
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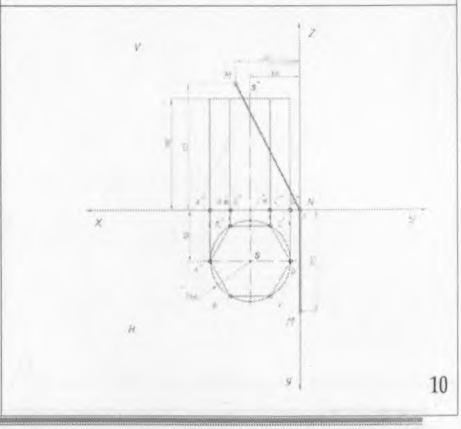
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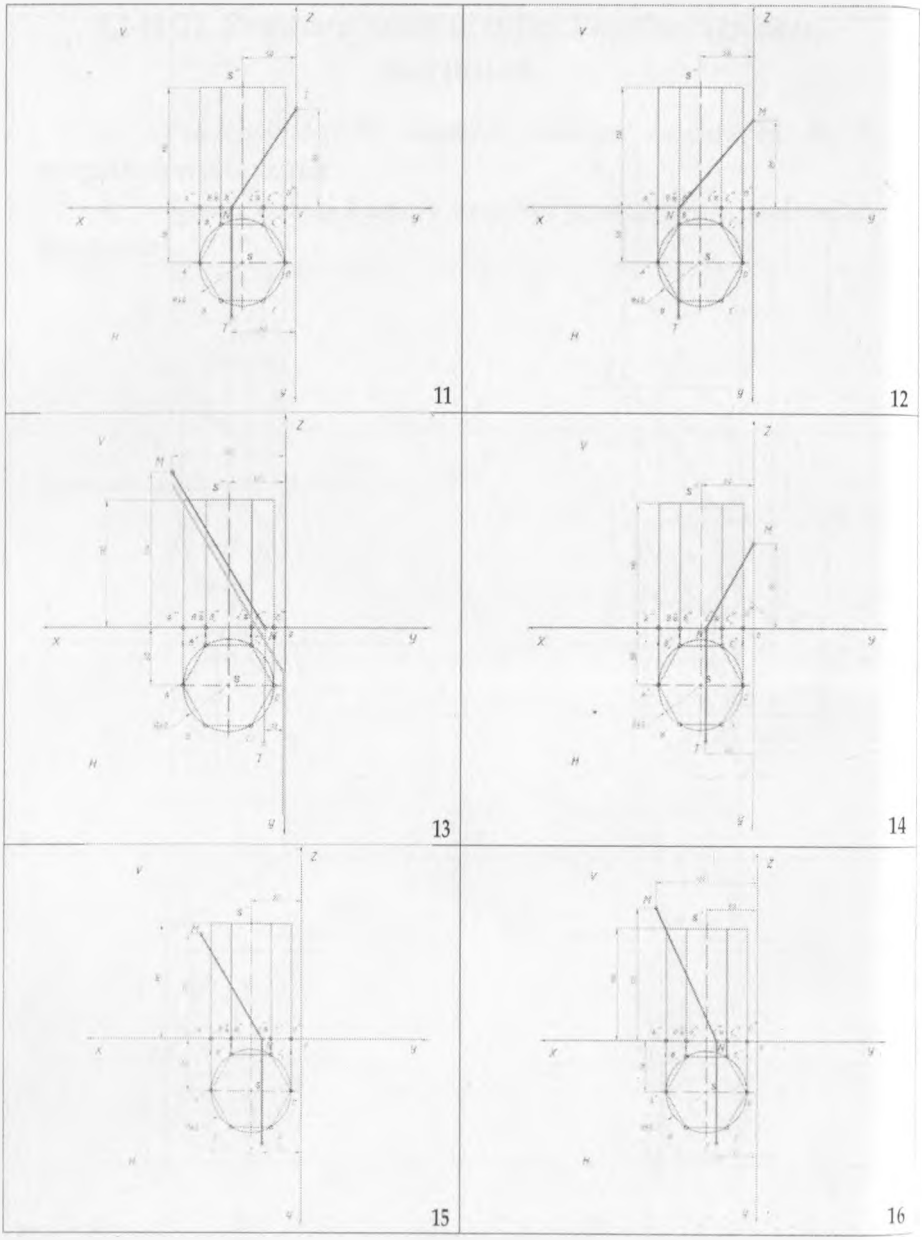
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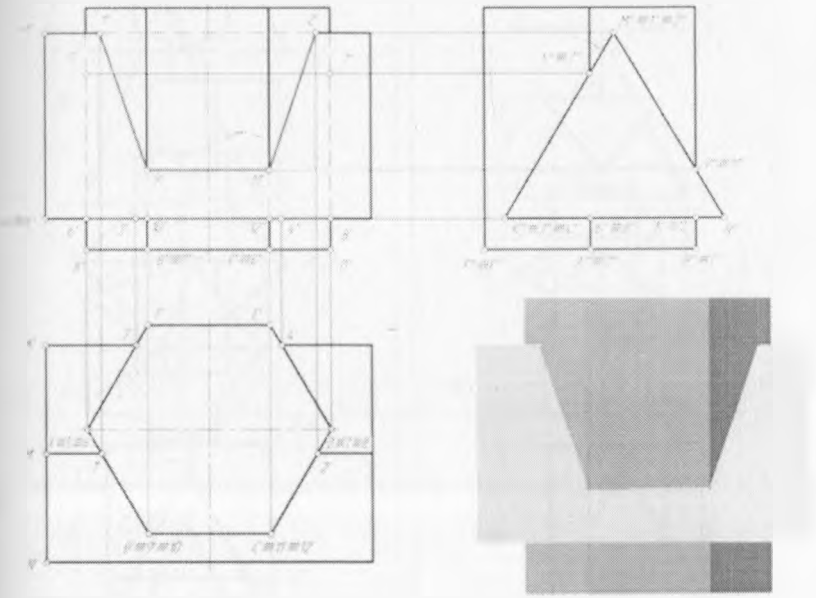
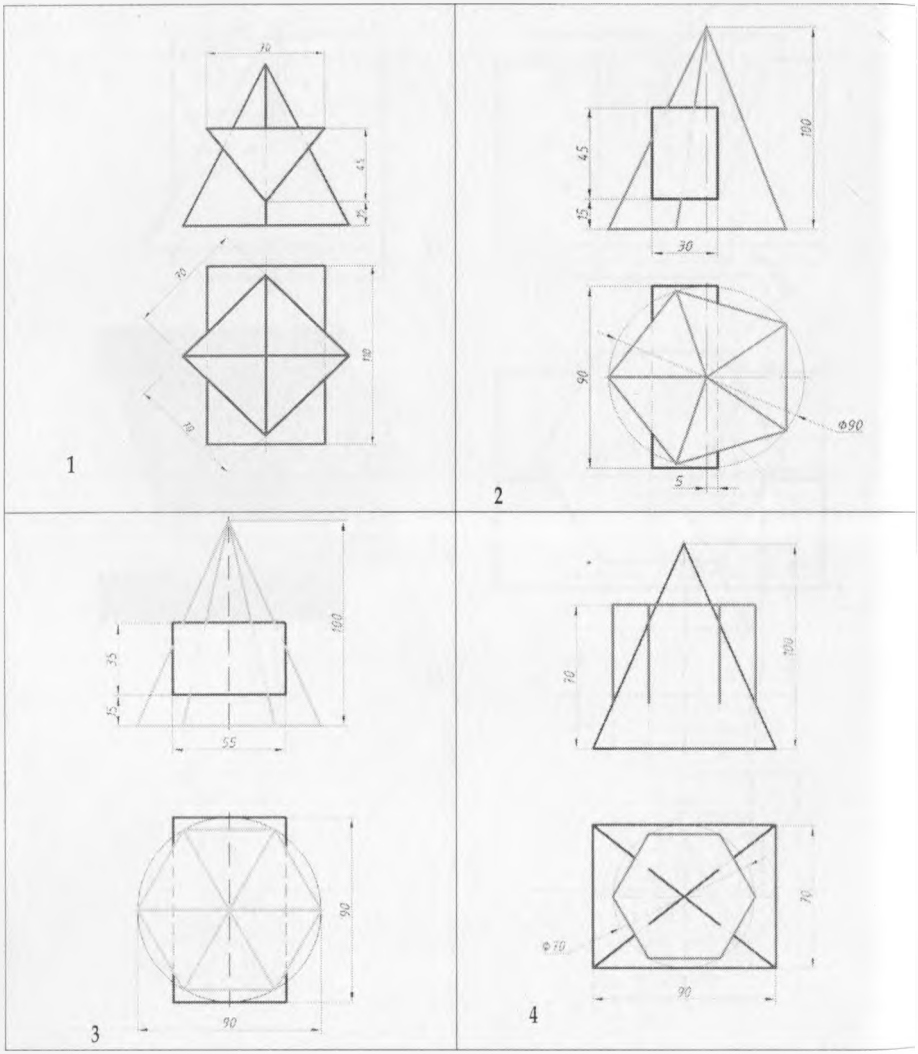
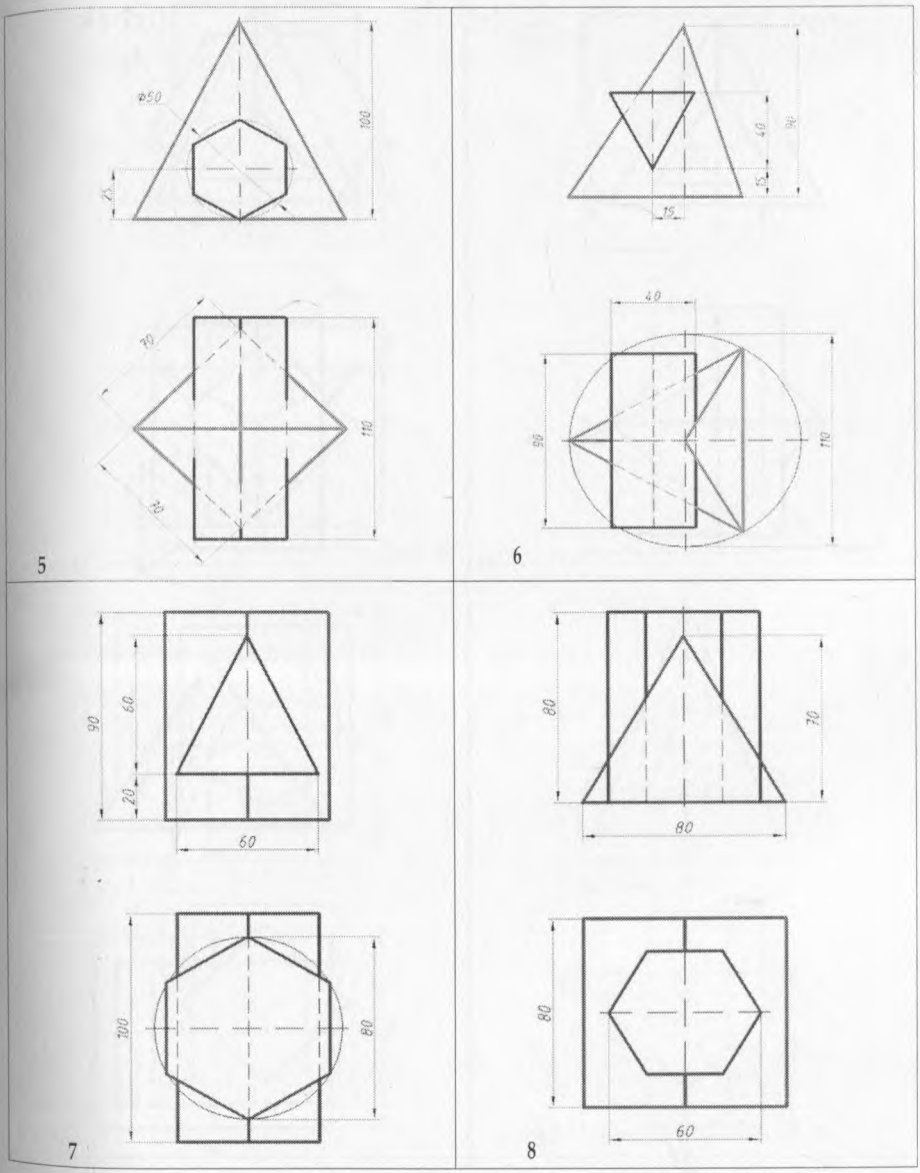
HGI-13. Geometrik jismlardan besh burchakli piramida va prizmalarning o'zaro kesishuviga doir topshiriqni, bajarish namunasi.



HGI-13. Geometrik jismlardan besh, olti, ush burchakli piramida va prizmalarning o'zaro kesishuviga doir variantlar.

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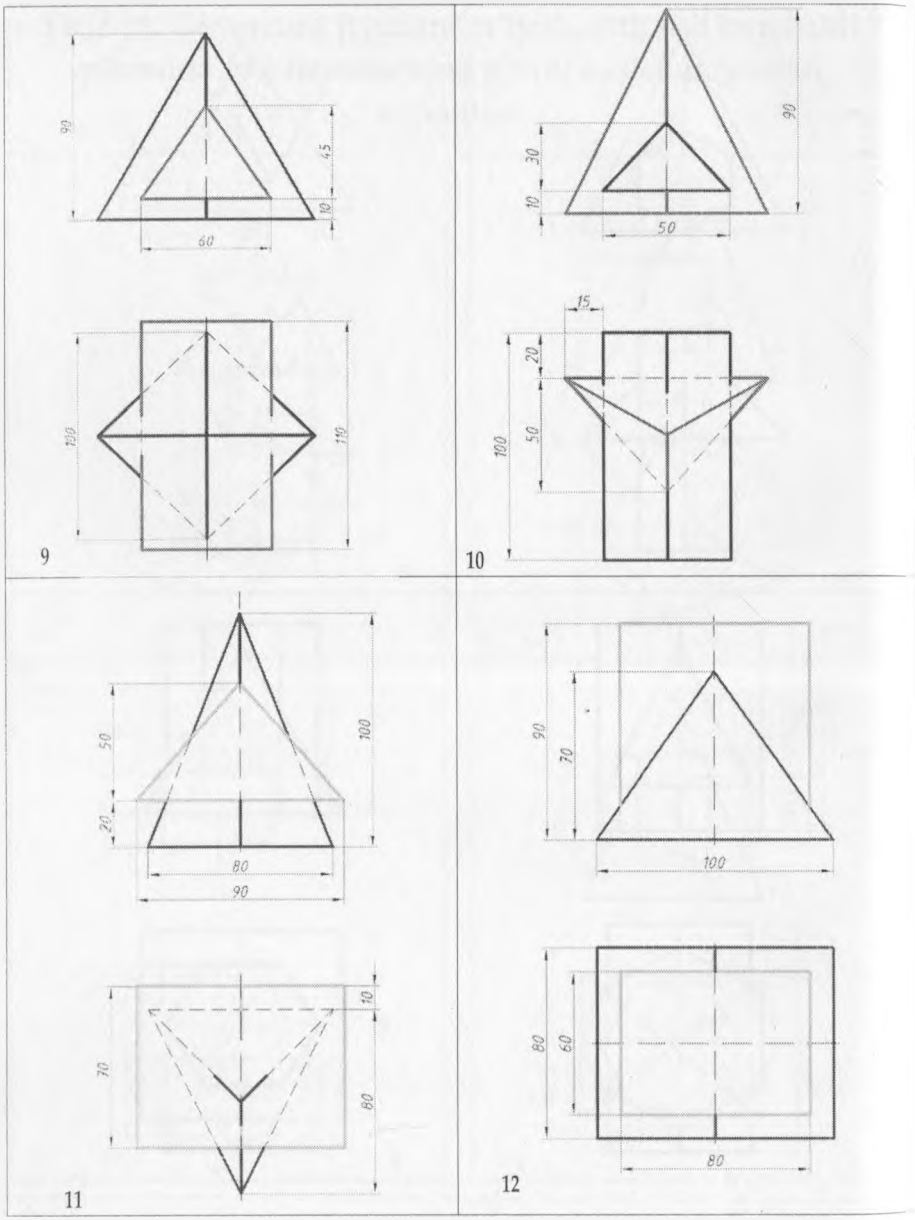
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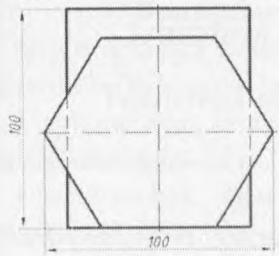
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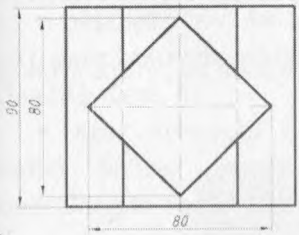
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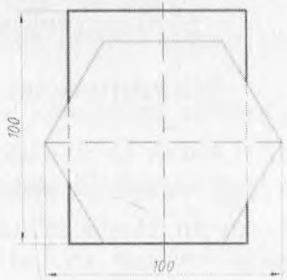
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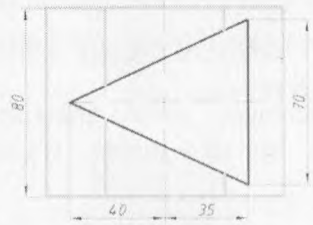
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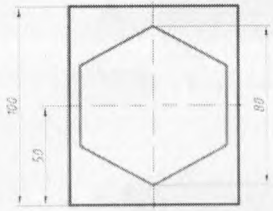
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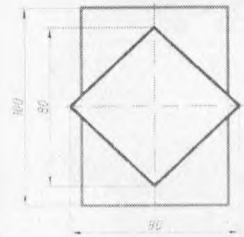
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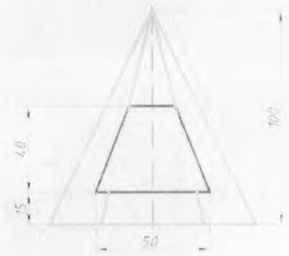
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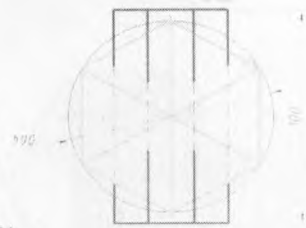
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Sirtlarni tekislik bilan kesishuvi

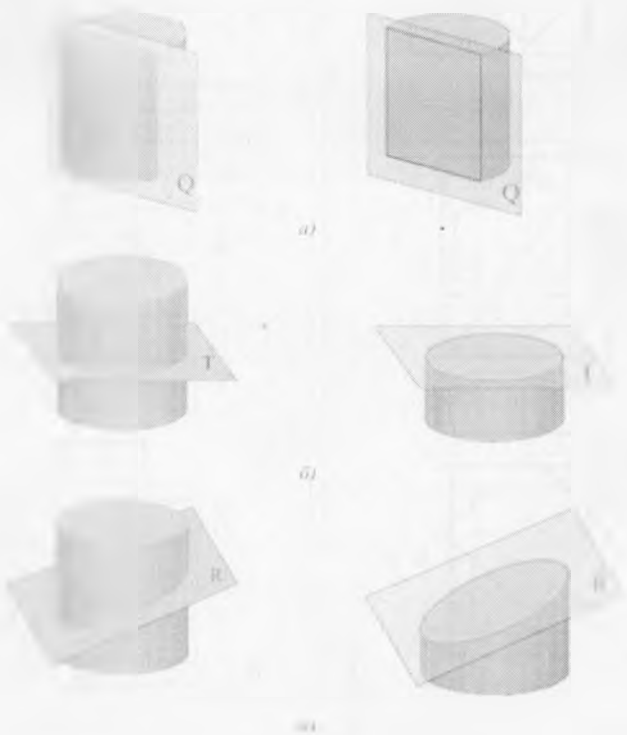
Silindrning tekislik bilan kesishuvi

To'g'ri silindr kesimdagi tekislik bilan kesishganda quyidagi shakllar hosil bo'lishi mumkin:

• kesuvchi tekislik silindr o'qiga parallel bo'lsa, to'rtburchak (81-rasm, *a*);

• kesuvchi tekislik silindr asosriga parallel bo'lsa, aylana (81-rasm, *б*);

• kesuvchi tekislik silindr o'qiga qiya bo'lsa, ellips shaklida bo'ladi (81-rasm, *в*)

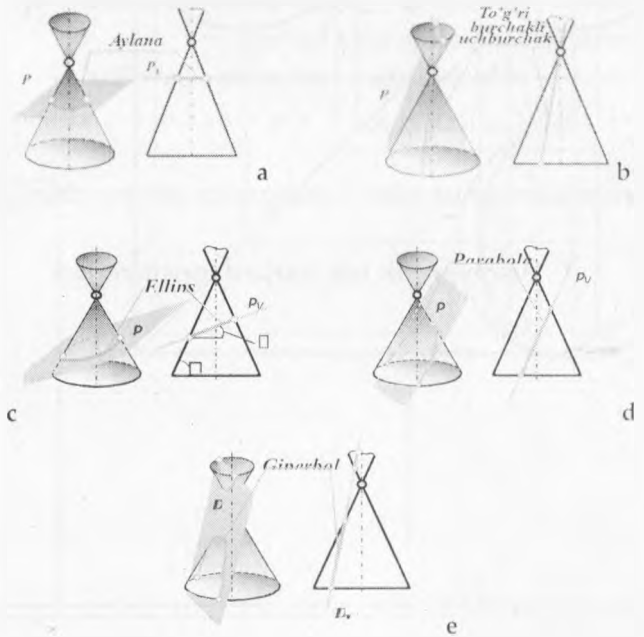


81-rasm

Konusning tekislik bilan kesishuvi

To'g'ri konusni kesimdagi tekislik kesib o'tganda, quyidagi shakllarda bo'lishi mumkin:

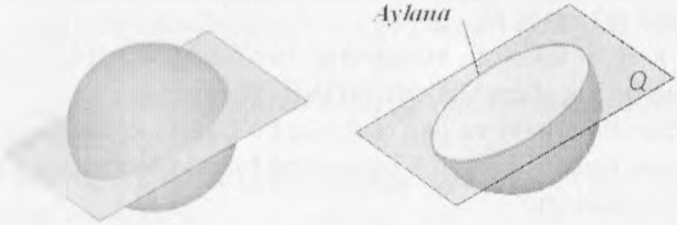
- aylana, agar kesuvchi tekislik konusning asosiga parallel bo'lsa (82- rasm,*a*);
- uchburchak, agar kesuvchi tekislik konusning uchidan kesib o'tsa (82-rasm, *b*);
- kesish tekisligi konusning barcha yasovchilarini kesib o'tadigan bo'lsa, ellips shaklda bo'ladi (82-rasm, *c)*
- parabola yoyi va to'g'ri chiziq bo'lagi bilan chegaralangan shakl, agar kesuvchi tekislik konusning bitta yasovchisiga parallel bo'lsa (82-rasm, *d*);
- agar kesuvchi tekislik konusning ikkita yasovchisiga parallel bo'lsa, giperbola va to'g'ri chiziq bo'lagi bilan chegaralangan shakl (82-rasm, *e*).



82-rasm

Sharning tekislik bilan kesishuvi

Har qanday tekislik sharni kesib o'tganda, kesma shakli aylana bo'ladi. Agar kesish tekisligi har qanday proyeksiya tekisligiga parallel bo'lsa, u holda aylana shu tekislikka to'liq hajmda proyeksiyalanadi.



83-rasm

Rasm-83 sharni frontal proyeksiya tekisligi Q kesib o'tadi. U V proyeksiya tekisligiga perpendikulyar, lekin H va W proyeksiyalar tekisliklariga qiya bo'ladi.

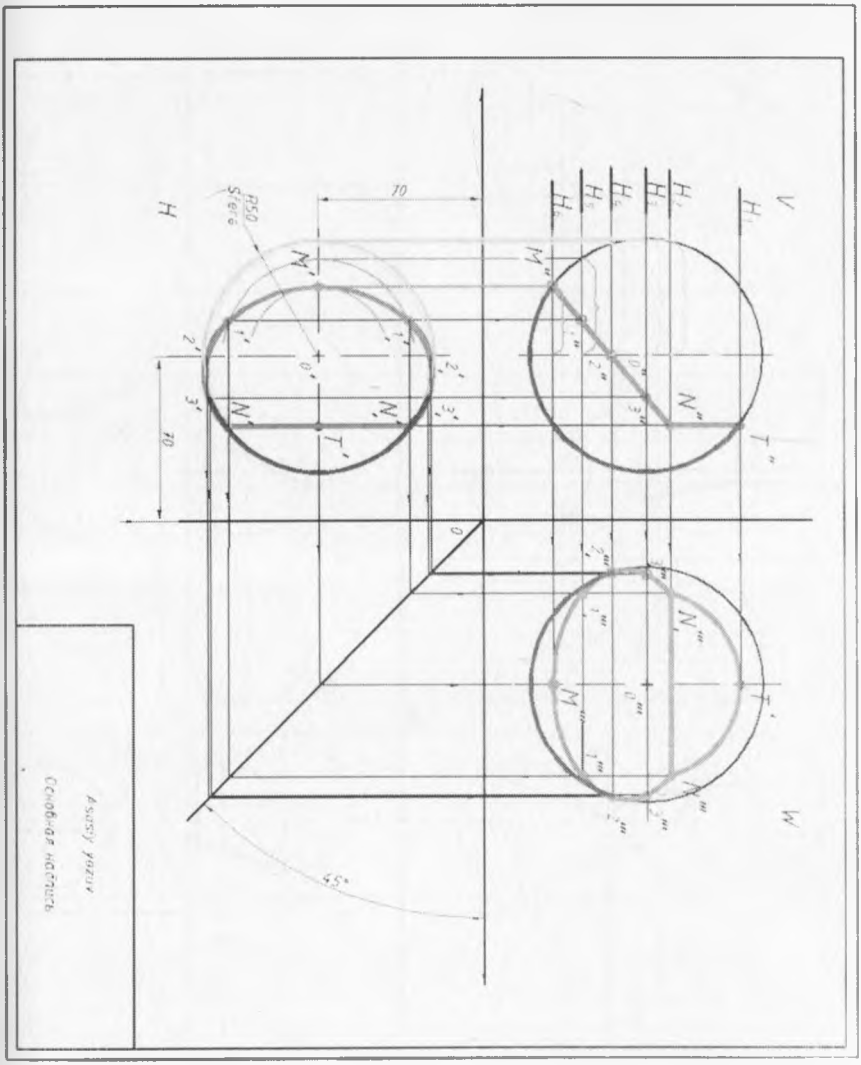
Mustahkamlash uchun savollar

1. Tekisliklar silindrni kesib o'tganda qanday chiziqlar hosil bo'ladi?

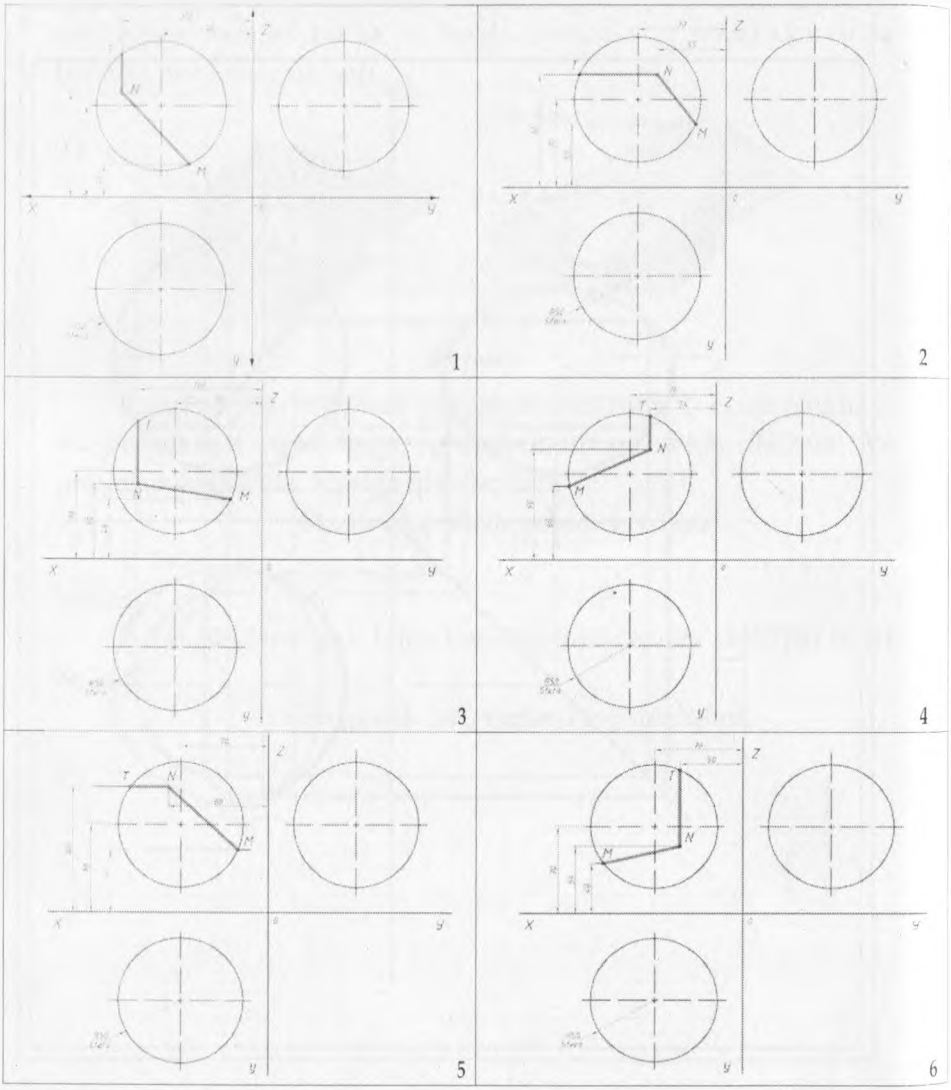
2. Tekisliklar konus bilan kesishganda qanday chiziqlar hosil bo'ladi?

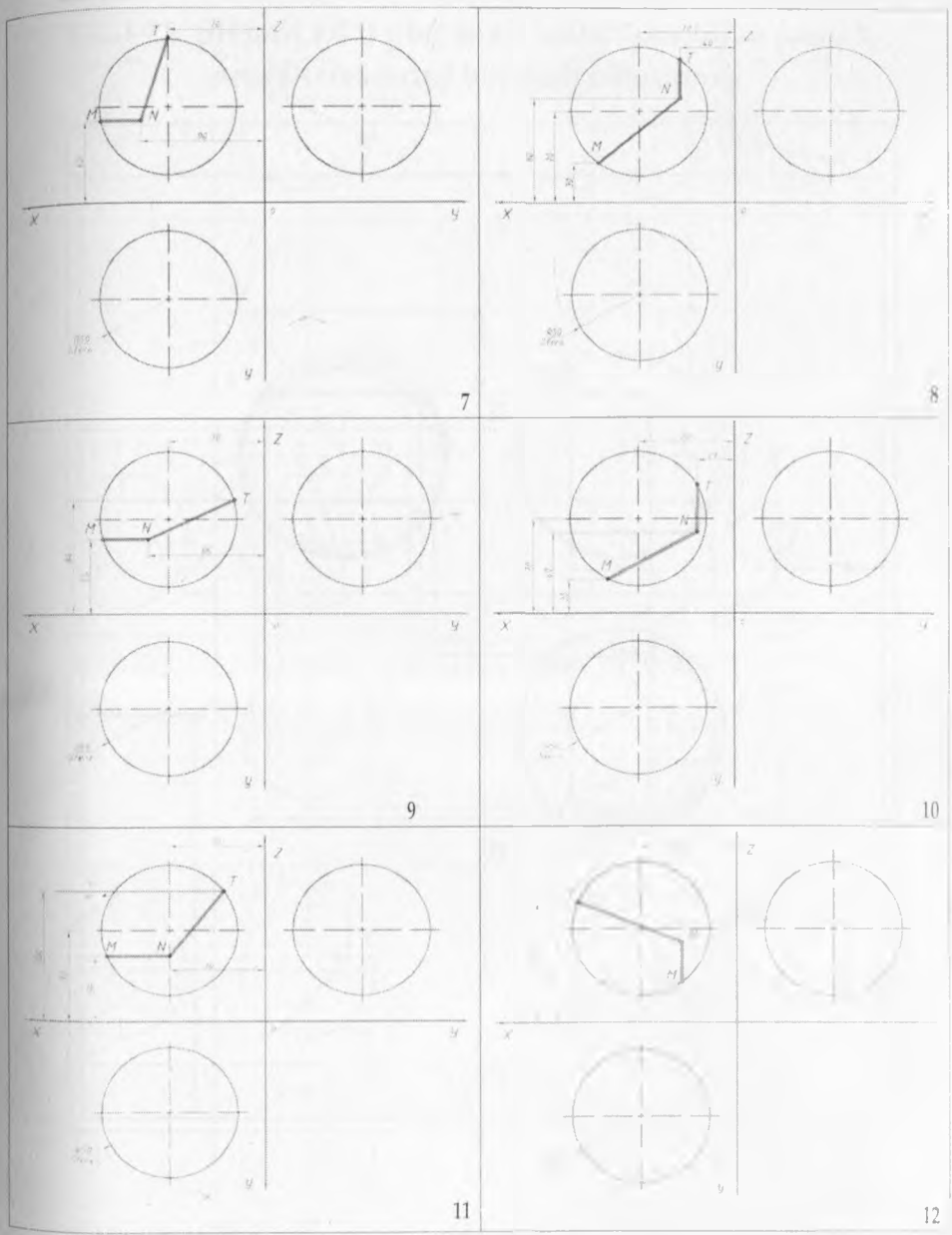
Hisob grafik ish, variant topshiriqlari.

HGI-14. Sferani tekisliklar bilan kesish, proyeksiyalarini bajarish namunasi.



HGI-14: Sferani tekisliklar bilan kesishga doir variant topshiriqlar.

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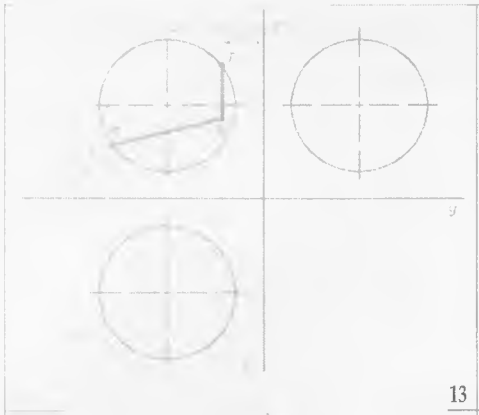

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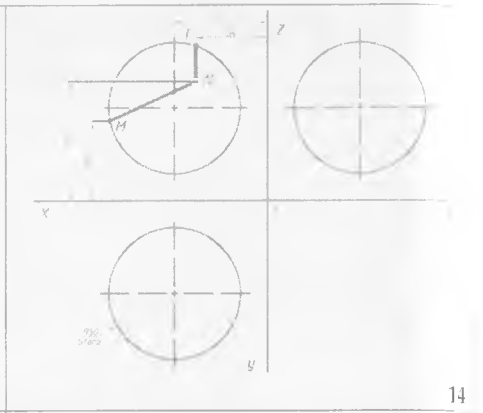

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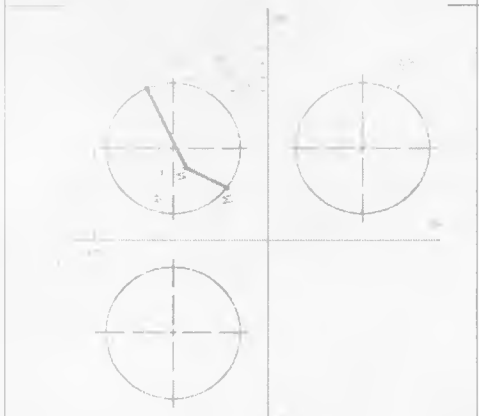

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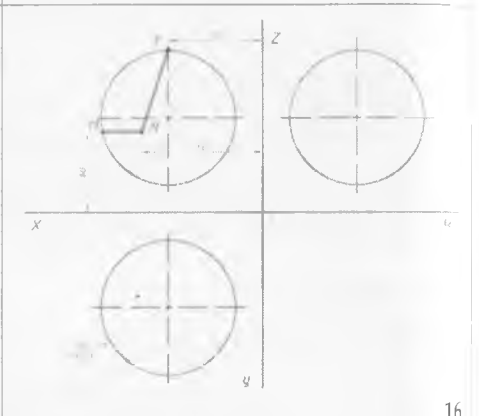

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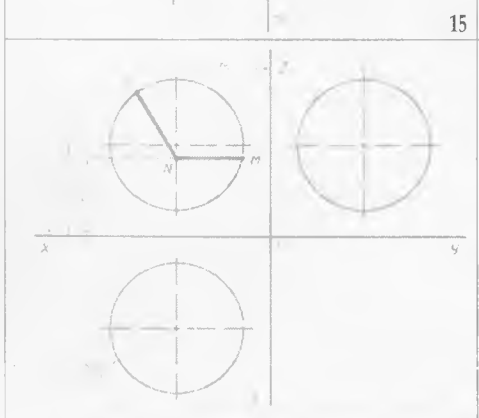

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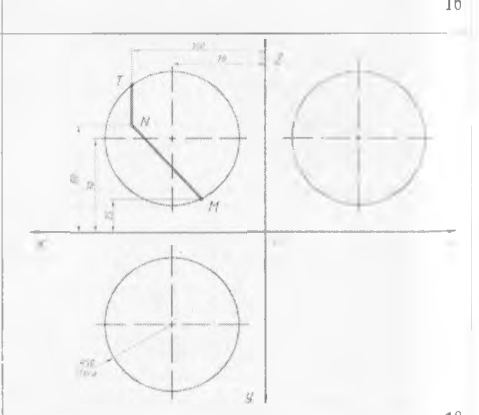

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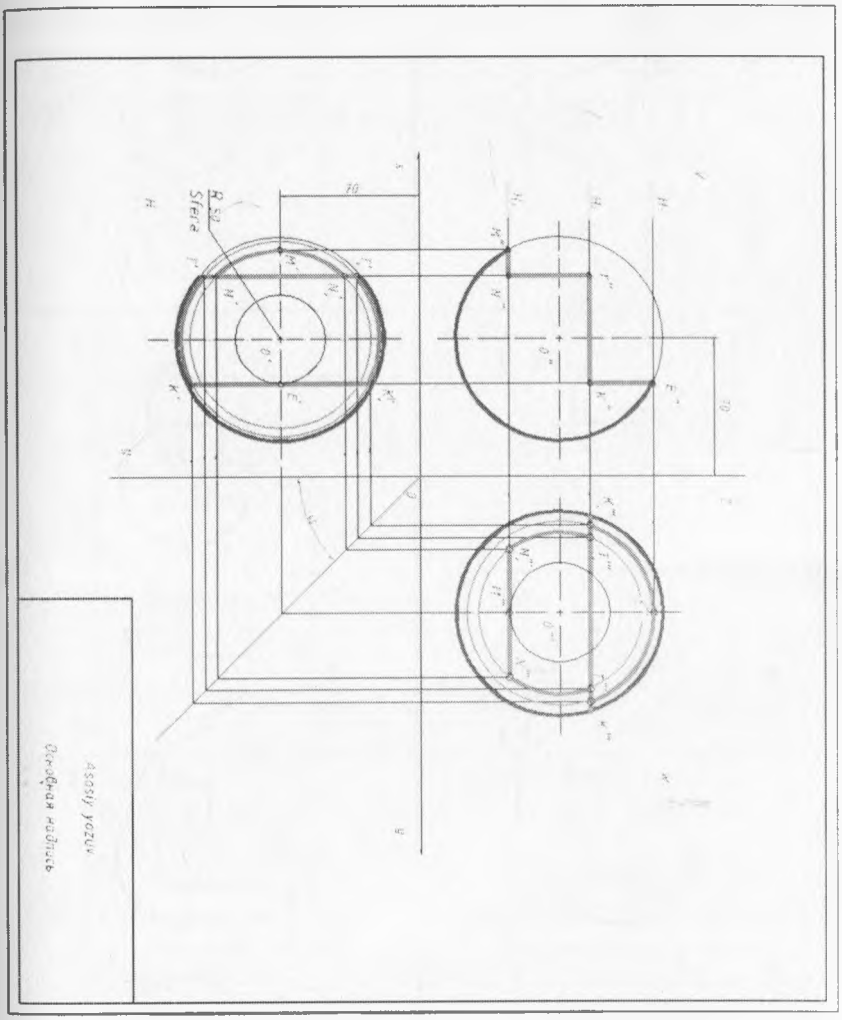
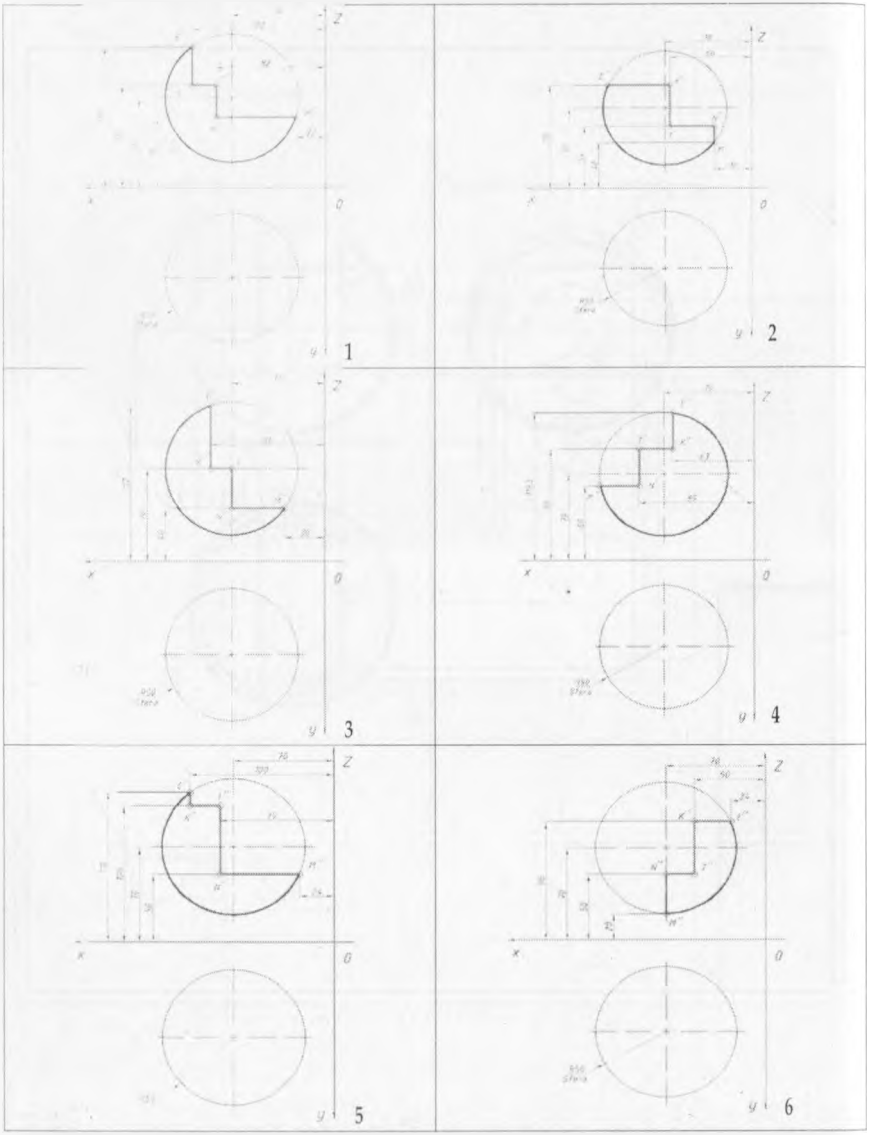
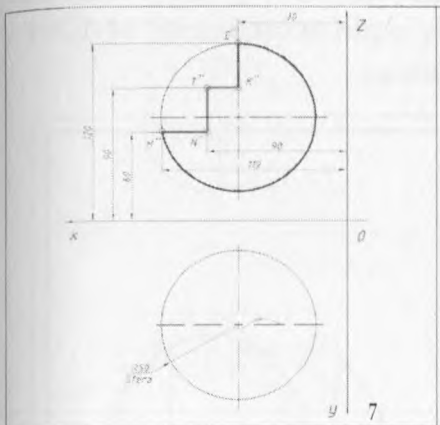
HGI-15. Sferani ko'p pog'onali tekisliklar bilan kesish, proyeksiyalarini bajarish namunasi.



HGI-15. Sferani ko'p pog'onali tekisliklar bilan kesishga doir topshiriq variantlar.





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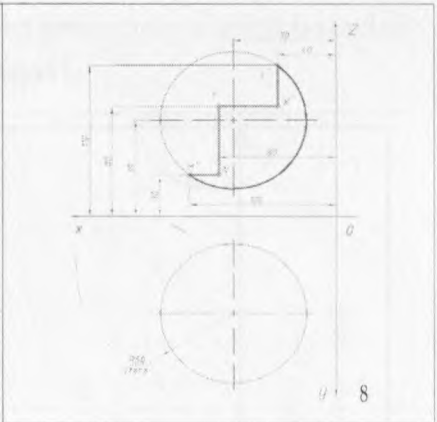

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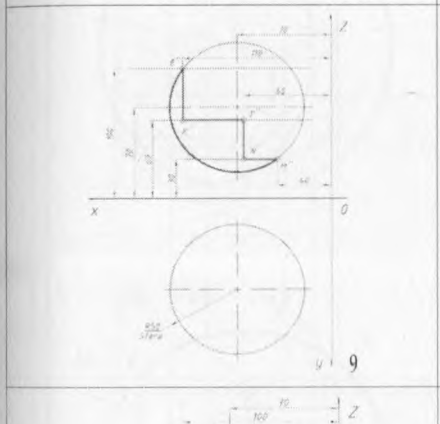

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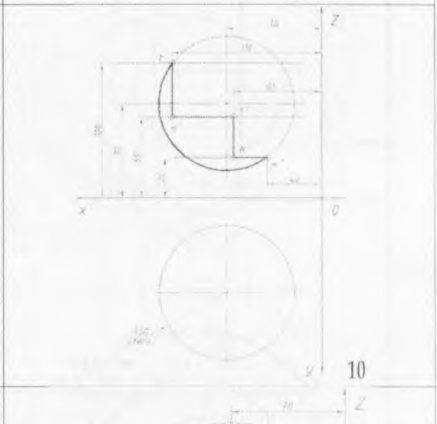

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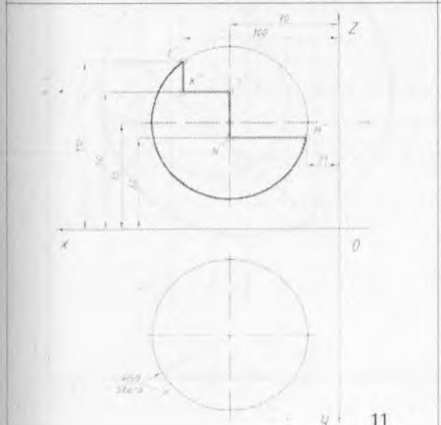

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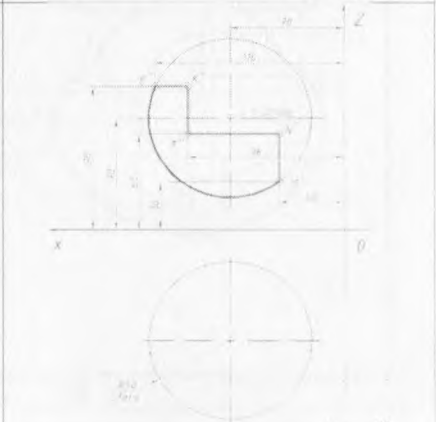

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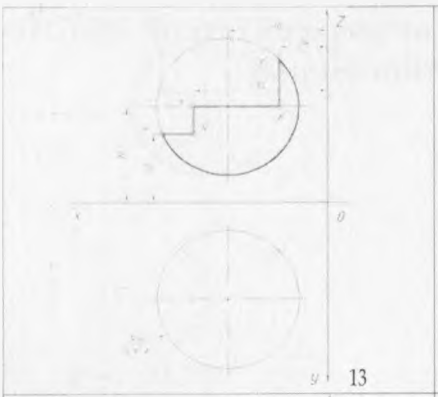

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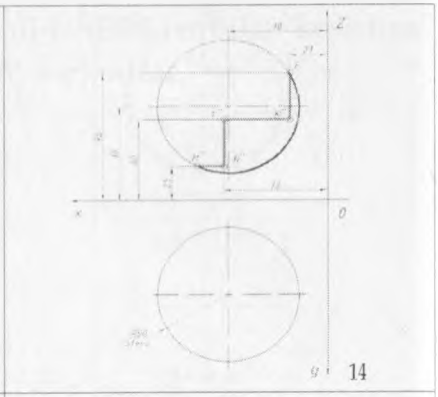

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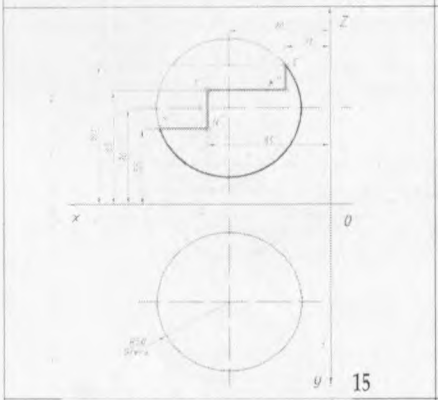

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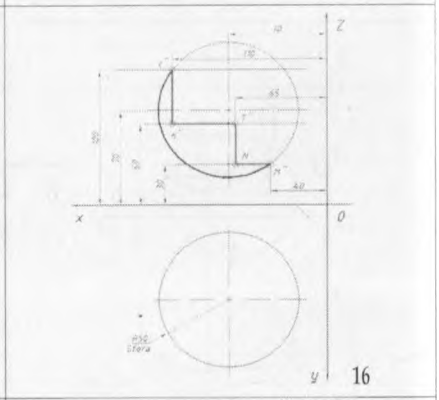

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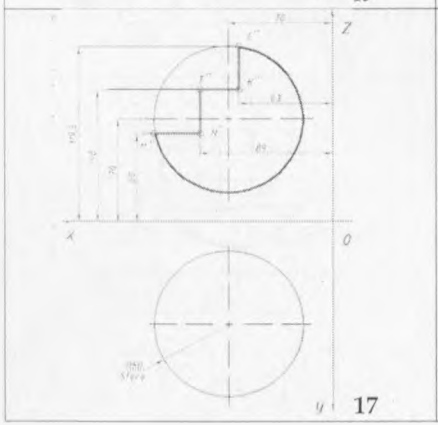

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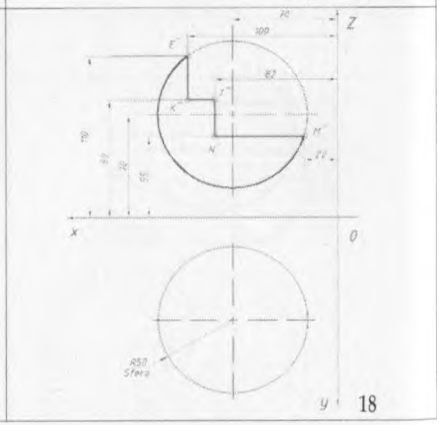

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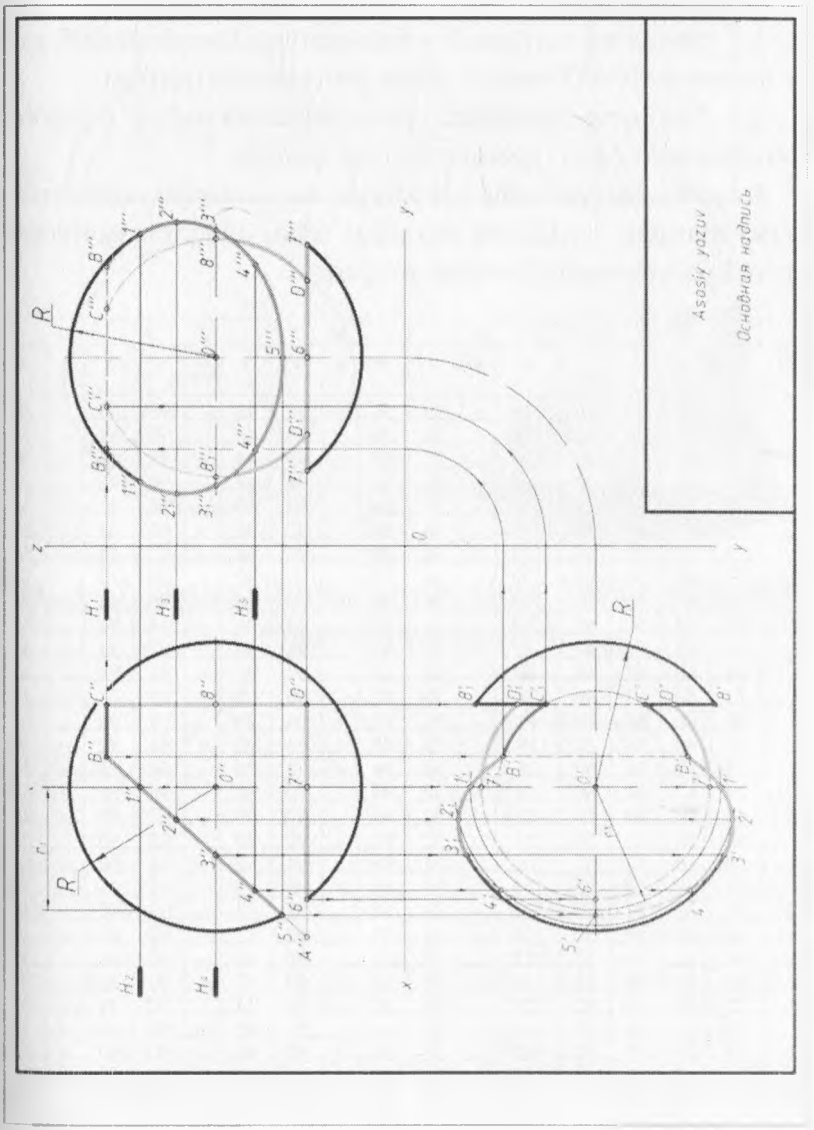
HGI-16. Sferadagi ochiq o'yiq proyeksiyalarini bajarish namunasi.



HGI-16. Sferadagi ochiq o'yiq proyeksiyalarini bajarish shartlari va variantlari:

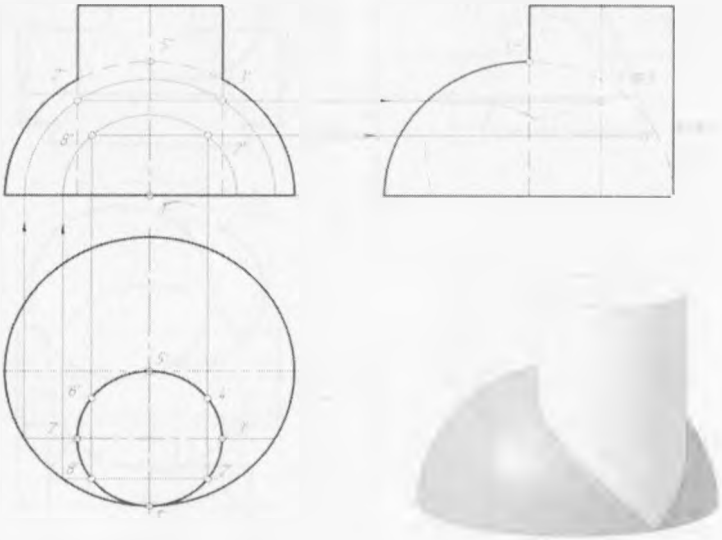
1. Sferaning berilgan *0* – markazining koordinatalari va *R* – radiusining qiymati asosida uchta proyeksiyasi qurilsin.

5. Sferaning gorizontal proyeksiyasida ochiq o'yiqning konturi bo'lgan *ABCD* geometrik shakl qurilsin.

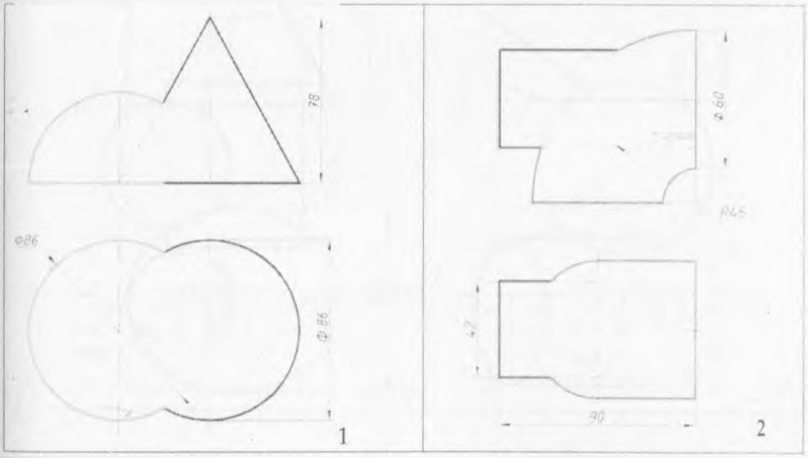
4. Proyeksiyalovchi tekisliklar va aylanish sirtlarining xususiyatlaridan foydalanib sferadagi ochiq o'yiqning gorizontal va profil proyeksiyalari konturi aniqlansin.

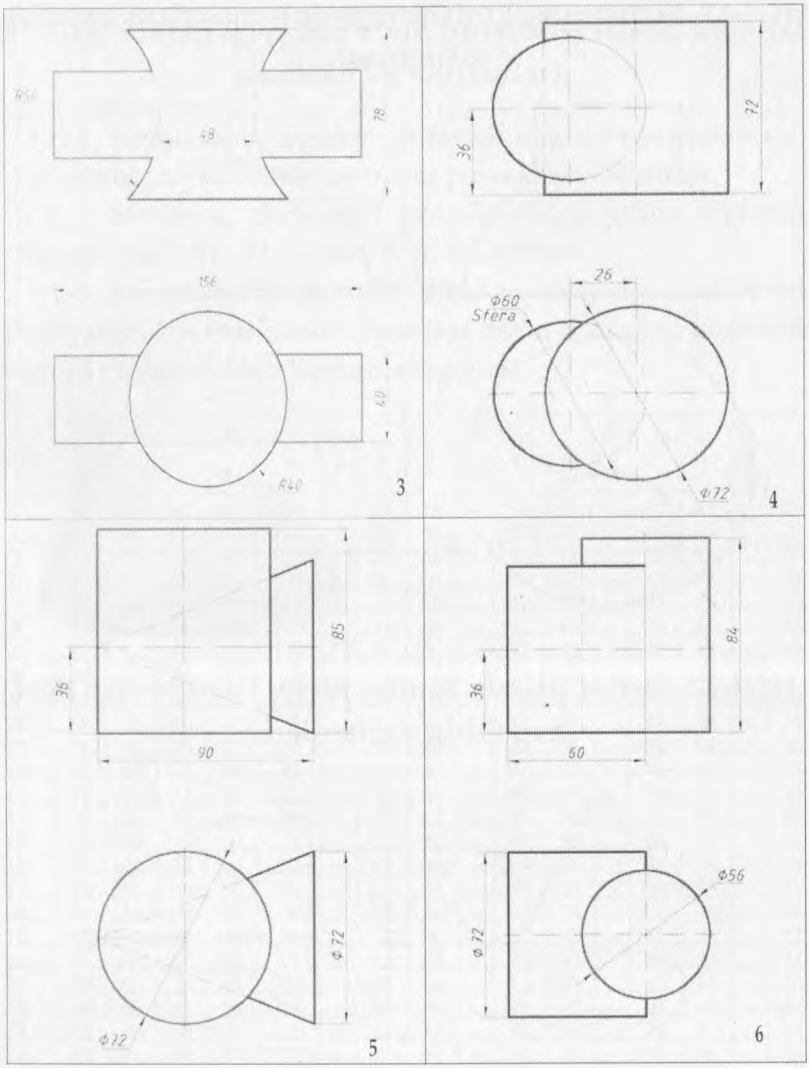
Bajar. №	*0*			*R*	*A*			*B*			*C*			*D*		
	x	*y*	*z*		*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*	*x*	*y*	*z*
1	70	58	62	46	118	–	35	56	–	95	45	–	95	45	–	35
2	70	60	60	46	118	–	35	56	–	95	44	–	95	44	–	35
3	70	60	58	48	120	–	35	58	–	95	44	–	95	44	–	35
4	70	60	58	48	120	–	36	56	–	94	42	–	94	42	–	36
5	69	58	60	47	116	–	36	58	–	94	45	–	94	45	–	36
6	72	60	58	47	116	–	36	60	–	92	42	–	92	42	–	36
7	72	58	60	48	120	–	34	60	–	92	42	–	92	42	–	34
8	72	58	58	45	122	–	34	60	–	90	40	–	90	40	–	34
9	74	62	60	45	122	–	34	55	–	90	40	–	90	40	–	34
10	69	58	60	47	20	–	36	81	–	94	94	–	94	94	–	36
11	74	62	58	47	20	–	36	80	–	92	94	–	92	94	–	36
12	72	62	62	48	20	–	35	80	–	92	92	–	92	92	–	35
13	72	60	62	48	22	–	35	82	–	90	92	–	90	92	–	35
14	70	60	60	48	18	–	35	82	–	90	90	–	90	90	–	35
15	70	60	58	50	18	–	34	82	–	94	92	–	94	92	–	34
16	72	62	58	50	20	–	34	84	–	94	96	–	94	96	–	34
17	70	62	60	50	18	–	32	84	–	90	96	–	90	96	–	32
18	68	60	60	50	20	–	32	86	–	92	95	–	92	95	–	32
19	68	58	62	50	20	–	32	86	–	92	95	–	92	95	–	32
20	70	58	62	52	18	–	32	86	–	94	90	–	94	90	–	32
21	70	60	58	52	118	–	35	60	–	95	45	–	95	45	–	35
22	70	62	62	50	120	–	36	60	–	92	42	–	92	42	–	36
23	68	62	60	50	120	–	34	62	–	92	42	–	92	42	–	34
24	68	62	58	52	122	–	35	62	–	90	40	–	90	40	–	35
25	68	60	58	52	120	–	36	60	–	90	42	–	90	42	–	36
26	70	60	60	52	120	–	35	60	–	92	44	–	92	44	–	35
27	70	58	60	50	120	–	32	62	–	92	45	–	92	45	–	32
28	72	58	55	50	122	–	37	60	–	90	40	–	90	40	–	37
29	75	60	60	45	125	–	34	65	–	90	50	–	90	50	–	34
30	70	58	60	47	20	–	36	80	–	94	94	–	94	94	–	36

HGI-17. Sirtlarning kesishuviga doir masalani bajarish namunasi.



HGI-17. Sirtlar silindr, konus, sfera, kesishuviga doir topshiriq variantlari.

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78
36
72
156
40
R40
3
Φ60
Sfera
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Φ72
Φ56
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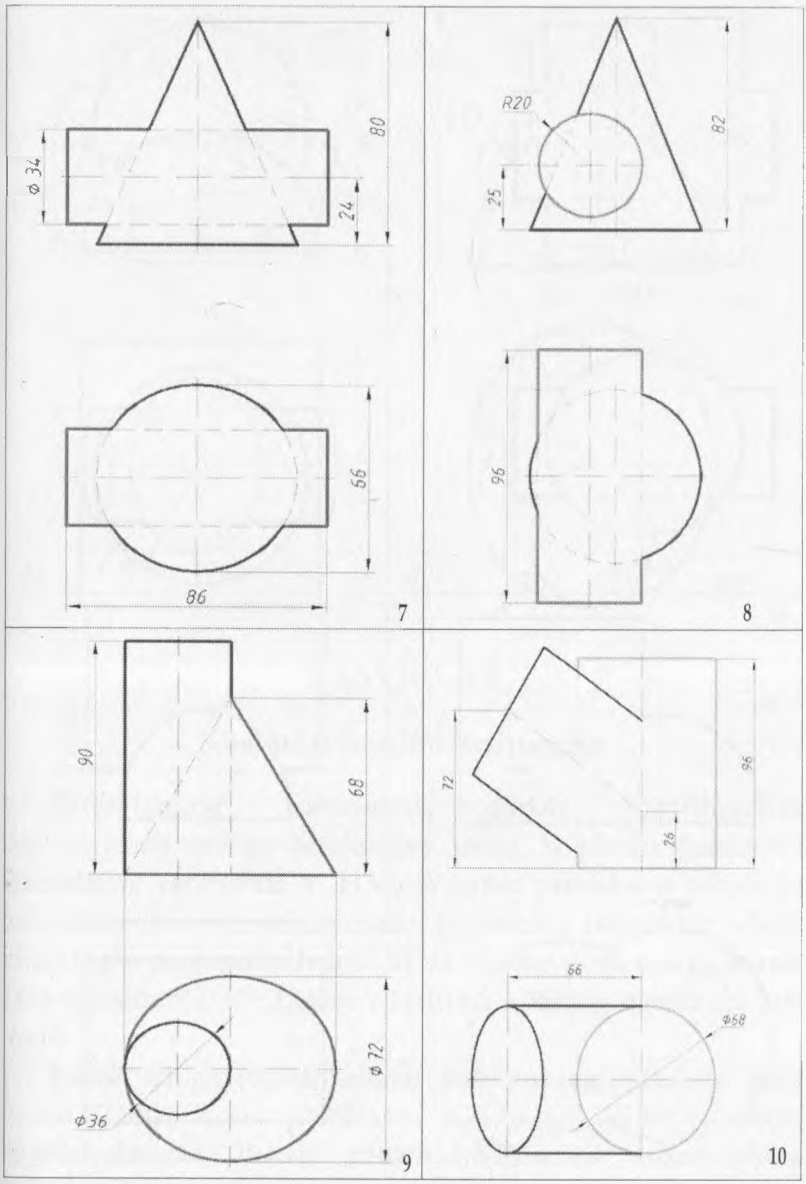
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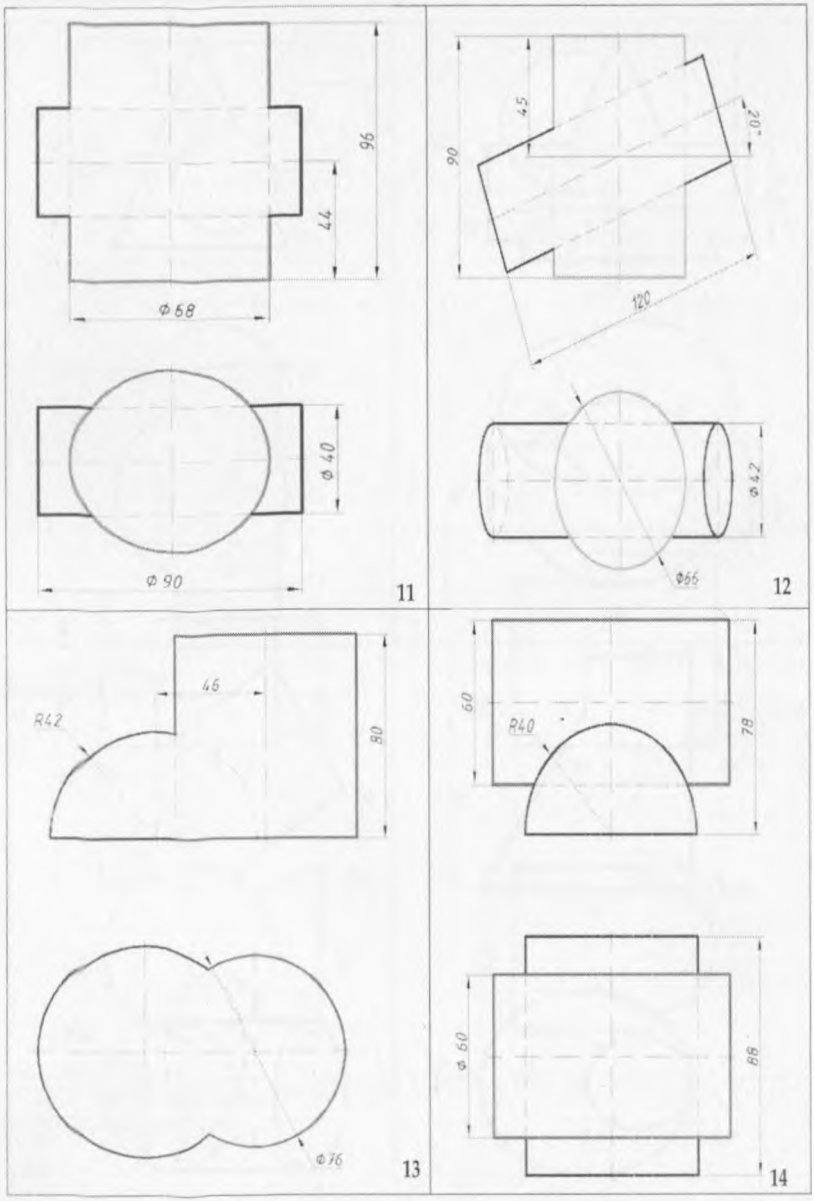
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Φ60
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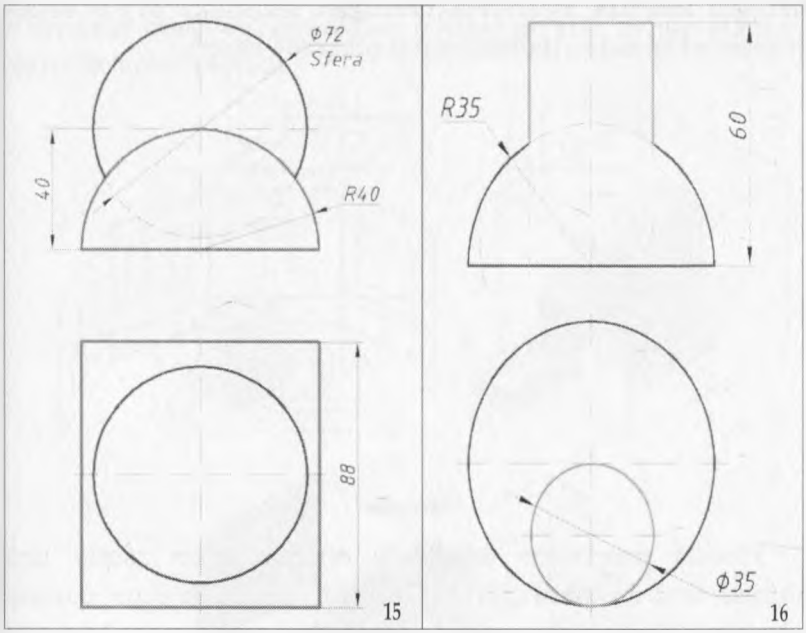


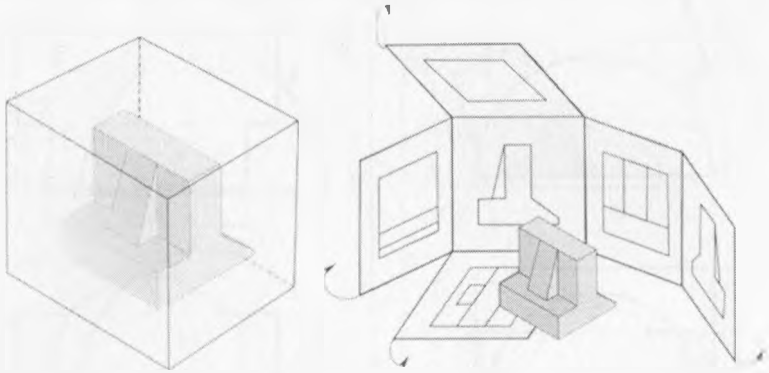
TASVIRLAR

Tasvirlar haqida tushuncha

Ob'ektlarning tasvirlarini qurish to'g'riburchakli proektsiyalash usuliga asoslangan. Biroq, ko'pincha jismlarning chizmalarini yaratishda V, H va W uchta proyeksiya tekisliklari etarli emas. Shuning uchun asosiy proyeksiya tekisliklari sifatida uchta o'zaro perpendikulyar V, H va W tekislik va ularga parallel uchta tekislik olinadi. Ushbu tekisliklar kubning qirralarini hosil qiladi.

Kubik ichiga joylashtirilgan tasavvurdagi jism va uning yuzlari (oltita asosiy proektsion tekisliklari) ichki yuzalariga proektsiyalangan. Bunda proyeksiya nurlari kuzatuvchidan qirralarga yo'naltiriladi. Kubning oltita yuzi ularning kesishish

chiziqlari atrofida aylantirib, chizilgan tekislikka to'g'ri keladi. Oltita proektsiyadan iborat rasmni oling (84-rasm).



84-rasm

Frontal proektsion tekislikda olingan rasm asosiy bosh ko'rinish sifatida qabul qilinadi. Shuning uchun ob'ektni shunday joylashtirish kerakki, asosiy tasvir uning shakli va o'lchamlari to'g'risida eng to'liq tasvirni beradi.

Tarkibiga qarab tasvirlar turlarga, kesimlar va qirqimlarga bo'linadi. Ko'rinishlar deb ataladigan tasvirlar orqali biz ob'ektning tashqi shaklini tasavvur qilishishimiz mumkin. Jismning ichki shaklini tushunish uchun kesimlar va qirqimlardan foydalanish mumkin. Ushbu tasvirlarni ko'rib chiqamiz.

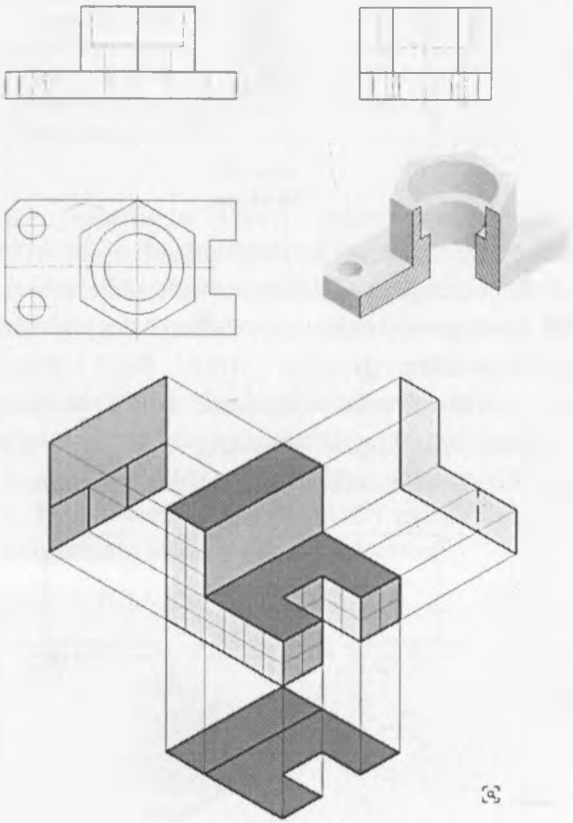
Ko'rinishlar

Ko'rinish - bu ob'ekt sirtining ko'rinadigan qismining kuzatuvchiga qaragan tasviridir.

Chizmadagi ko'rinishlarning soni eng kam va jismning shakli va hajmini to'liq anglash uchun etarli bo'lishi kerak.

Ko'rinishlarda, shtrix chiziqlar yordamida jismning ko'rinmas qismlarini ko'rsatishga ruxsat beriladi (85-rasm).

Ko'rinishlar orasidagi masofalar, o'lchov qo'yish uchun etarli joy qoldirilib tanlab olinadi.

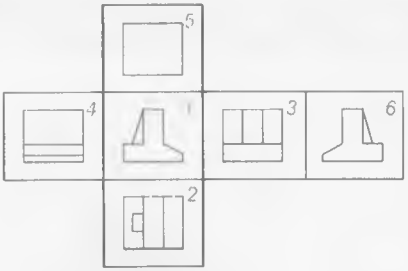


85-rasm

Ko'rinishlar *asosiy, qo'shimcha va mahalliy* turlarga bo'linadi.

Asosiy ko'rinishlar

Oltita asosiy proektsion tekisliklarda olingan ko'rinishlar *asosiy ko'rinishlar* deb nomlanadi va quyidagi nomlarga ega (86-rasm): (asosiy yoki bosh ko'rinish),

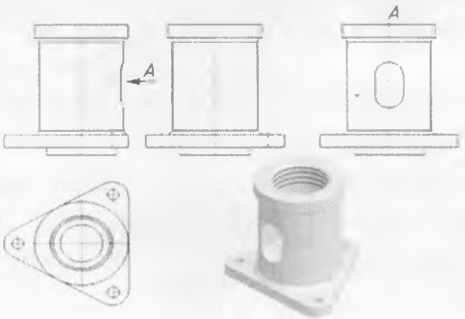


1– old ko'rinish (bosh),
2– ust ko'rinish,
3 – chap ko'rinish
4 – o'ng ko'rininish,
5– ost ko'rinish.
6– orqa ko'rinish.

86-rasm

86, rasmdagi asosiy ko'rinishlar shaklda ko'rsatilganidek, ma'lum bir tartibda joylashtirilgan. Agar ko'rinishlar shu tartibda va bir-biri bilan proektsion munosabatlarda joylashgan bo'lsa, u holda ular ko'rsatilmaydi

Agar proektsion havola saqlanmasa, u holda proyeksiya yo'nalishi o'q bilan ko'rsatiladi. Rus alifbosining bosh harfi o'qning yonida joylashgan. Ko'rinish xuddi shu harf bilan belgilanadi (87-rasm).



87-rasm

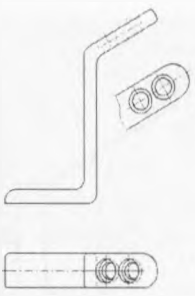
Qo'shimcha ko'rinishlar

Qo'shimcha ko'rinish - bu asosiy proektsion tekisliklariga parallel bo'lmagan tekislikda olingan ko'rinish. Qo'shimcha turlar mavzuning biron bir qismini hech qanday asosiy qarashlarda buzilmasdan tasvirlash mumkin bo'lmagan hollarda qo'llaniladi (88-rasm).

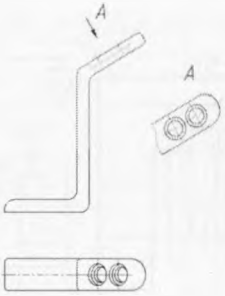
88-rasm

Agar mos keladigan tasvir bilan proektsion aloqada qo'shimcha ko'rinish joylashtirilgan bo'lsa, unda u belgilanmagan (89-rasm). Agar proektsion bog'lanish saqlanmagan bo'lsa, u holda proektsiyaning yo'nalishi o'q bilan ko'rsatiladi (90-rasm). Rus alifbosining bosh harfi o'qning yonida joylashgan. Qo'shimcha ko'rinish xuddi shu harf bilan rasm. 90.

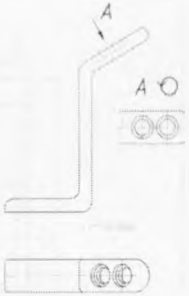
Qo'shimcha ko'rinishni aylantirishga ruxsat beriladi, lekin asosiy rasmda ushbu ob'ekt uchun joylashishni saqlab qolish. Bunday holda, ko'rinishni belgilash odatiy grafik belgisi ⟲ bilan "aylantirilib" to'ldirilishi kerak - (91-rasm).



89-rasm



90-rasm

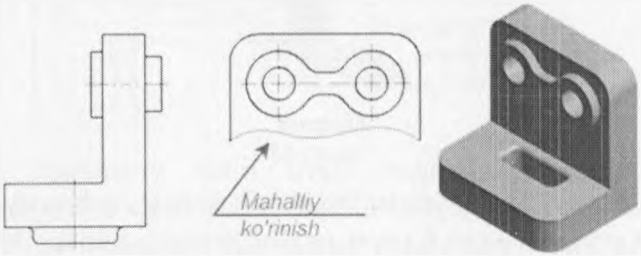


91-rasm

Mahalliy ko'rinishlar

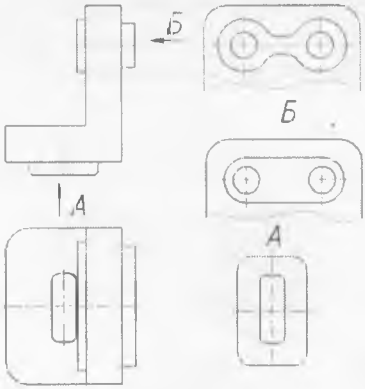
Mahalliy ko'rinish - bu ob'ekt yuzasida alohida chegaralangan tasvirini ajratib ko'rsatishdir. U jismning alohida elementlarining shakli va o'lchamlarini ko'rsatish zarur bo'lganda foydalaniladi. Mahalliy ko'rinishni ishlatish grafik ish hajmini kamaytiradi va rasm maydonida bo'sh joyni tejaydi.

Chizilgan rasmdagi mahalliy ko'rinish qo'l bilan chizilgan tanaffus chizig'i bilan cheklanishi kerak. Mahalliy ko'rinishni chizmaning bo'sh joyiga yoki boshqa tasvirlar bilan proektsion aloqada joylashtiriladi. (92-rasm).



92-rasm

Agar mahalliy ko'rinish proektsion aloqada bo'lmasa, u holda belgilanishi kerak. Mahalliy ko'rinish va qo'shimcha ravishda rus alifbosidagi o'q va harf bilan belgilanadi (93-rasm).

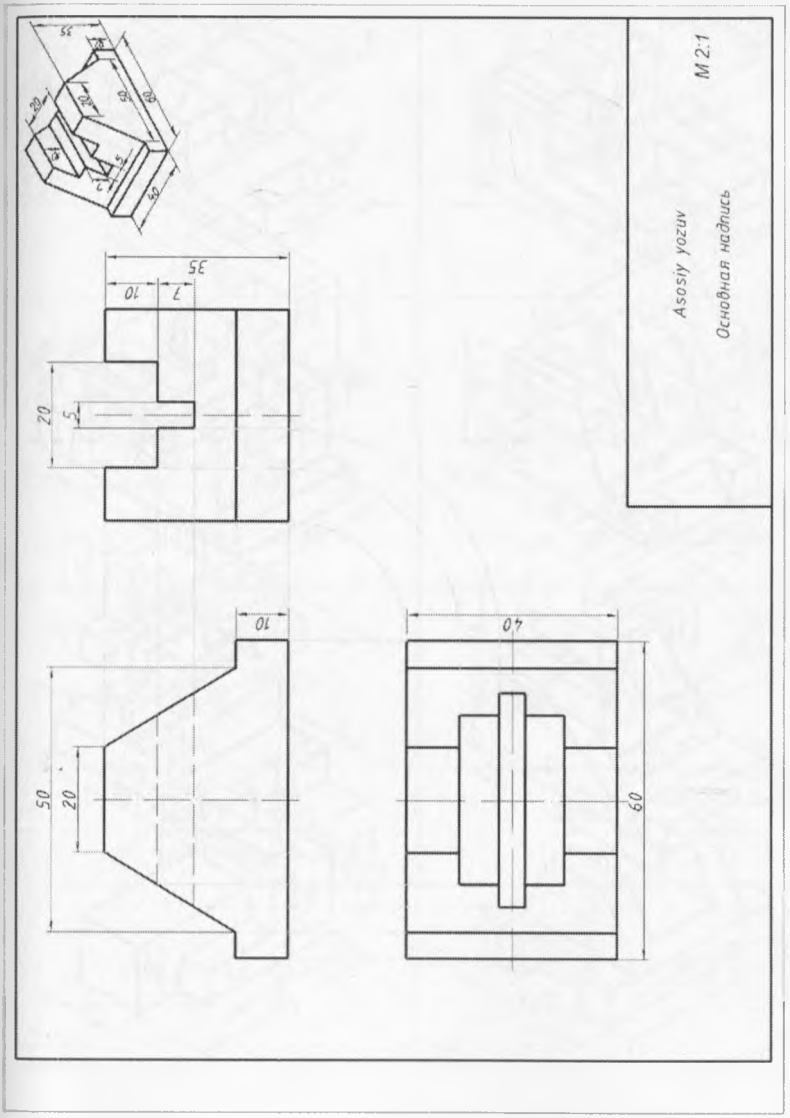


93-rasm

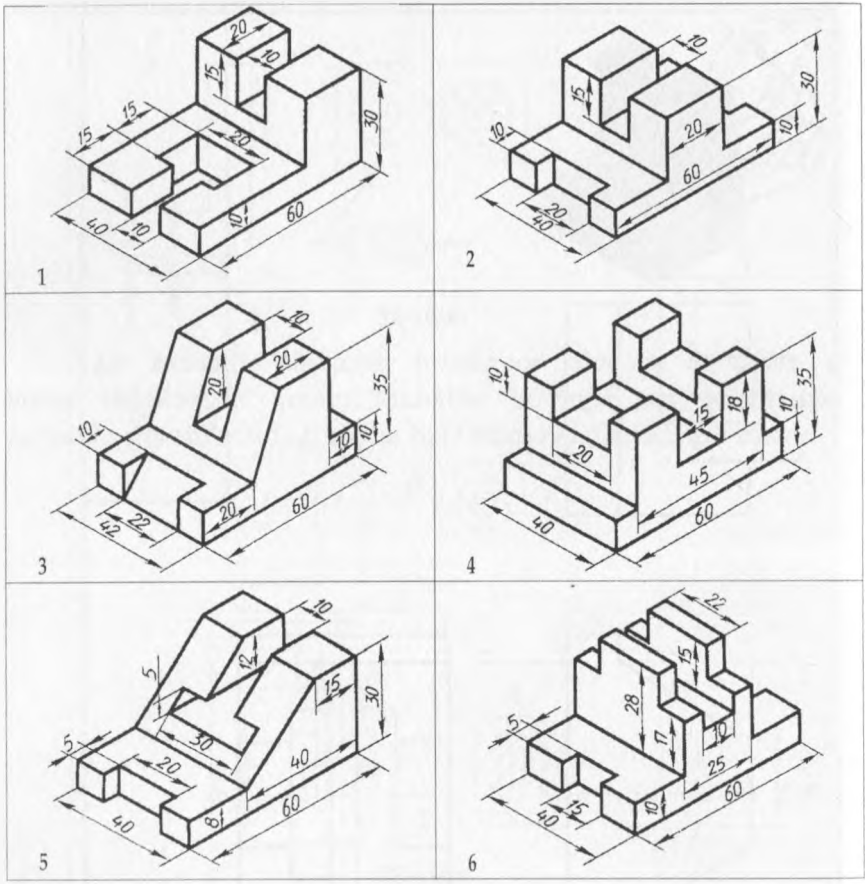
Eslatma! Mahalliy va qo'shimcha ko'rinishlarni bir-biri bilan chalkashtirib yubormaslik kerak. Mahalliy ko'rinish asosiy proektsion tekisliklardan birida, qo'shimcha ko'rinish esa hech qanday asosiy tekisliklarga parallel bo'lmagan qo'shimcha tekislikda olinadi.

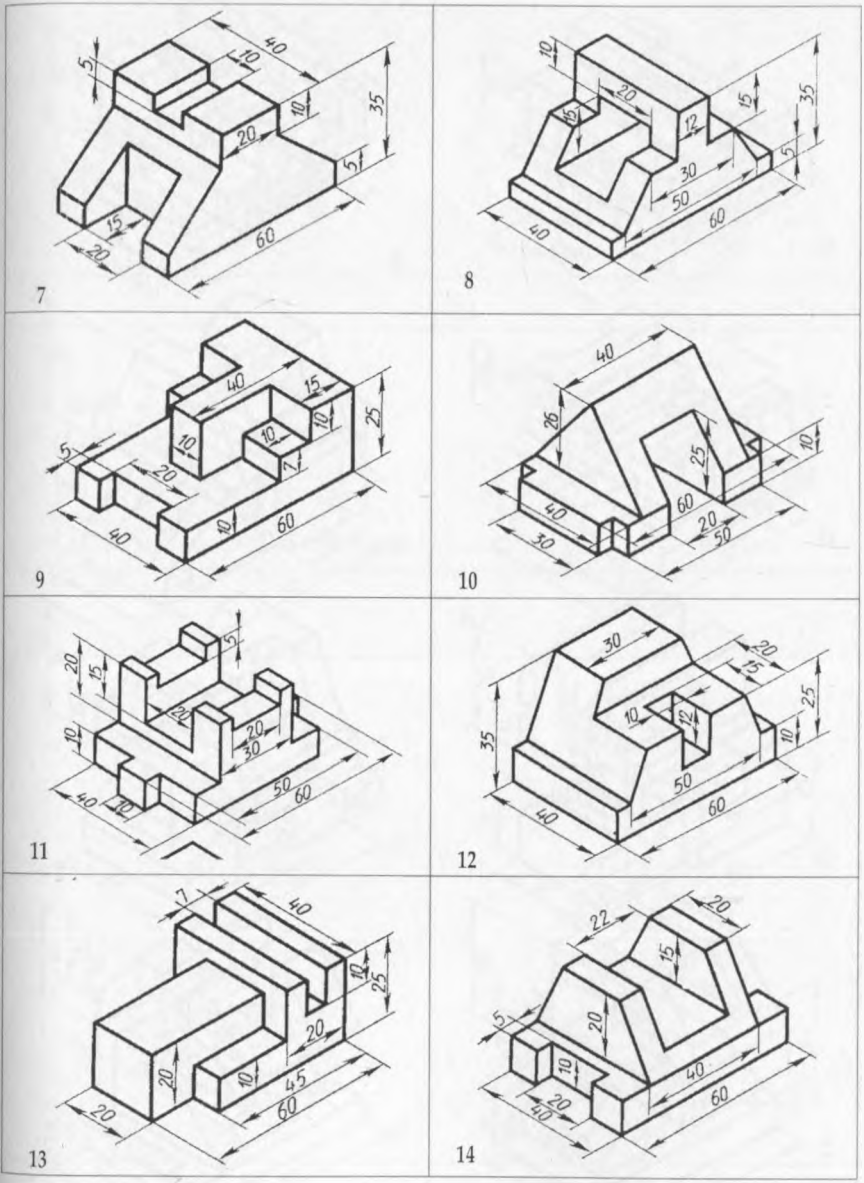
Hisob grafik ish, variant topshiriqlari

HGI-18. Asosiy ko'rinishlarni bajarish namunasi (murakkab bo'lmagan).



HGI-18. Murakkab bo'lmagan asosiy ko'rinishlar variantlari.

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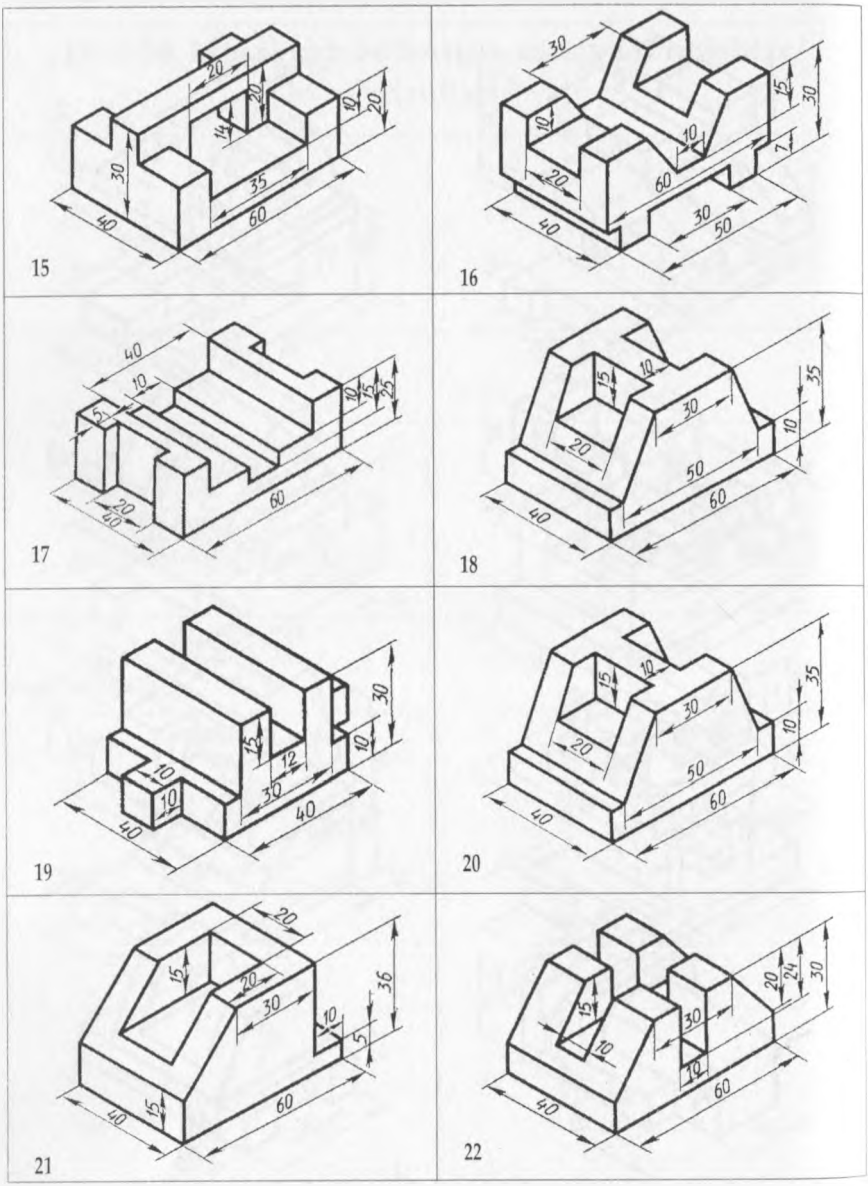
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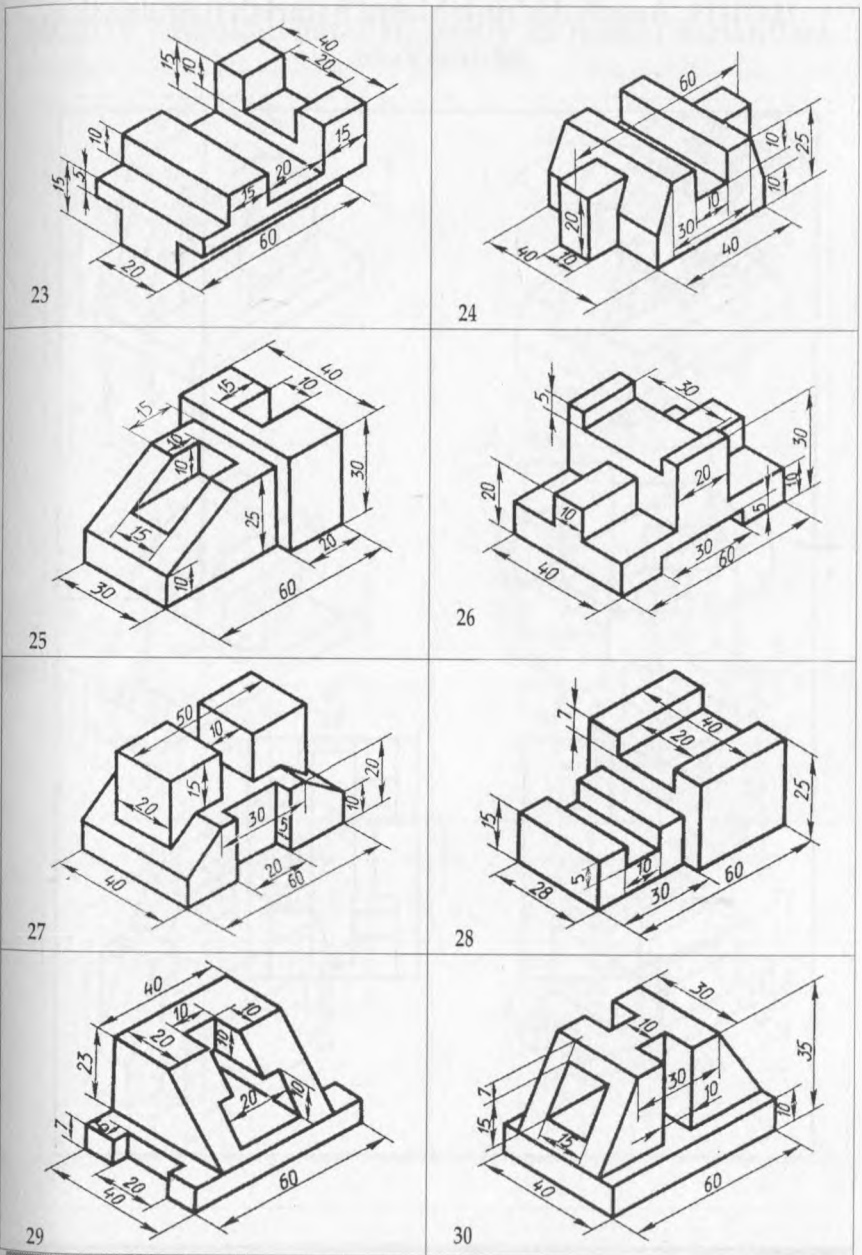
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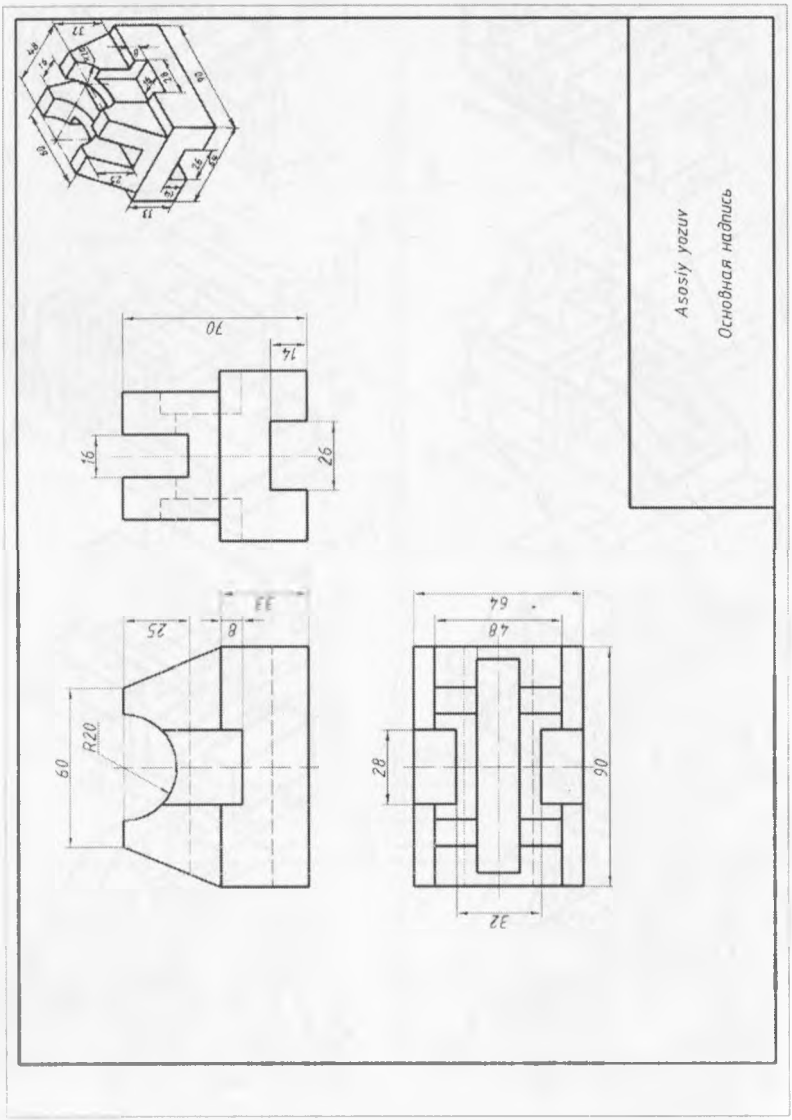
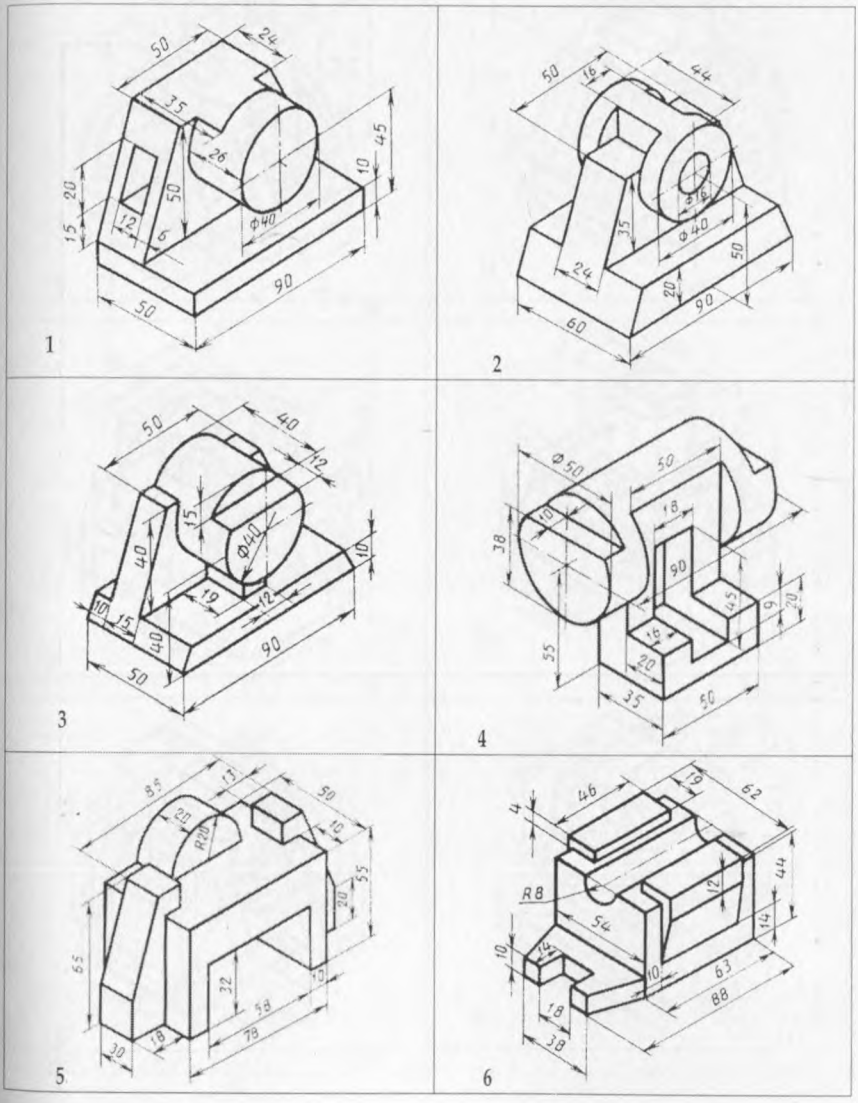
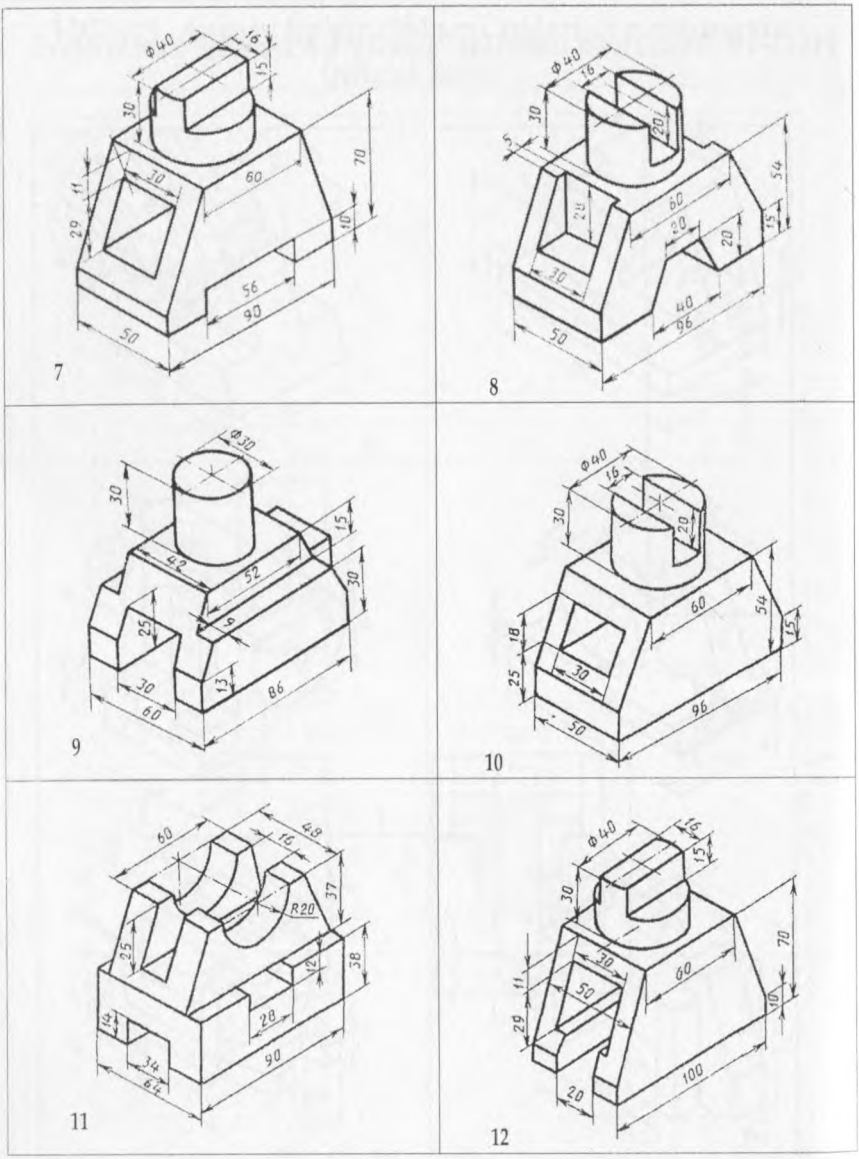
HGI-19. Asosiy ko'rinishlarni bajarish namunasi (murakkab).



HGI-19. Murakab detallar, asosiy ko'rinishi variantlari.

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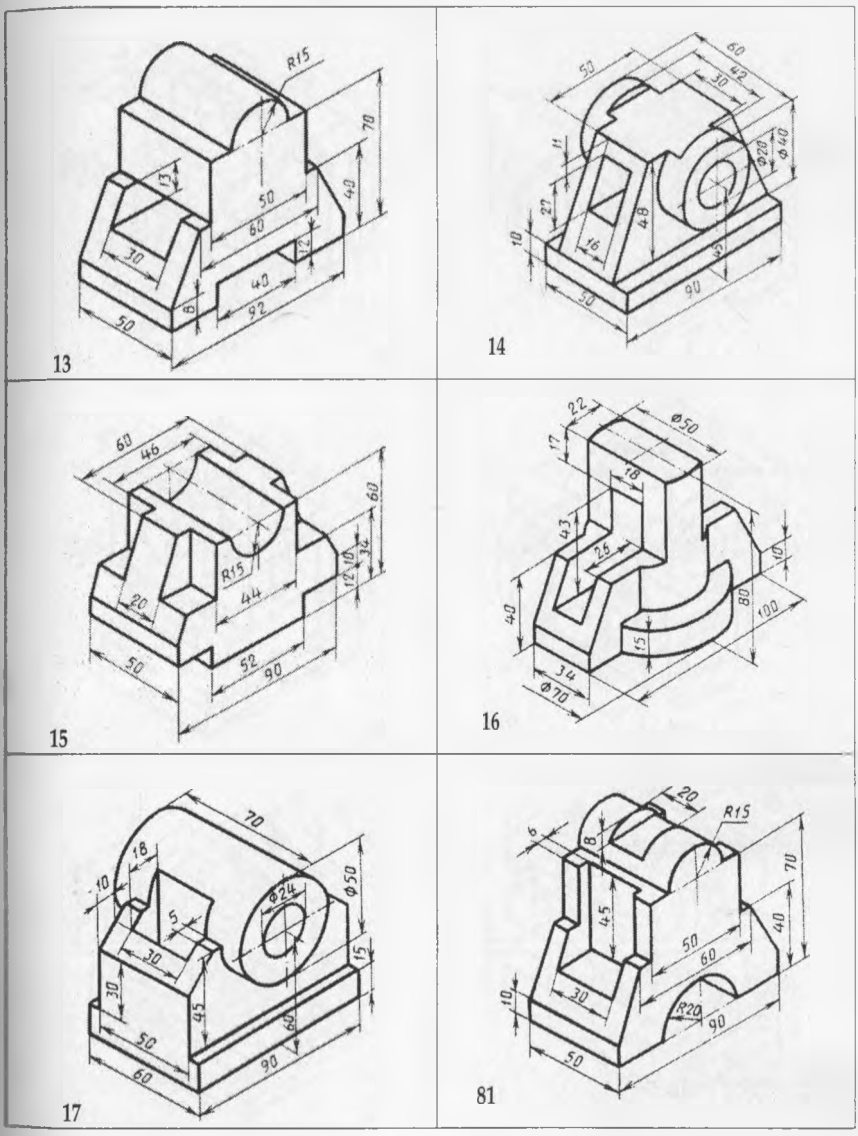

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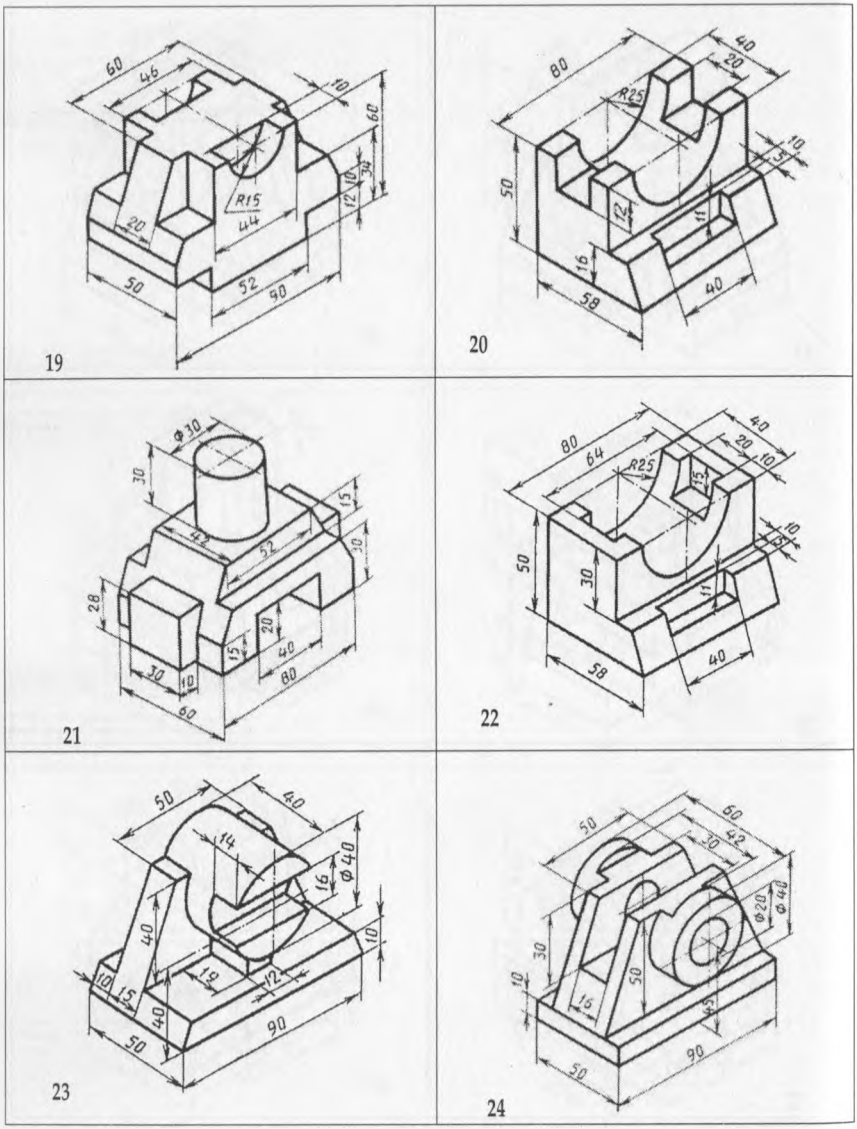
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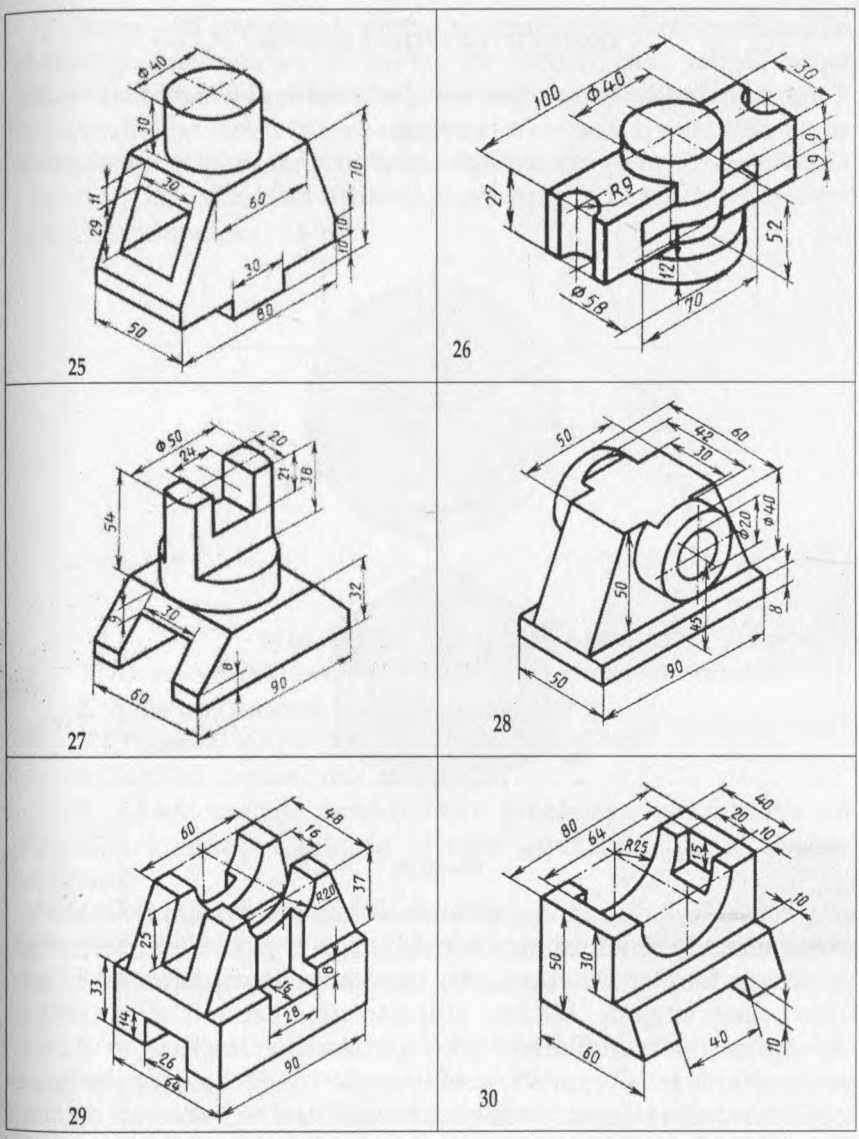
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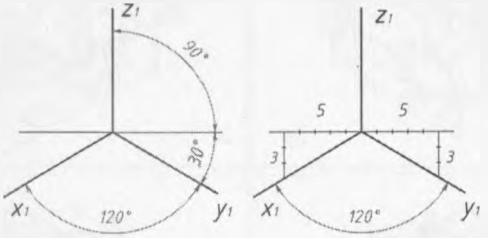
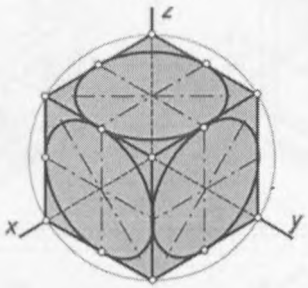
Izometriya o'qini qurish

To'g'riburchakli izometriyada o'qlar orasidagi burchaklar = 120 ga teng.

Rasm- 94 to'g'riburchakli izometriyada o'qlar qurilishini transportir yoki sirkul yordamida bajarish ko'rsatilgan.



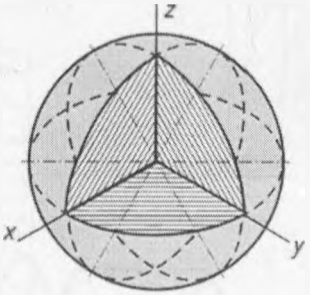
94-rasm



95-rasm

Rasm-95 kubning to'g'ritburchakli izometriyasini ko'rsatadi, uning uchta yuzi koordinata tekisliklariga to'g'ri keladi. Kubning yuzlariga doiralar chizilgan, ular izometriyada uchta bir xil ellips bilan tasvirlangan. Ushbu ellipslarning katta o'qlari ellips tekisligiga perpendikulyar bo'lgan aksonometrik o'qlarga perpendikulyar. O'zgarish koeffitsientlari *0,82* ga teng bo'lgan to'g'riburchakli izometriyani qurishda ellipsning katta o'qi aylana diametrining haqiqiy qiymatiga, kichik o'qi esa bu diametrning *0,58* ga teng bo'ladi. O'zgarish koeffitsientlari biriga teng ravishda chizilganida ellipsning katta o'qi aylana diametrining *1,22* ga, kichik o'qi esa *0,7* ga teng bo'ladi.

Rasm - 96 gorizontal, frontal va profil tekisliklari yordamida sharning markazidan o'tuvchi va koordinata tekisliklariga parallel ravishda sakkizdan bir qismi kesilgan to'pning to'rtburchaklar izometrik ko'rinishini ko'rsatadi. Ushbu tekisliklar sharning sirtini doiralar bilan kesib o'tadi, ular izometriyada rasmdagi kabi bir xil ko'rinishga ega bo'lgan uchta bir xil ellips bilan tasvirlangan.

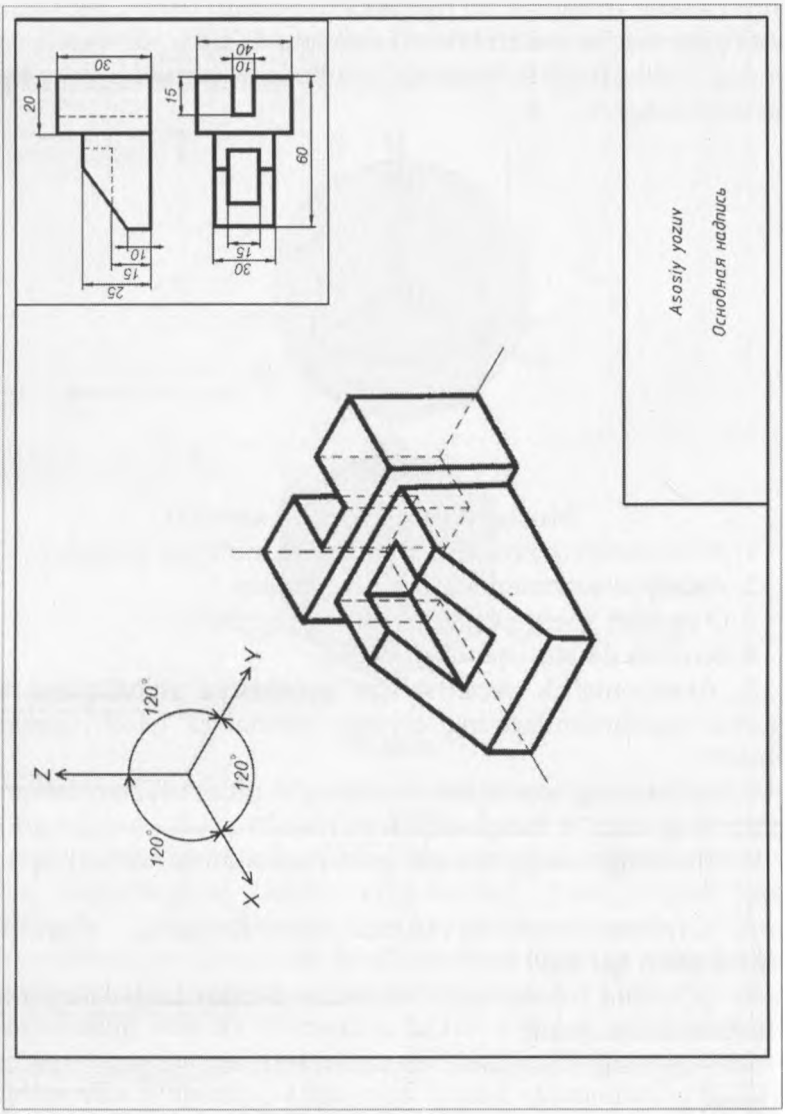


96-rasm

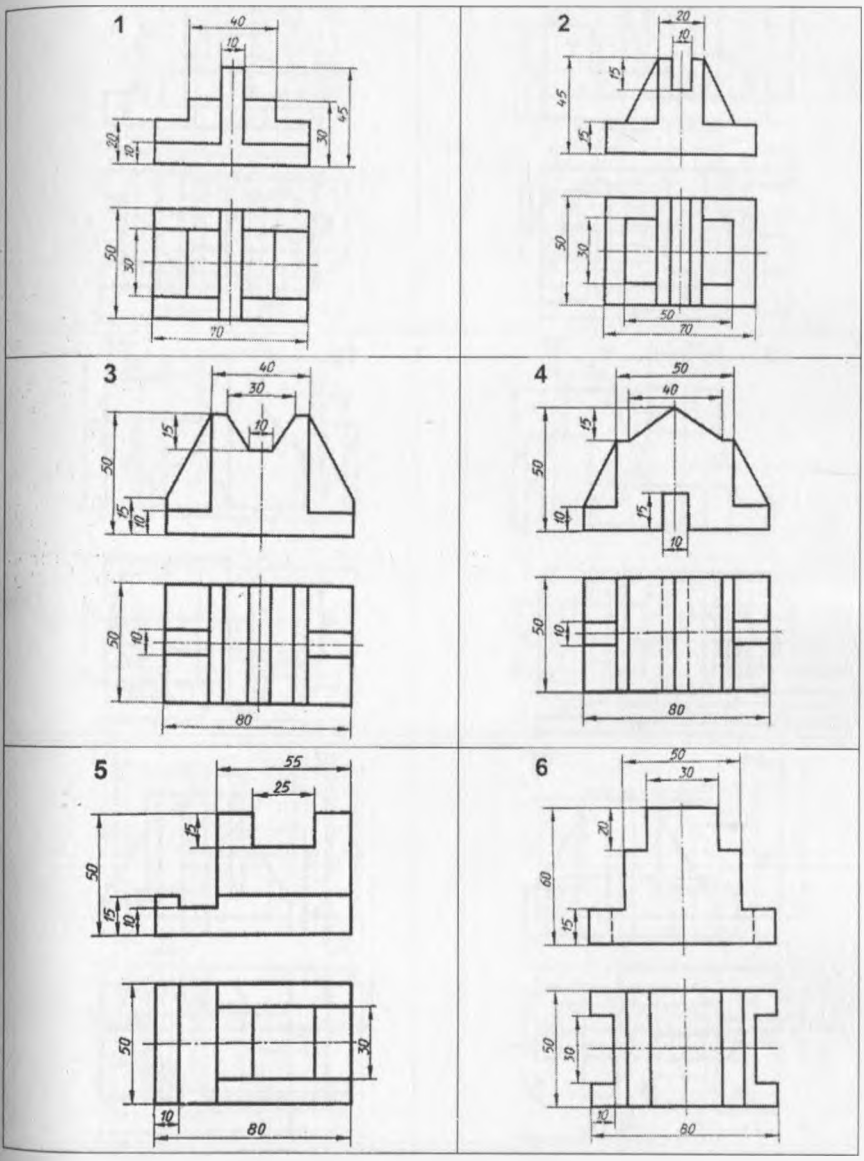
Mustahkamlash uchun savollar

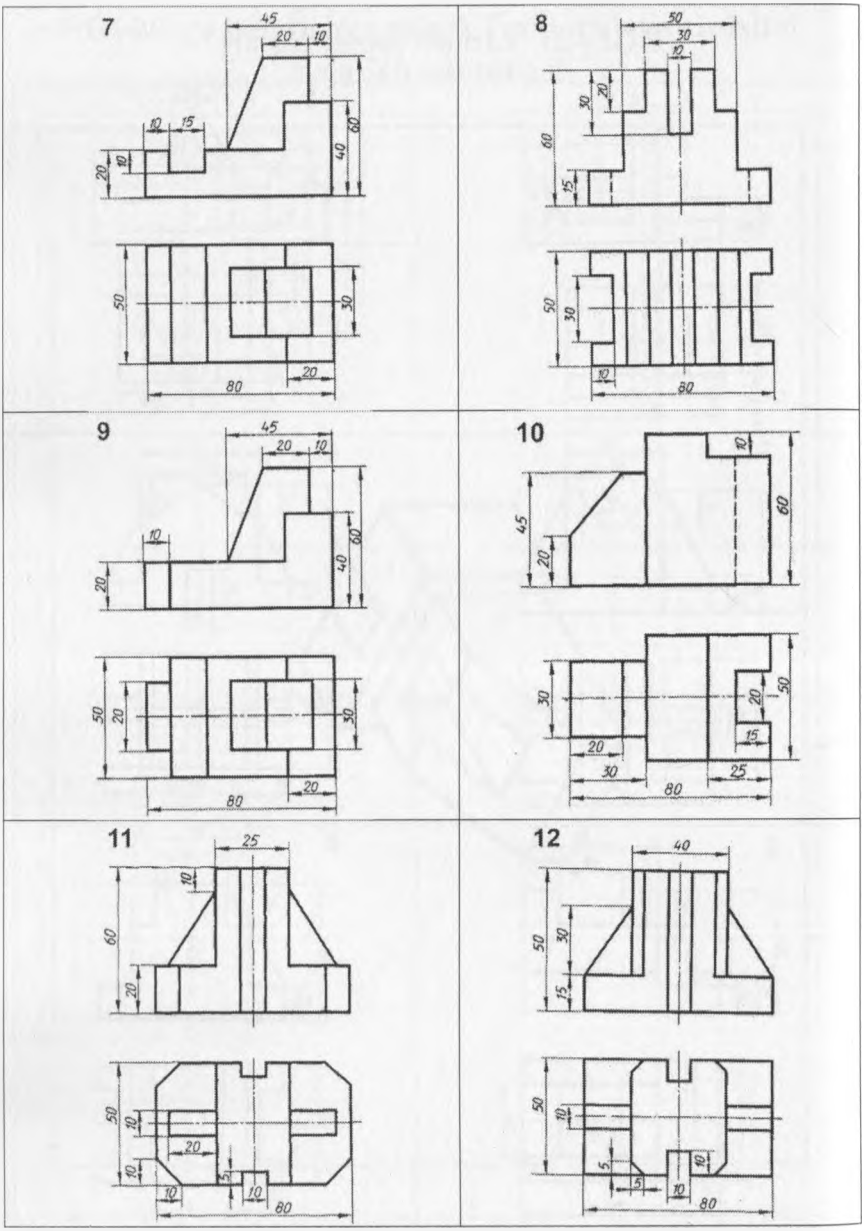
1. Aksonometrik proektsiya usulining mohiyati nimada?
2. Asosiy aksonometrik teoremani tuzing.
3. O'zgarish koeffitsienti deb nimaga aytiladi?
4. Buzilish darajasi qanday bog'liq?
5. Aksonometrik proektsiyalar proektsiya yo'nalishiga va o'zgarish koeffitsientlarining qiyosiy qiymatiga qarab qanday bo'linadi?
6. Aylananing izometrik va dimetrik proektsiyalari bo'lgan ellipslarning katta va kichik o'qlari yo'nalishi qanday aniqlanadi?
7. Sharning aksonometrik proektsiyasining konturi qaysi chiziq?
8. Qiyshiq burchakli frontal izometriyadagi o'zgarish koeffitsientlari qanday?
9. Qiyshiq burchakli frontal o'lchovdagi o'zgarish koeffitsientlarini ayting.
10. Qiyshiq burchakli aksonometriyada o'qlar qanday qurilgan?

HGI-20. ga bajarishga misol. Izometrik ko'rinishni bajarish namunasi



HGI –20. Variant topshiriqlari

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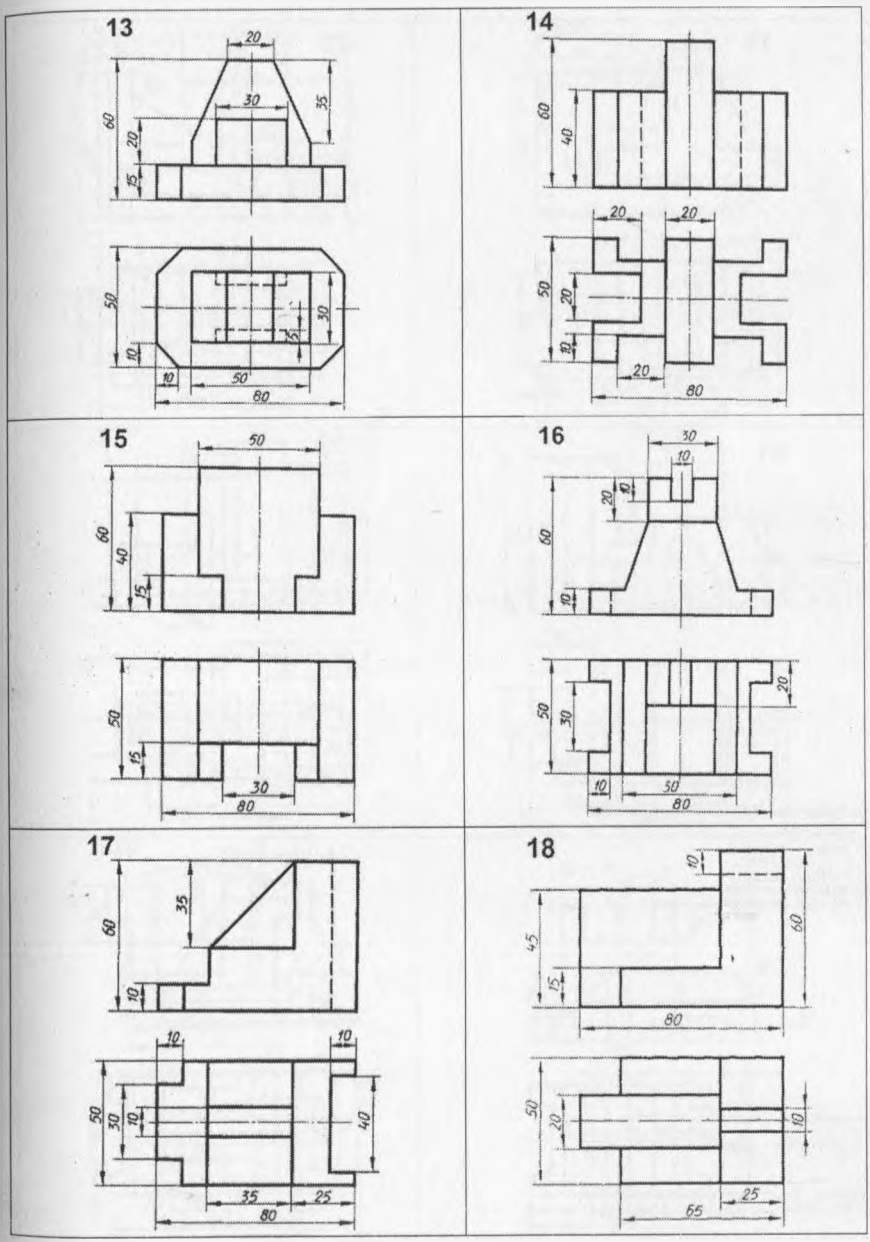
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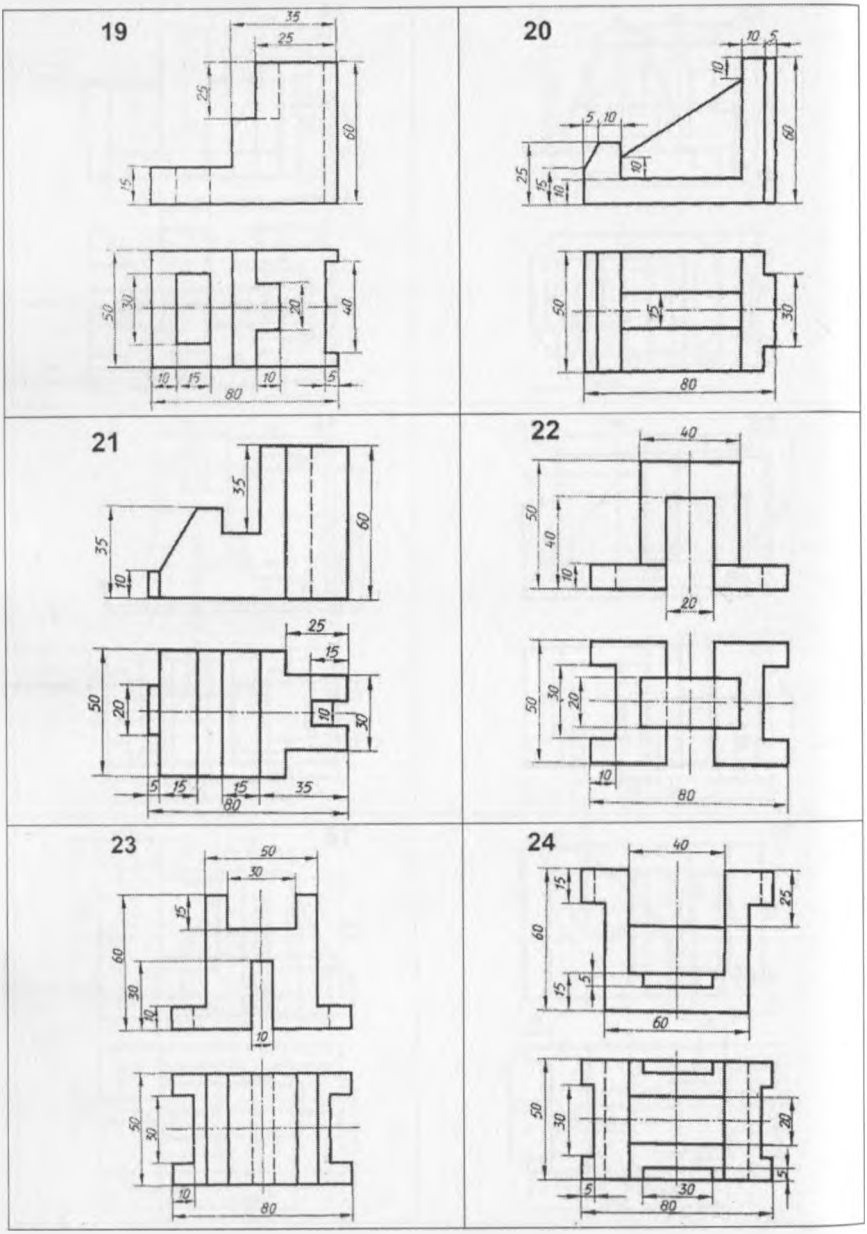
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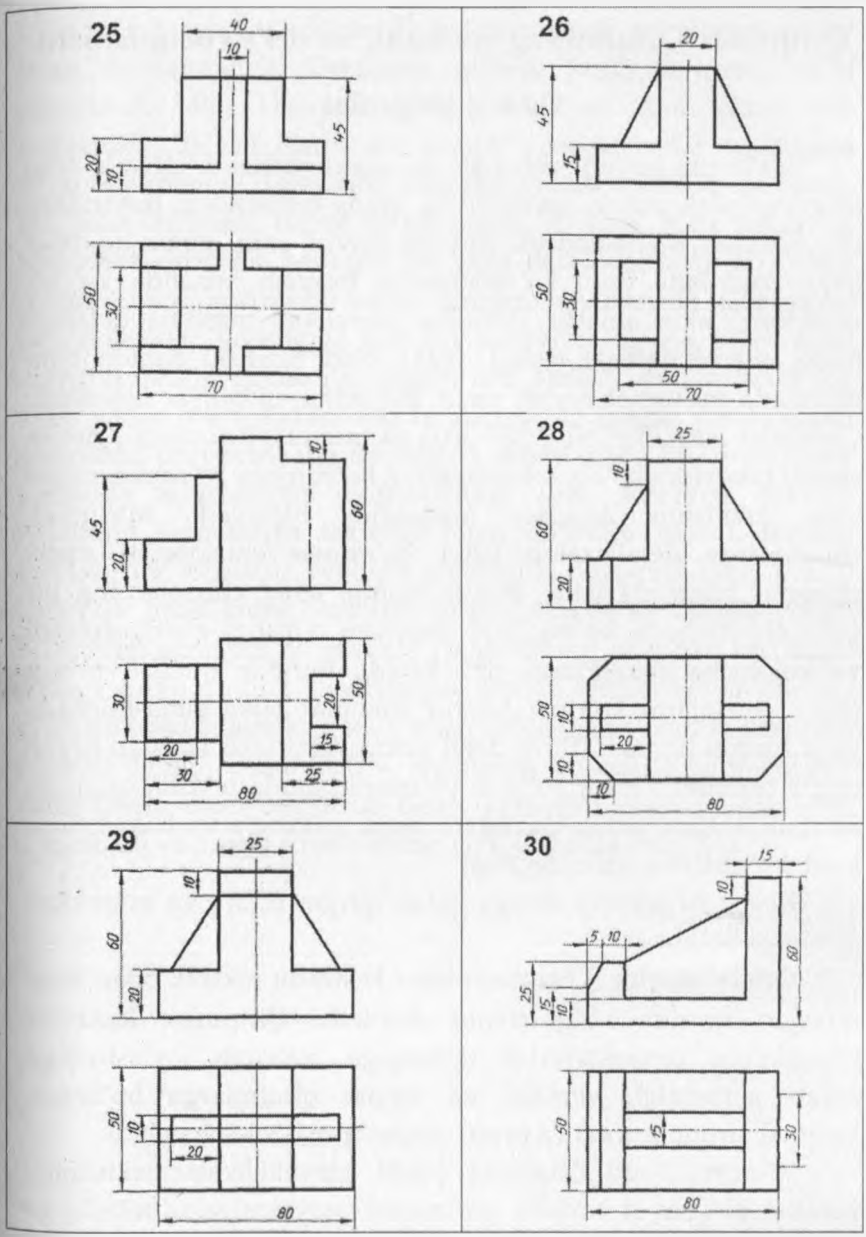
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Qirqimlar. Qirqimning berilishi, tasviri va belgilanishi

Oddiy qirqimlar

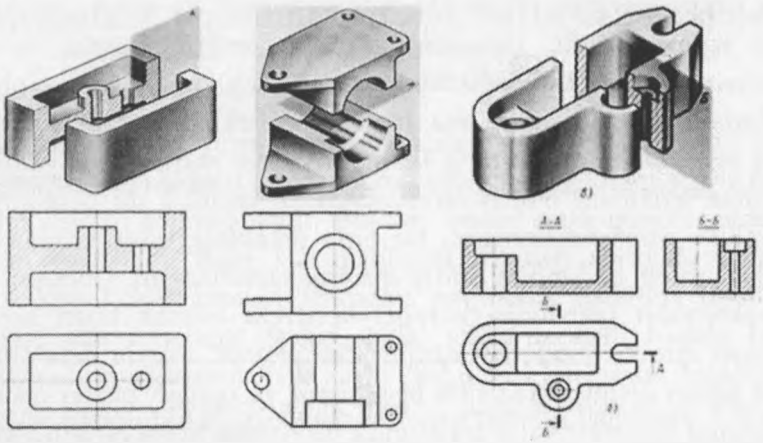
Ma'lumki buyum chizmasi va xususiyatlari to'g'risida aniq tasavvur olish uchun, qo'shimcha, uning tekislikdagi tasviridan-chizmasidan foydalaniladi. Buyum tasviri aniq qonun-qoidalar bilan bajariladi, Buni ko'rinishlarini bajarish misolida ko'rish mumkin. Lekin amalda shunday murakkab mashina detallari borki, ularni nafaqat tashqi, balki ichki tuzilishi haqida ham chizmada ma'lumot berish zarur. Bu uchun qirqimlar bajariladi. Qirqimlar ham O'zDST 2.305-2003 ga muvofiq bajariladi. Qirqim shartli tasvirlash bo'lib, u buyumning ko'zimizga ko'rinmaydigan ichki tuzilishini aniqlash maqsadida bajariladi. Ma'lumki, chizmalarda detallarning ichki ko'rinmas chiziqlarini shtrix chiziqlar bilan chiziladi. Bunda tashqi, ichki chiziqlarning bir yo'la chizmalarda ko'rsatilishi chizmani o'qishni qiyinlashtiradi va ko'pincha xatoliklarga olib keladi. Bundan qutilish uchun shtrix chiziqlarni ko'rinar kontur chiziqlar bilan almashtiriladi, ya'ni qirqim beriladi. Biror detal yoki uzelni tekislik bilan fikran qirqib tekislikda hosil bo'lgan yo'zuvni hamda tekislik orqasida ko'rinib qolgan teshik chiziqlari, qirra, qovurg'a va hokazolarni kesib ko'rsatish qirqim deyiladi.

Kesuvchi tekislik soniga qarab qirqim oddiy va murakkab qirqimga bo'linadi.

Oddiy qirqim. Chizmada birta kesuvchi tekislik bilan hosil qilingan qirqim *oddiy qirqim* deyiladi. Qirqimlar kesuvchi tekislikning proyektsiyalar tekisligiga nisbatan joylashishiga qarab gorizontal, vertikal va og'ma qirqimlarga bo'linadi. Vertikal qirqim frontal va profil qirqimlarni o'z ichiga oladi.

97-rasm, *a* da detalning profil proyektsiyalar tekisligiga parallel bo'lgan *A* tekislik gorizontal proyektsiyalar tekisligiga perpendikulyar bo'lib, deltani simmetriya o'qi bo'yicha kesib

o'tsa uning vaziyati chizmada belgilanmaydi va qirqim yozuv bilan izohlanmaydi. Detalning oldingi kesilgan qismi, ya'ni kuzatuvchi bilan kesuvchi tekislik orasidagi qism fikran olib tashlanadi, qolgan qismi esa frontal proyektsiyalar tekisligida to'liq tasvirlanadi. Detalning kesilgan yuzasi shtrixlab qo'yiladi. Bu bilan chizmani o'qish osonlashadi. 97-rasm, *b* da detalning kompleks chizmasi berilgan. Bu erda detalning bosh ko'rinishi o'rnida uning gorizontal oddiy qirqimi tasvirlangan. Gorizontal proyektsiyalar tekisligiga parallel kesuvchi tekislik bilan hosil qilingan qirqim gorizontal qirqim deb ataladi. Bunda detalning ustki yarim qismi fikran olib tashlanadi va qolgan pastki qismi gorizontal proyektsiyalar tekisligida tasvirlanadi. Bu qirqim ham yuqorida ko'rsatilgan mosliklardagi kabi, kesuvchi tekislik detalning simmetriya tekisligi bilan qo'shilib qoladi, tegishli tasvirlar bir formatda bevosita proektsion boglanishdaligi uchun kesuvchi tekislikning vaziyati belgilanmaydi va qirqim yozuv bilan izohlanmaydi. 97-rasm, *c* da detalning chapdan ko'rinishi o'rniga profil qirqimi tasvirlangan. Bunda qirqim kesish chizig'i bilan ko'rsatilib, strelka yozuv bilan belgilangan, chunki kesuvchi tekislik detalni nosimmetrik qismlarga bo'ladi. Kesim chizig'i uzuq chiziq bilan belgilanib tasvir konturini kesmaydigan qilib o'tqaziladi va asosiy tutash chiziq yo'g'onligida chiziladi.

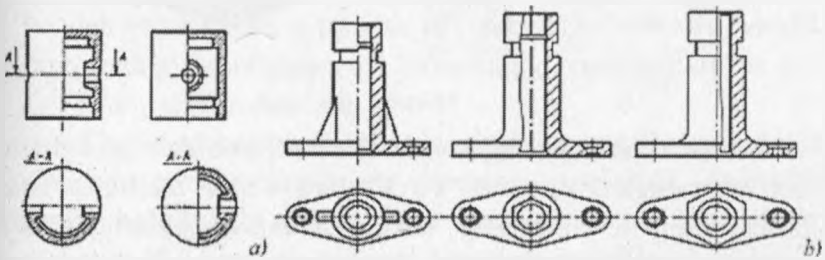


a) b) c)

97-rasm

O'zDST talabiga asosan simmetrik detallarga oddiy qirqim berishda ko'rinishning yarmi bilan qirqimning yarmini birlashtirib tasvirlashga ruxsat beriladi. Bunda ko'rinish bilan qirqimni simmetriya o'qi ajratib turadi. 98-rasm, *a* da qirqim ko'rinishning bir qismi bilan qo'shib tasvirlangan, ko'rinish qismidagi ko'rinmas kontur chiziqlar ko'rsatilmaydi. Gorizontal qirqimning yarmi simmetriya o'qidan pastda yoki o'ng tomonda joylashtirilishi mumkin. Shuningdek detalning ko'rinishi bilan qirqimni, butun tasvirini emas, balki uning bir qisminigina, agar bu qismi aylanish sirtidan iborat bo'lsa, simmetriya tekisligi izi bilan qo'shilib qoluvchi shtrix-punktir chiziq bilan ajratib chizishga ruxsat etiladi. Agar simmetriya o'qiga buyumning biron bir qirrasi to'g'ri kelsa ko'rinish va qirqimni ingichka to'lqinsimon chiziq bilan ajratish kerak. Ichki qirrani tasvirlashda ingichka to'lqinsimon chiziq ko'rinishni va tashqi qirrani tasvirlashda qirqimni cheklashi lozim 98-rasm, *b*.

Qirqimlarga oid xorijiy adabiyotdan keltirilayotgan materiallarda ham buni ko'rish mumkin: "Mashina qismlarining ichki va tashqi detallari mavjud. Ichki qirralar tashqi ko`rinishida ko`rinmaydi va ko'rinmas chiziqlar shtrix chiziqlar bilan chiziladi. Shtrix chiziqlar bilan tasvirlangan bunday ko'rinmas chiziqlar ko`p bo`lsa chizma chalkash bo`ladi. Bunday chalkashliklardan qutulish uchun obyektlarga qirqim beriladi".

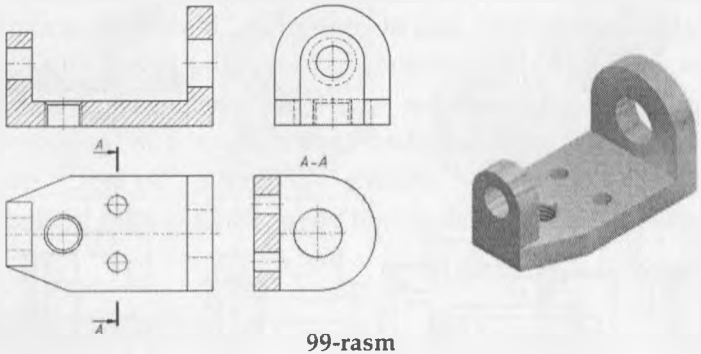


98-rasm

Qirqim - bu jismni tekislik (yoki bir nechta tekislik) bilan xayolan ravishda kesish natijasida olingan tasvir. Bunday holda, qirqim kesuvchi tekisligida olingan va kesuvchi tekisligining orqasida joylashgan narsaning tasvirini ko'rsatadi.

Qirqimda ichki kontur chiziqlar bilan tasvirlangan jismning ichki chiziqlari ko'rinadigan bo'lib, qattiq asosiy chiziqlar bilan yasalgan.

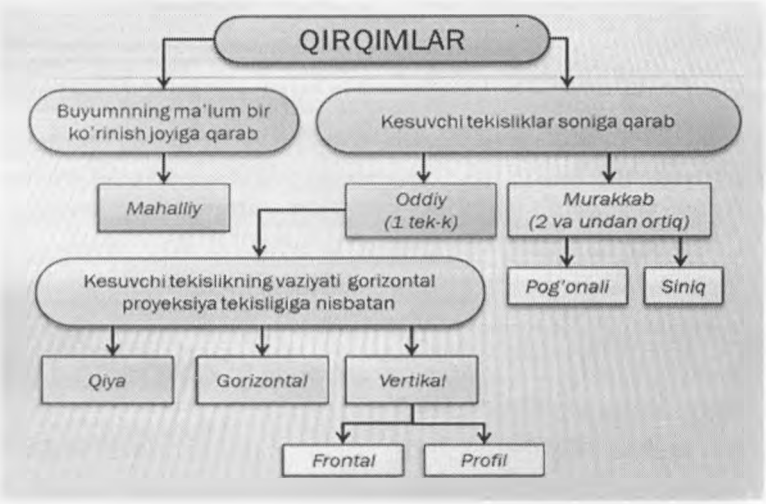
Agar kesuvchi tekisligi jismning simmetriya tekisligiga to'g'ri keladigan bo'lsa va qirqim proektsion bog'lanish orqali joylashgan bo'lsa, u holda qirqim belgilanmaydi. Boshqa hollarda, qirqim kesimday bir xil tarzda belgilanadi 99-rasm.



99-rasm

Kesuvchi tekisligining holati rasmda ajratib chizilgan chiziq bilan ko'rsatilgan. Kuzatish yo'nalishini o'qlar bildiradi. Ular ajratib chizilgan chiziqning tashqi uchlarida joylashgan. Va o'qlarning tashqi tomonida rus alifbosining bir xil katta harflari qo'llaniladi. Xuddi shu harflar kesik ustida chiziq bilan ajratilgan holda yozilgan.

Qirqimlar quyidagi turlarga bo'linadi. Rasm- 100.



100-rasm

Kesuvchi tekisliklarning soniga qarab qirqimlar oddiy (bitta kesuvchi tekislik bilan) va murakkab (bir nechta kesuvchi tekislik bilan) qirqimlarga bo'linadi.

Qirqimlar kesuvchi tekislikning vaziyatiga qarab gorizontal tekisligiga nisbatan joylashishganda vertikal, gorizontal va qiya qirqimlarga bo'linadi.

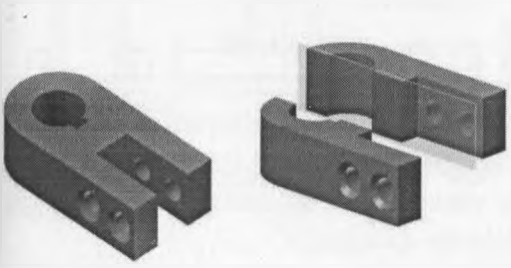
Kesilgan tekisliklar buyumning uzunligi yoki balandligi bo'ylab yo'naltirilsa, qirqimlar *bo'ylama*, agar kesuvchi tekisliklar buyumning uzunligiga yoki balandligiga perpendikulyar bo'lsa, *ko'ndalang* qirqim deyiladi.

Quyidagi barcha misollarda, ob'ektlar metall ekanligi odatiy ravishda qabul qilingan va jismning qismlarida materialning grafik belgilanishi uchun soya chizilgan hoshiya chiziqlariga nisbatan 45 ° burchak ostidagi qiyalikda ingichka chiziqlar bilan amalga oshiriladi. (o'ng yoki chapga qiyalik).

Vertikal va gorizontal qirqimlar

Qirqimlar kesuvchi tekislikning vaziyatiga qarab gorizontal tekisligiga nisbatan joylashishganda vertikal va gorizontal qirqimlarga bo'linadi.

Agar kesish tekisligi gorizontal proyeksiya tekisligiga perpendikulyar bo'lsa, u holda qirqim vertikal deb ataladi. Rasm- 101da vertikal qirqim ko'rsatilgan.



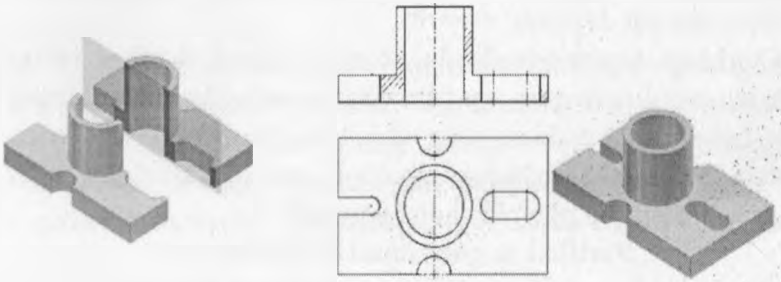
101-rasm

102-rasm

Agar kesuvchi tekislik gorizontal proyeksiya tekisligiga parallel bo'lsa, u holda qirqim gorizontal deyiladi. Rasm-102da gorizontal qirqim ko'rsatilgan.

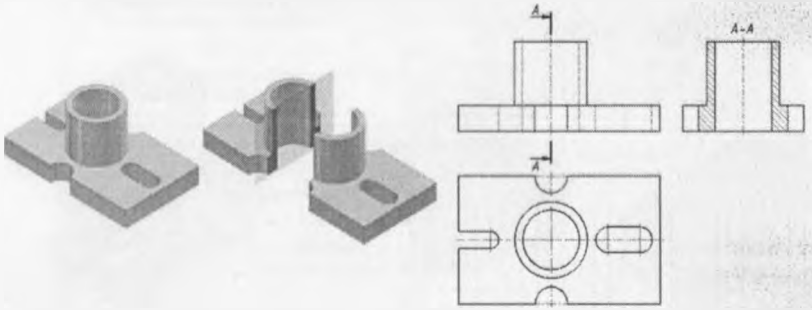
Kesuvchi tekislikning frontal va profil proektsiya tekisliklariga nisbatan holatiga qarab vertikal qirqimlar *frontal* va *profilga* bo'linadi.

Agar kesuvchi tekislik proektsiyalarning frontal tekisligiga parallel bo'lsa, u holda bu qirqim *frontal* deb nomlanadi. Rasm-103 da frontal qirqim ko'rsatilgan.



103-rasm

Agar kesuvchi tekislik proektsiyalarning profil tekisligiga parallel bo'lsa, u holda qirqim *profil* deb nomlanadi. Rasm-104 da profil qirqim ko'rsatilgan.



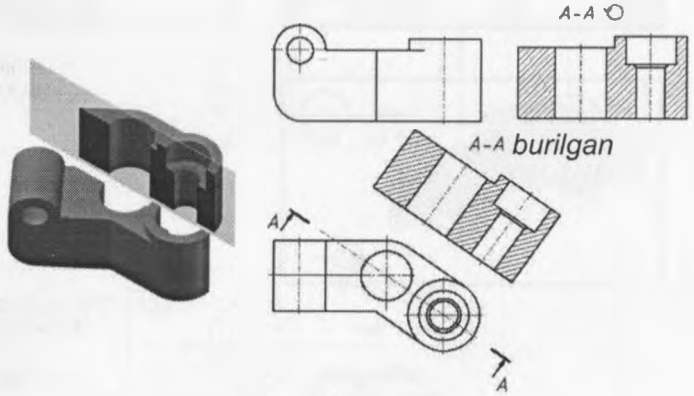
104-rasm

Og'ma qirqim

Agar jismda egri joylashgan bo'shliq elementlari bo'lsa, og'ma qirqim ishlatiladi.

Kesuvchi tekislik proyeksiya tekisliklaridan biriga, masalan, gorizontal tekislikka nisbatan biror o'tkir burchak ostida bo'lsa, buyumda og'ma qirqim (qiya) hosil bo'ladi.

Og'ma qirqimni chizmaning bo'sh joyiga joylashtirib, kerak bo'lganda burib ko'rsatishga ruxsat etiladi. Bunda A-A belgi yonida **"burilgan"** so'zi yoziladi. . Agar kesuvchi tekisliklar o'zaro parallel bo'lmasa *"burilgan"* so'zi yozilmaydi. Rasm-105 da og'ma qirqim ko'rsatilgan.



105-rasm

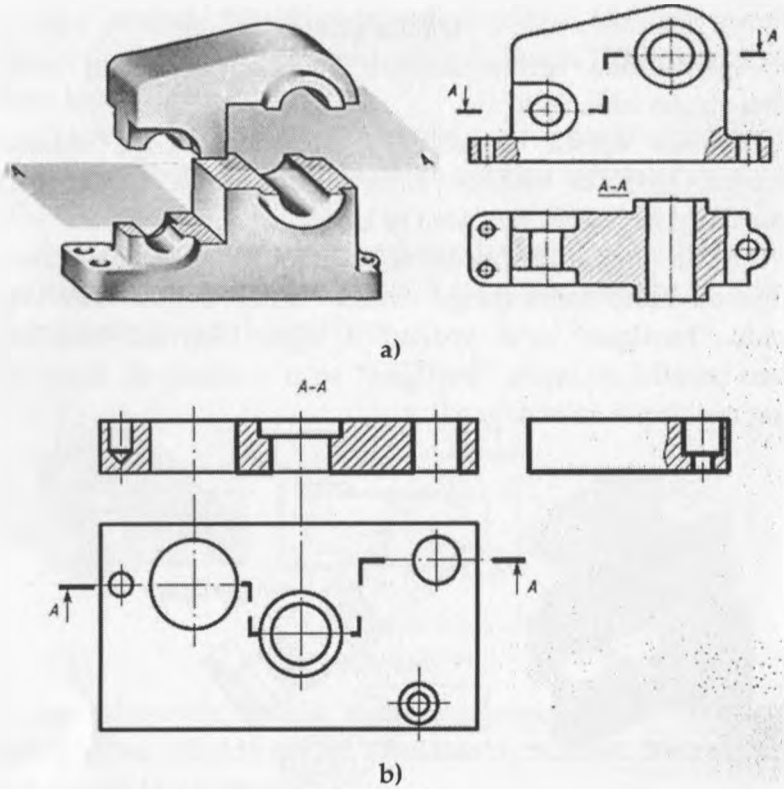
Oddiy va murakkab qirqimlar

Kesish tekisliklari soniga qarab qirqimlar oddiy va murakkab turlarga bo'linadi.

Chizmada bitta kesuvchi tekislik bilan hosil bo'lgan qirqim oddiy qirqim deyiladi. Rasm 104, 105 da oddiy qirqim ko'rsatilgan.

Murakkab qirqimlar

Murakkab qirqim – buyumni ikki va undan ortiq kesuvchi tekislik bilan kesib hosil qilinadi. Agar kesuvchi tekisliklar o'zaro parallel' joylashsa *pog'onali qirqim* hosil qilinadi (106-rasm, *a, b*).



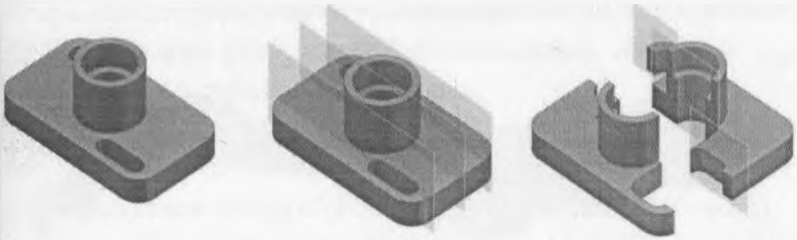
106-rasm

Agar kesuvchi tekisliklar o'zaro ma'lum bir burchak ostida o'tkazilsa *siniq qirqim* hosil qilinadi Bunda kesuvchi tekisliklar bir tekislikka jipslashtiriladi. Zarur holda proyeksiya siniq qirqim asosida bajariladi. Ayrim hollarda siniq qirqimni pog'nali ko'rinishda berish mumkin.

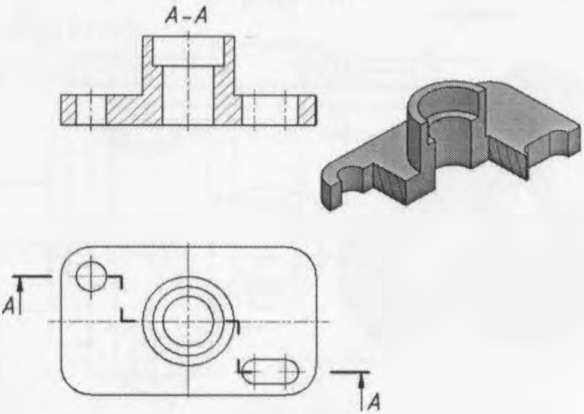
Kesuvchi tekisliklarning vaziyatiga qarab murakkab qirqimlar *pog'onali* va *siniq qirqimlarga* bo'linadi.

Kesuvchi tekisliklar o'zaro parallel joylashgan bo'lsa, pog'onali qirqim hosil bo'ladi.

Rasm-106 *b*-da uchta kesuvchi tekislik tomonidan amalga oshirilgan frontal pog'onali qirqim misolida ko'rsatilgan bo'lib, uning holati pog'onali qirqim chizig'i bilan ustdan ko'rinishda belgilanadi (107-rasm).



107-rasm



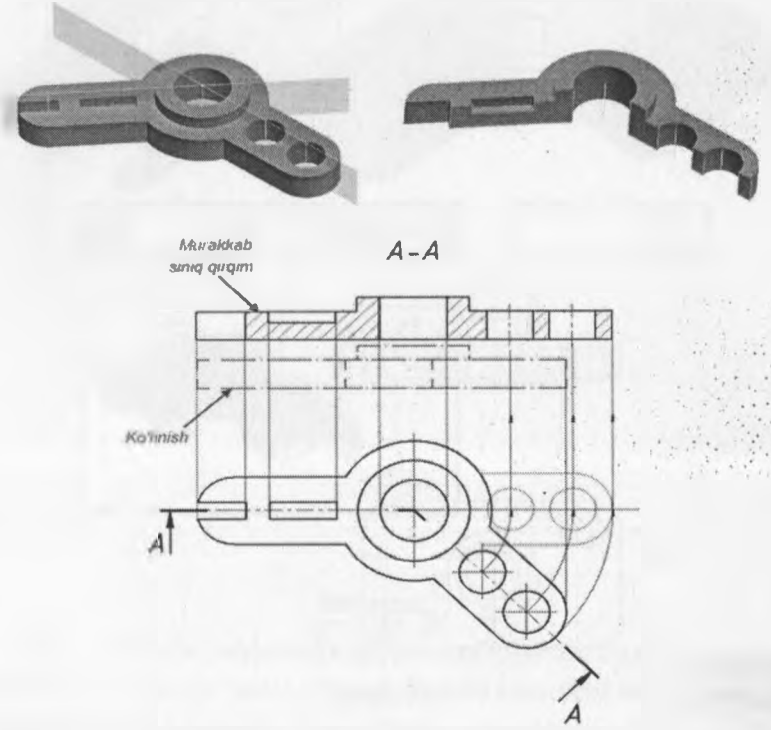
108-rasm

Agar murakkab qirqimdagi kesish tekisliklari kesishgan bo'lsa, u holda qirqim *siniq qirqim* deb ataladi.

Bunday holda, bitta proektsiya tekisligi shartli ravishda proektsiya tekisliklarining kesishish chizig'i atrofida boshqa proyeksiya tekisliklariga parallel bo'lgan boshqa proektsiya tekisligiga to'g'ri kelguncha aylantiriladi, ya'ni singan qism tegishli ko'rinish o'rniga joylashtiriladi.

Rasm-108 jismni kesishgan ikkita tekislik ajratadi, ulardan biri frontal tekislikdir.

Siniq qirqimni uchta kesishgan tekislik bilan kesish orqali olish mumkin. Kesuvchi tekislikning aylanish yo'nalishi ko'rish yo'nalishiga mos kelmasligi mumkin, (rasm – 109).



109-rasm

Oddiy qirqimlardan farqli o'laroq, chizmalardagi murakkab siniq qirqimlar har doim uzuq chiziq orqali, o'qlar va harflar bilan ko'rsatiladi.

To'liq va mahalliy qirqimlar

Qirqimning to'liqligiga qarab qirqimlar to'liq va mahalliyga bo'linadi.

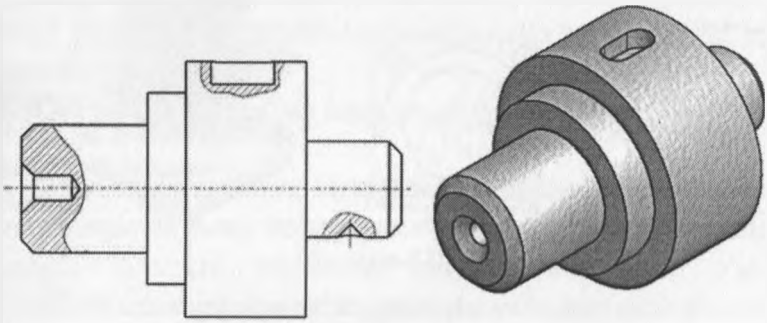
Agar kesma tekisligi jismni to'liq kesib o'tgan bo'lsa, u holda qirqim to'liq deb nomlanadi. Yuqoridagi barcha misollarga to'liq qiqimlar ko'rsatiladi.

Biroq, ba'zi hollarda, ob'ekt shaklining ichki tuzilishini alohida, cheklangan joyda ko'rsatish kerak.

Jismning qiya qismiga aniqlik kiritish, alohida cheklangan joyga chiqarilgan qirqim mahalliy deb nomlanadi.

Mahalliy qirqimni olish uchun buyum shaklining kichik bir qismi xayolan olib tashlanadi. Bunday holda, kesuvchi tekislik ko'rsatilgan elementning o'qi bo'ylab harakatlanadi (110-rasm).

Chizmada to'lqinsimon ingichka chiziq bo'lishi mumkin. Ushbu maqsaddagi chiziqlar chizilgan boshqa elementlari bilan mos kelmasligi kerak.



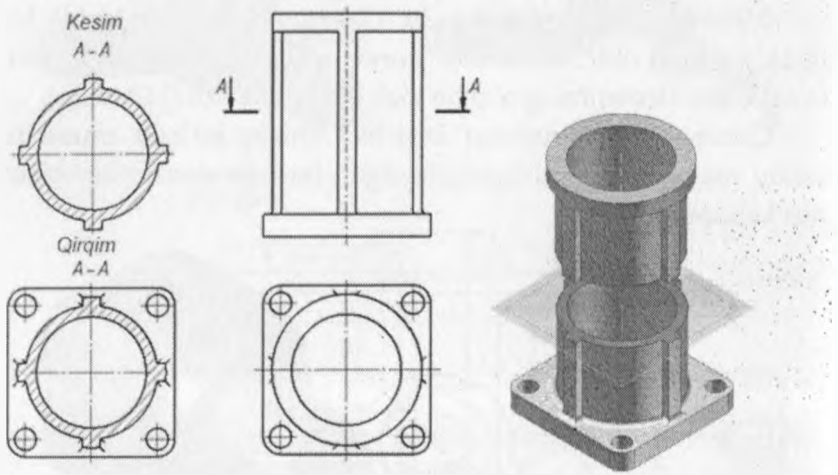
110-rasm

Kesimlar

Kesim - bu jismni tekislik bilan fikran kesish natijasida tekislikda hosil bo'ladigan shaklning tasviriga aytiladi. Kesim kesuvchi tekislik yuzasida hosil bo'ladi. Kesimlar ham ko'rinish va qirqimlar singari O'zDST 2.305-2003 ga muvofiq bajariladi. Kesimning qirqimdan farqi shundaki bunda detalning kesishuvchi tekislik orqasida ko'rinib qolgan qismi chizilmaydi.

Kesimning qirqimdan farqini yaxshiroq tushunish uchun 111-rasmlardagi tasvirlarni taqqoslab ko'rishning o'zi kifoya. Demak kesim detalning tekislik kesib o'tgan joyining chizmasini (dumaloqligi, to'g'ri turtburchakligi, oval yoki biror boshqa shakldaligini) ko'rsatish uchun ishlatiladi.

Kesimning asosiy maqsadi - rasmda jismning yoki uning elementlarining ko'ndalang shaklini ko'rsatish (111-rasm).

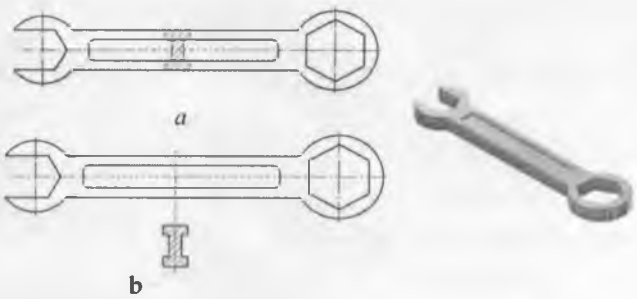


111-rasm

Kesim turlari va ularning chizmada joylashuvi

Chizilgan joyiga ko'ra kesimlar buyumning *ustiga chizilgan* va *chiqarilgan* bo'ladi.

Ustiga chizilgan kesimlar to'g'ridan-to'g'ri ko'rinishga joylashtiriladi. Buyumni o'ziga chizilgan kesimning konturi qattiq ingichka chiziq bilan chizilgan (112-rasm, *a*).



112-rasm

Olingan kesimlar jismning konturidan tashqarida yoki bir xil turdagi qismlar orasidagi bo'shliqda yoki kesim chizig'ining davomida yoki chizilgan maydonning bo'sh joyida joylashgan. Belgilangan qismning konturi tasvirning ko'rinadigan kontur chizig'i bilan bir xil qalinlikdagi qattiq qalin asosiy chiziq bilan chizilgan (112- rasm, *b*).

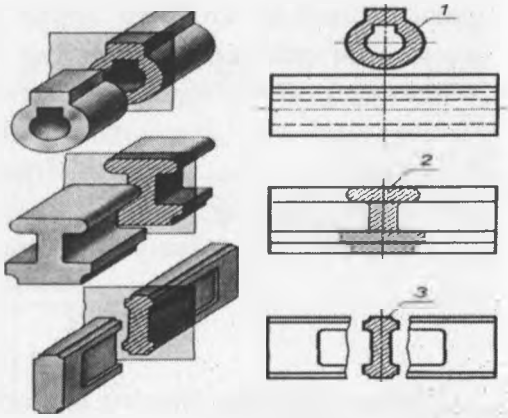
Chizmalarda chiqarilgan kesimlardan foydalanish afzalroq.

Kesimning belgilanishi

Kesim deb, buyumni birta yoki bir nechta tekisliklar bilan fikran kesganda hosil bo'ladigan chizmaning tasviriga aytiladi. Kesimda kesuvchi tekislikda nima bo'lsa, faqat o'shani ko'rsatiladi va kesimga tushgan yuza shtrixlanadi. Kesuvchi tekislik deb, detalni fikran kesiladigan yordamchi tekislikka aytiladi.

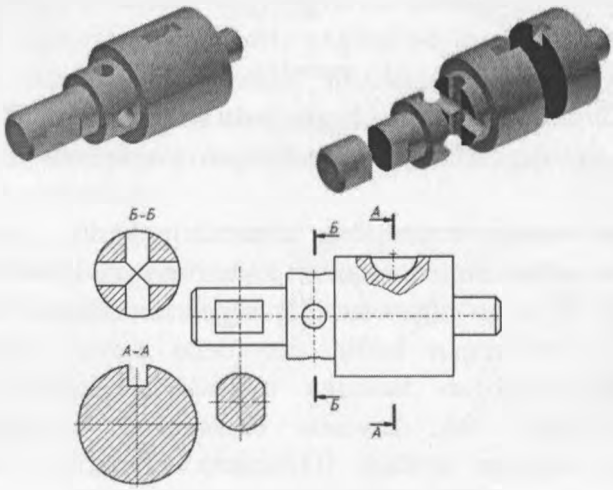
Kesim asosan, buyumning ko'ndalang kesimi chizmasini ko'rsatish uchun qo'llaniladi. Joylashuviga qarab kesim tashqariga ustiga qo'yilgan va chiqarilgan kesimlarga bo'linadi. Tashqariga chiqarilgan kesim deb detal tasviri konturidan tashqarida joylashgan kesimga aytiladi (113-rasm). Ustiga qo'yilgan kesim deb, bevosita chizmaning ko'rinishlarida joylashgan kesimga aytiladi (113-rasm). Chiqarilgan kesimni buyum tasviri tushurib qoldirilgan joyda ham tasvirlash mumkin.

113-rasm



Agar kesim chiqarilsa, unda, odatda, uzuq chiziq chiziladi. O'qlar kuzatuvning yo'nalishini bildiradi. Ular uzuq chiziqning tashqi uchlarida joylashgan. O'qlarning tashqi tomonida rus alifbosining bir xil bosh harflari qo'llaniladi. Kesimning yuqorisiga xuddi shu harflarni chiziqcha bilan yoziladi (112, 113-rasm (A-A kesim)). Chizmada har bir kesimning belgilash harflari mavjud.

Agar kesim simmetrik buyumda bo'lsa, u holda kesim chizig'ining davomiga joylashtirilishi mumkin, shtrixpunktir chiziq bilan o'rnatiladi. Bunday holda, o'qlar va harflar qo'llanilmaydi (114-rasm).

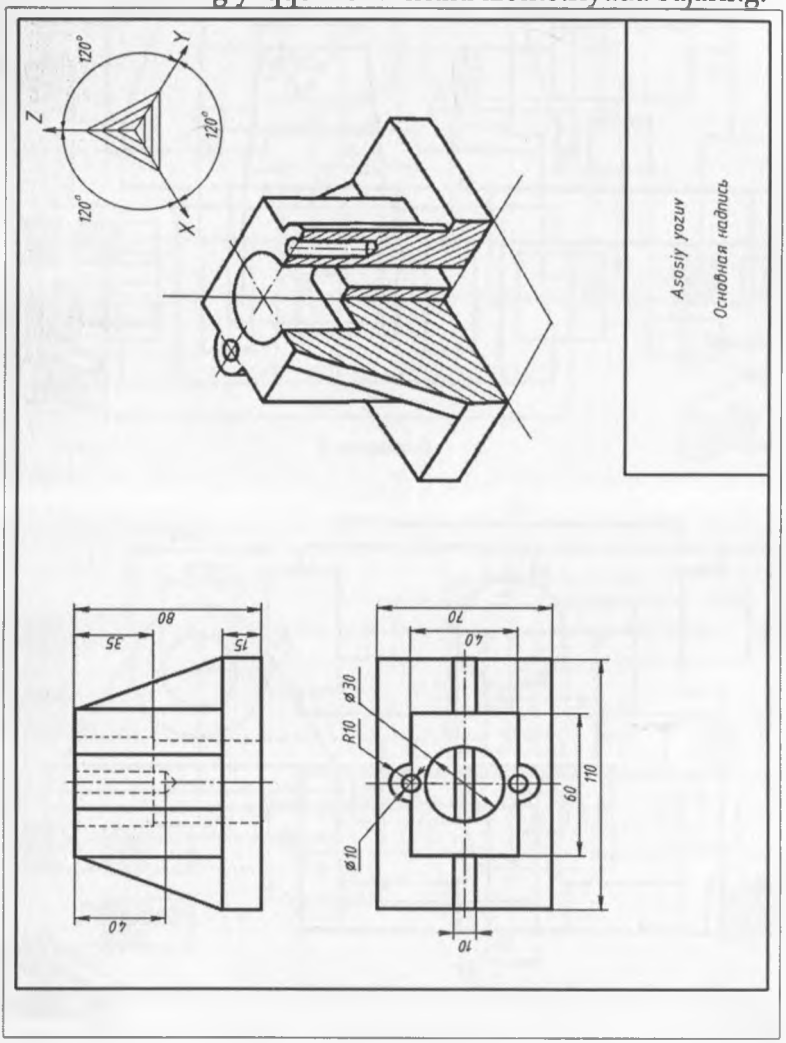


114-rasm

HGI-21. Detalning yaqqol tasvirini bajarish namunasi.

1. Detalning ikki ko'rinishiga qarab etishmayatgan uchinchi ko'rinishini chizing.

2. Detalning yaqqol ko'rinishini izometriyada bajaring.



HGI-21. Variant topshiriqlar.

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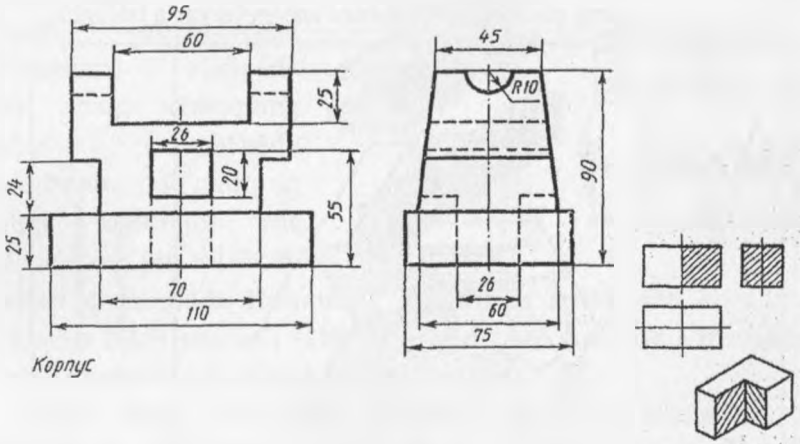
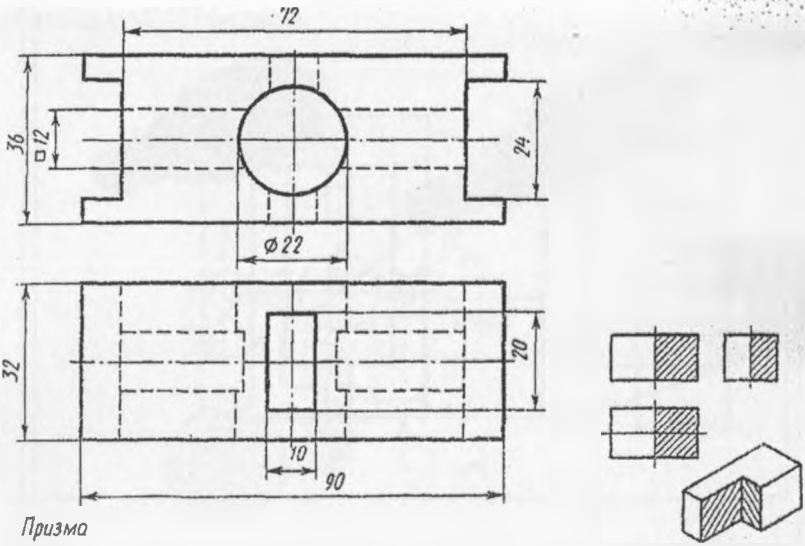


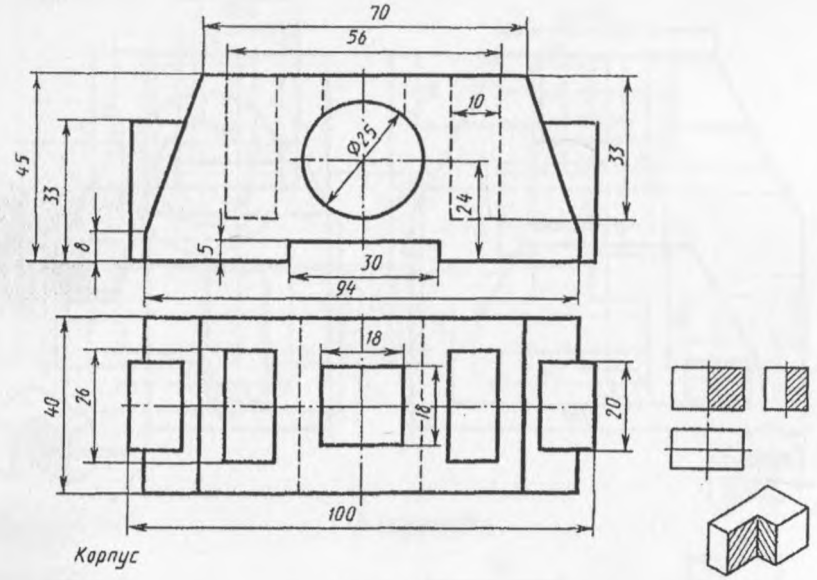
Корпус

Вариант 2



Призма

Вариант 3



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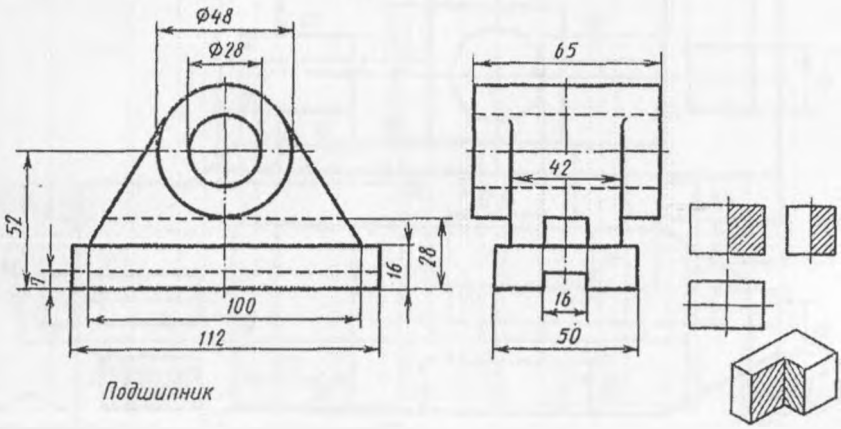

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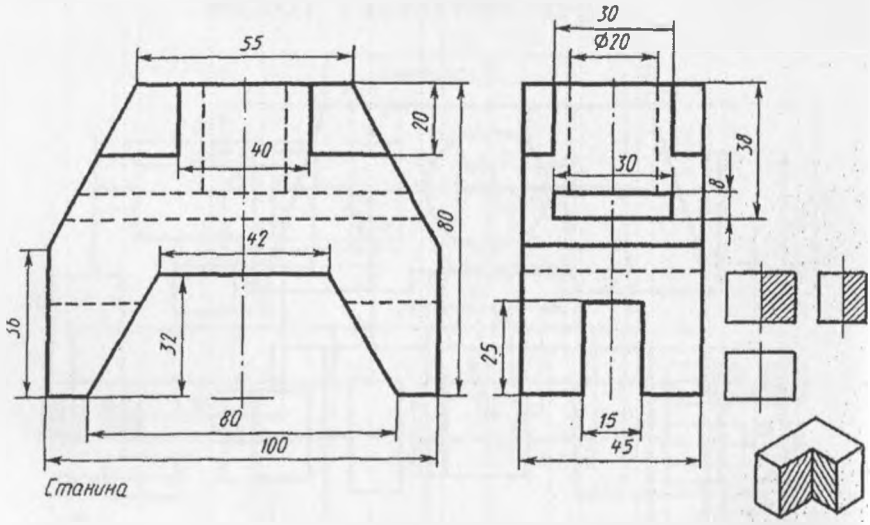
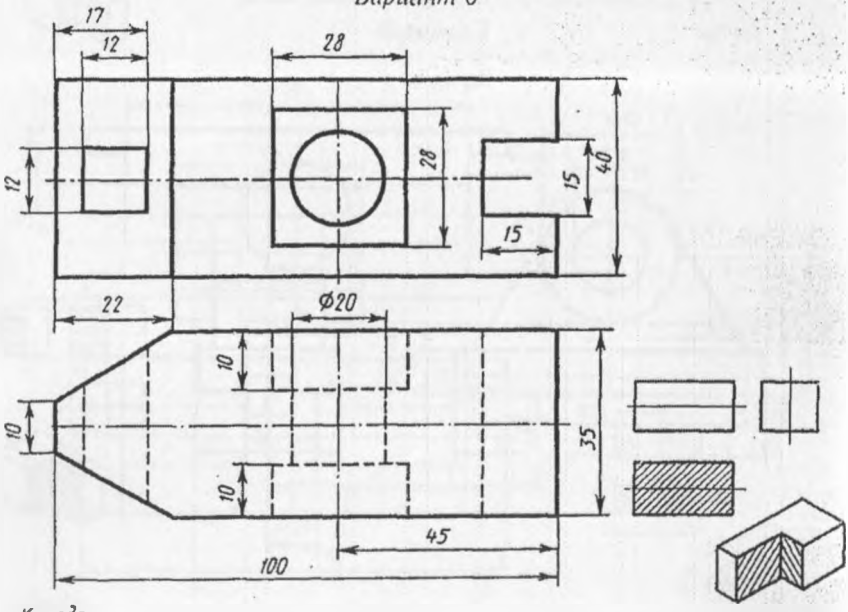


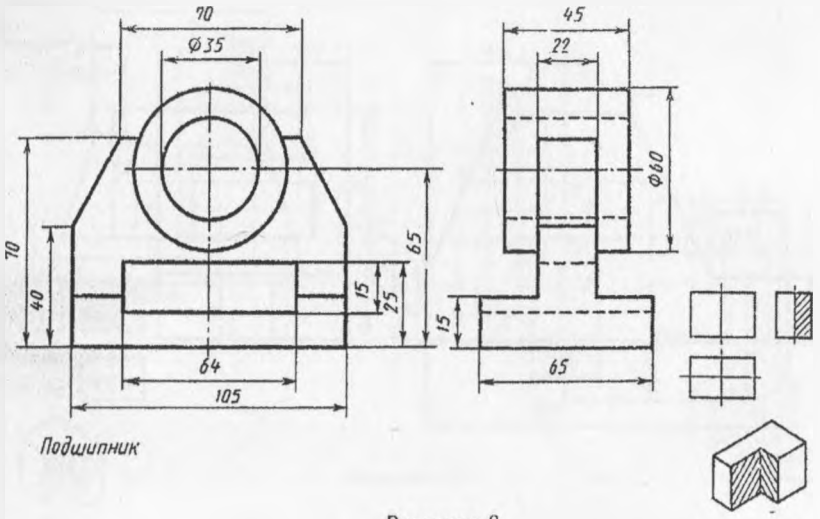
Станина

Вариант 6



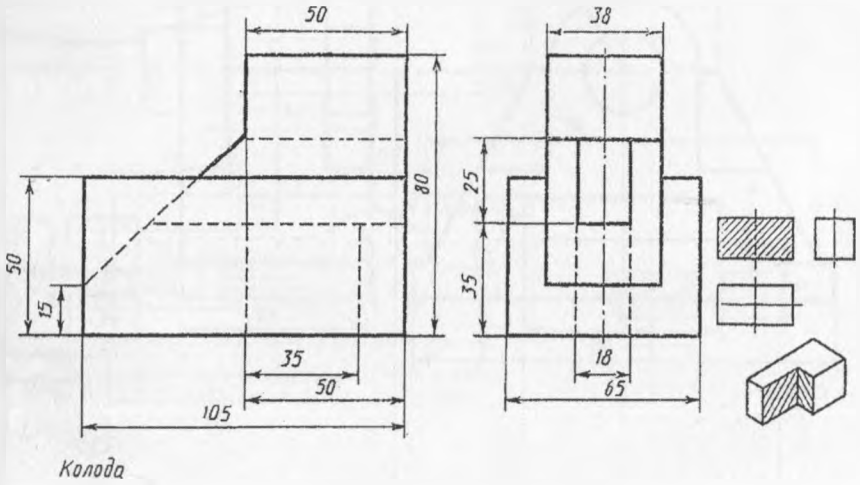
Колода

Вариант 7



Подшипник

Вариант 8



Колода

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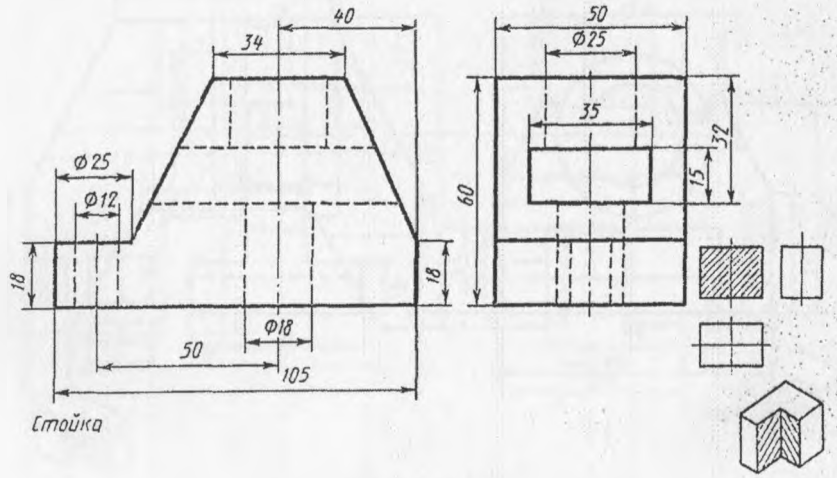
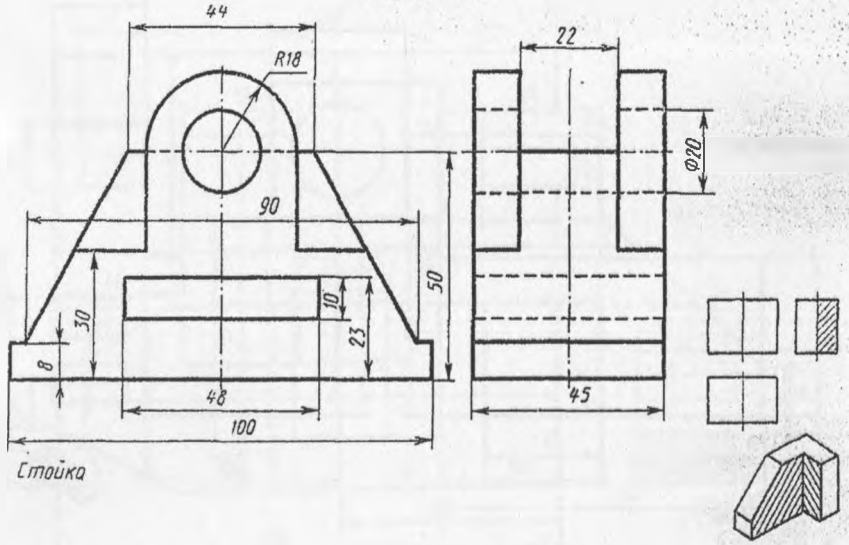


Стойка

Вариант 10



Стойка

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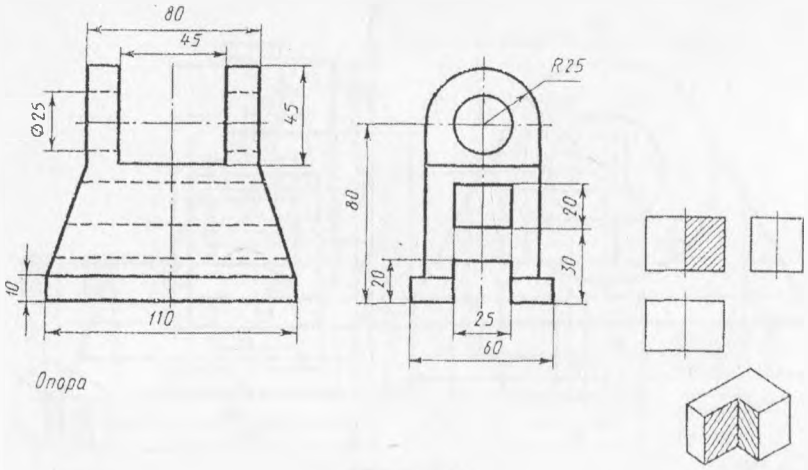

Опора

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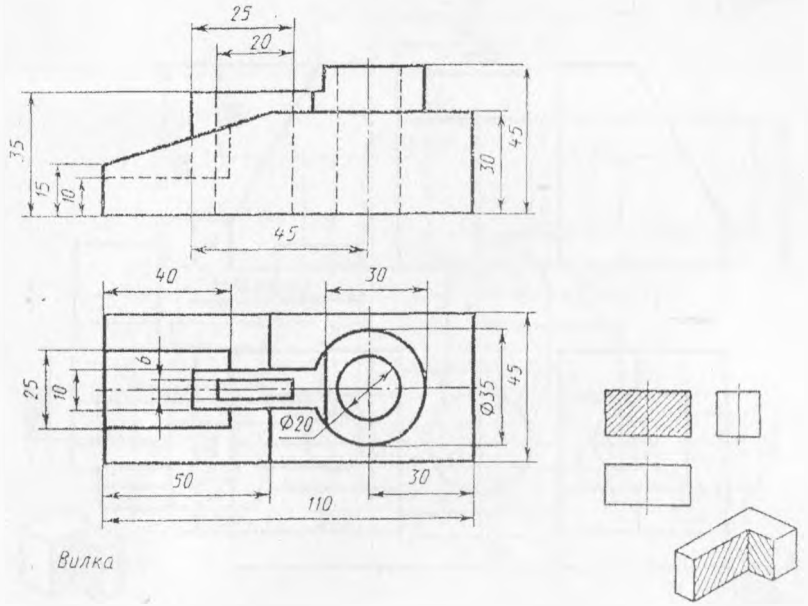

Вилка

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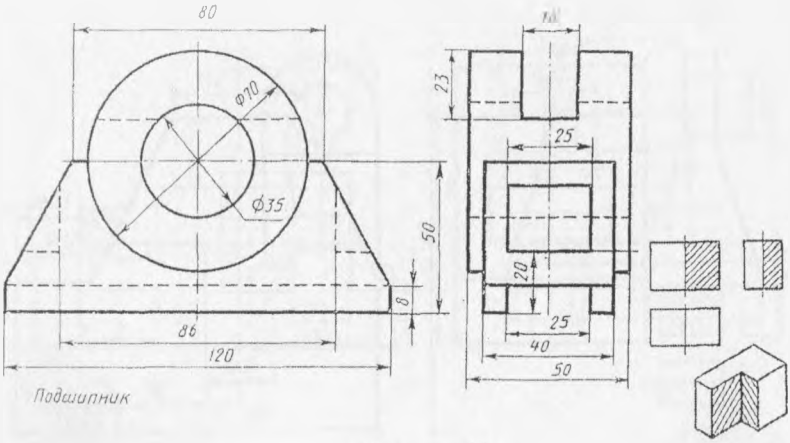

Подшипник

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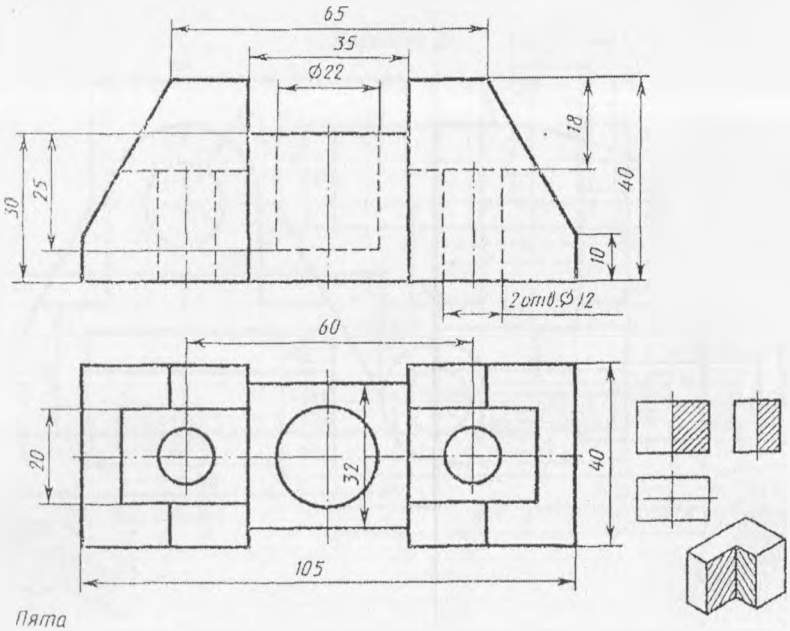
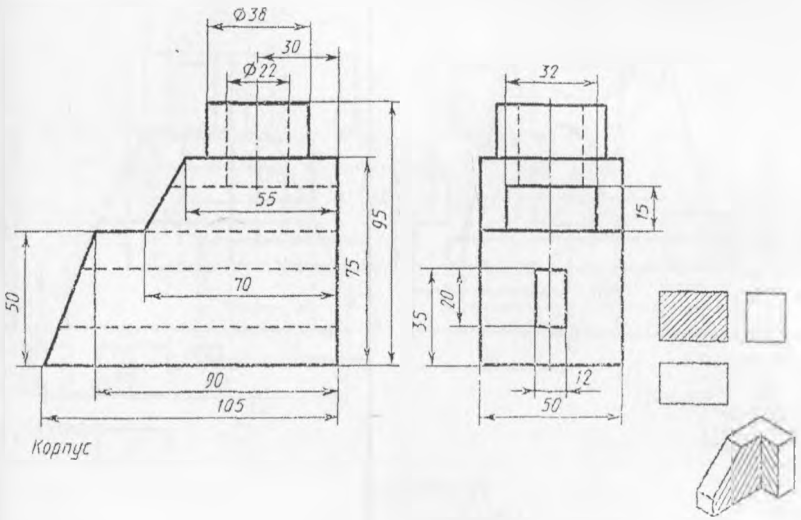


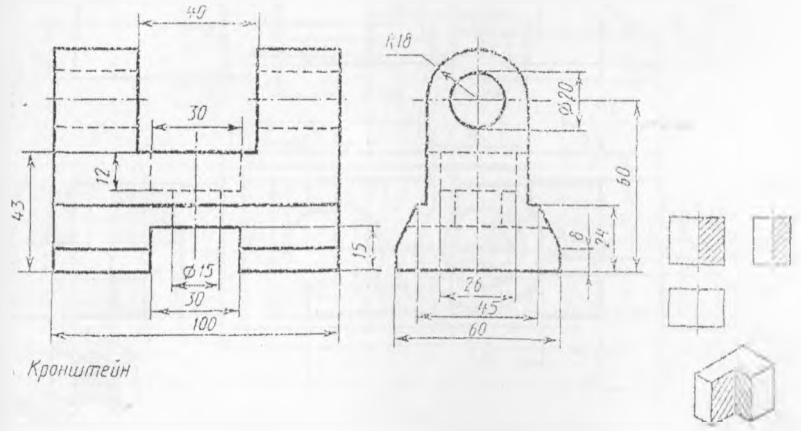
Пята

Вариант 15



Корпус

Вариант 16



Кронштейн

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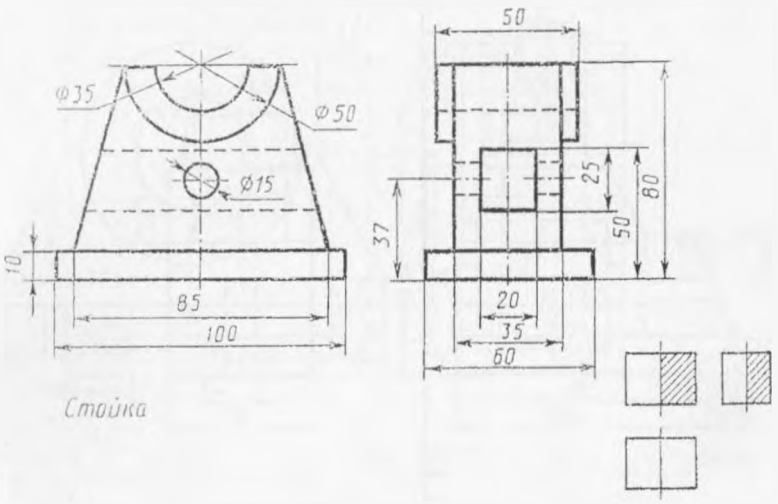

Стойка

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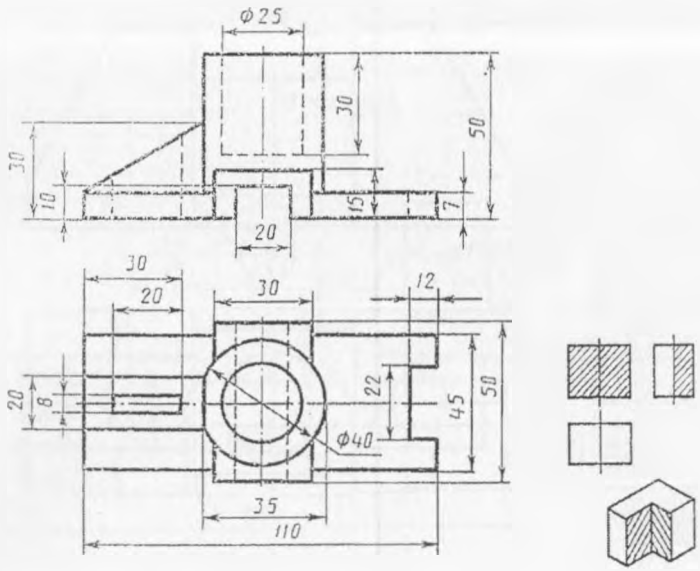

Корпус

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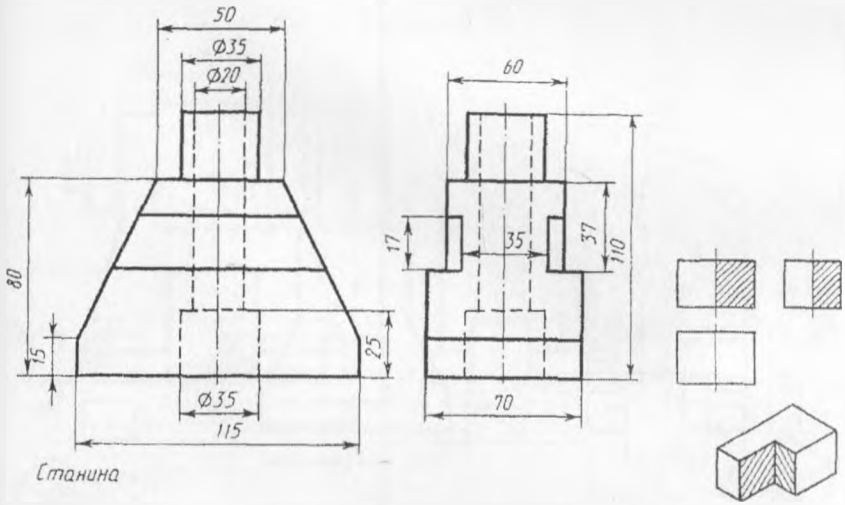

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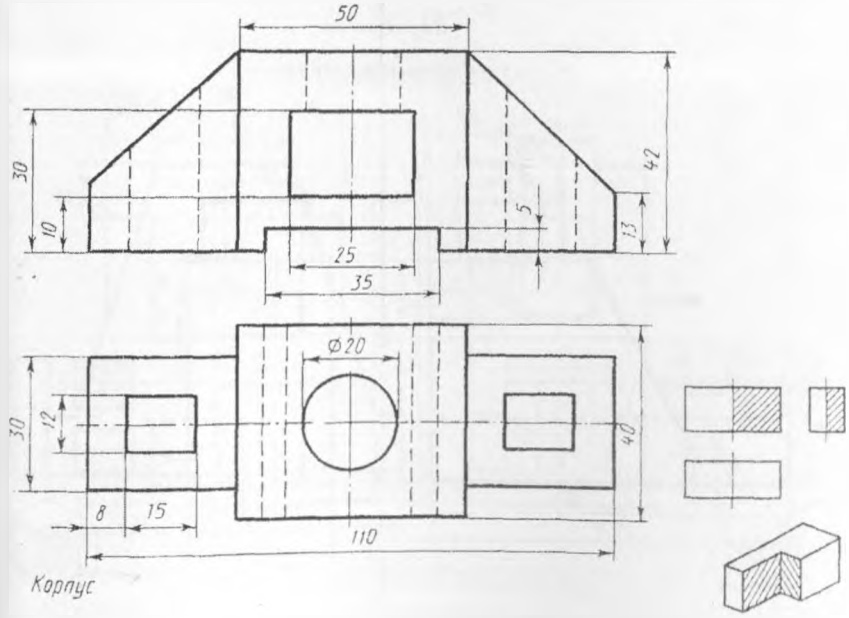

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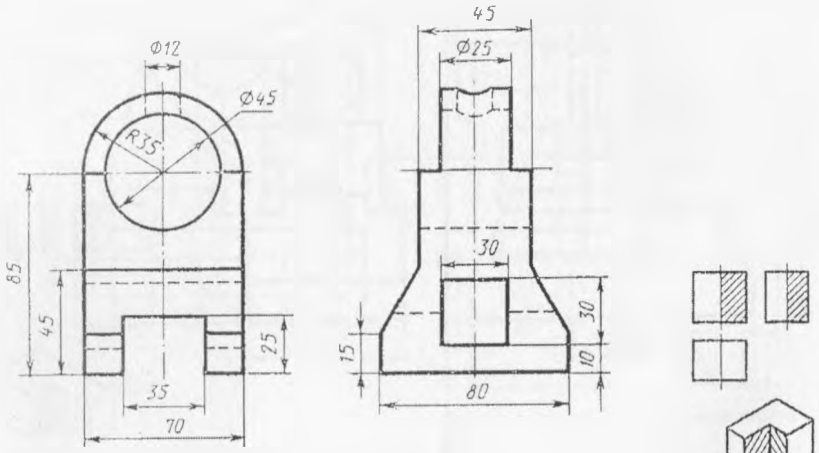

Кронштейн

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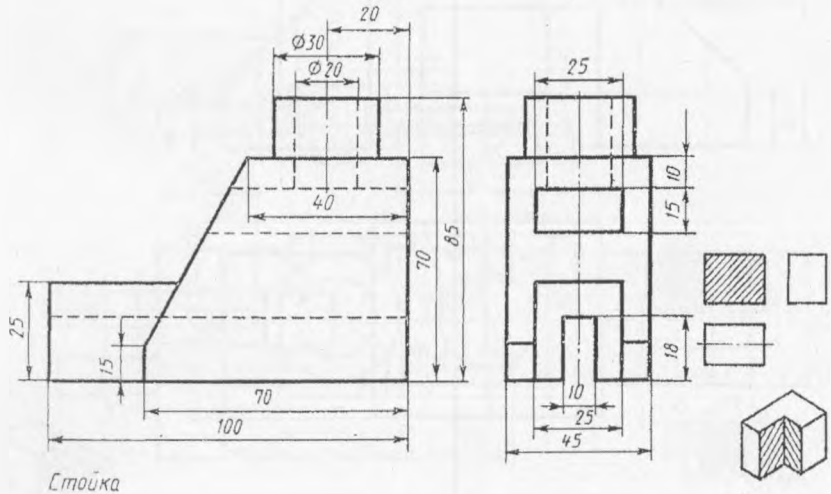

Стойка

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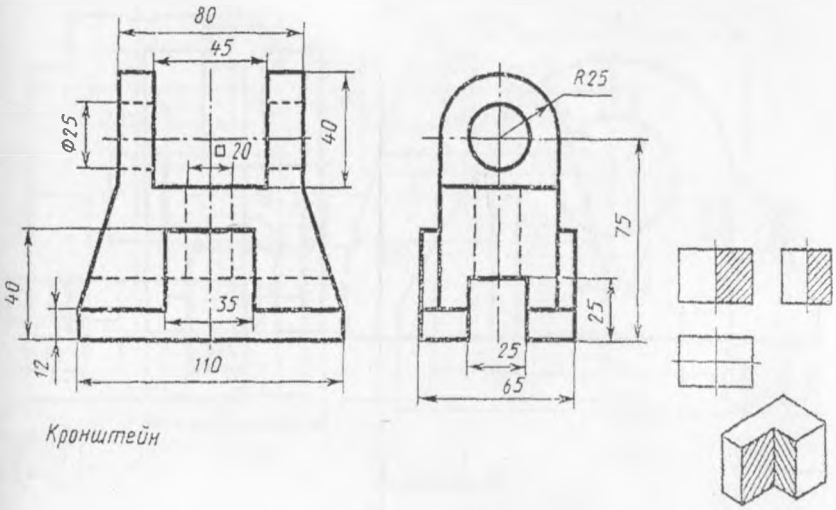

Кронштейн

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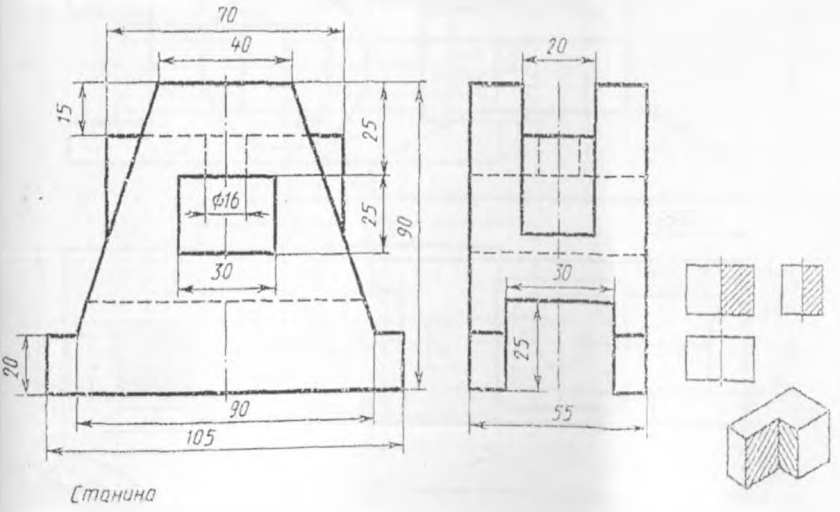

Станина

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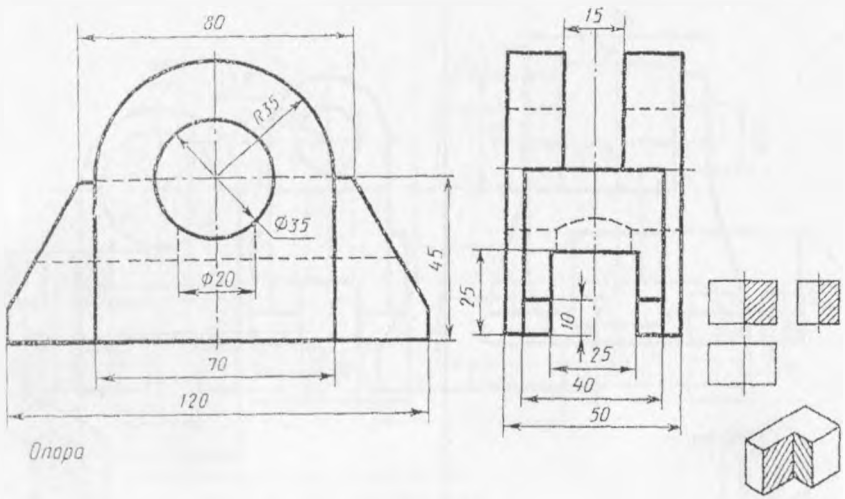
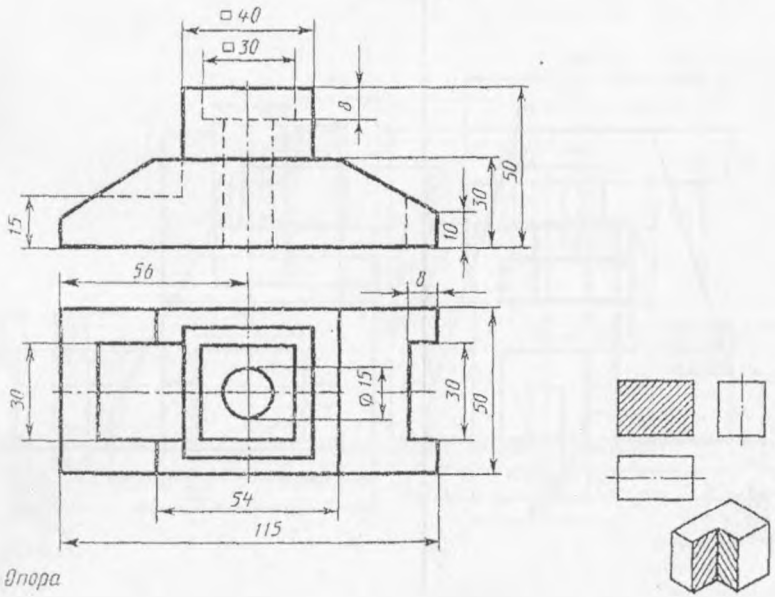


Опора

Вариант 26



Опора

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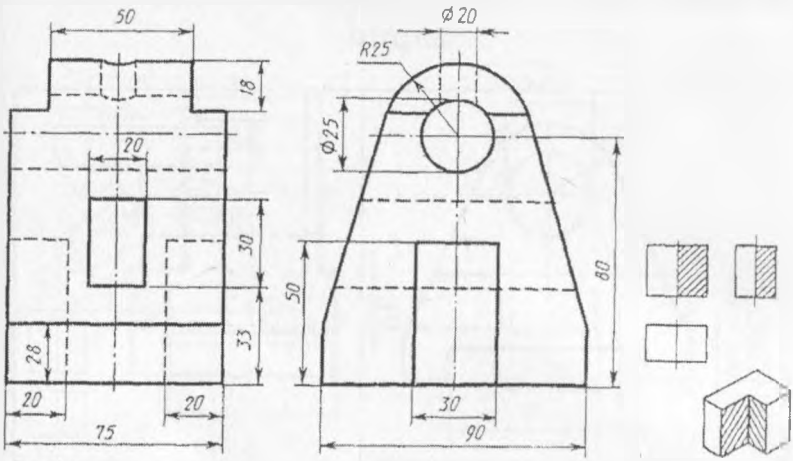

Стойка

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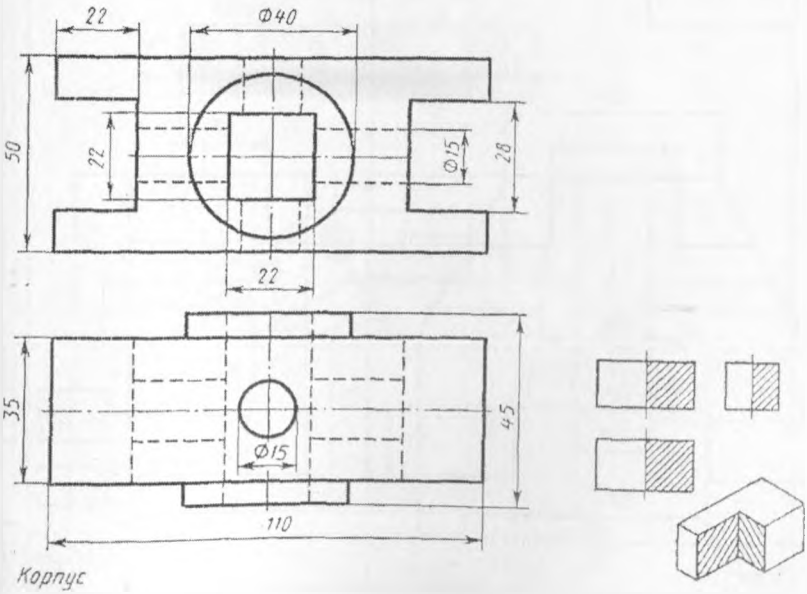
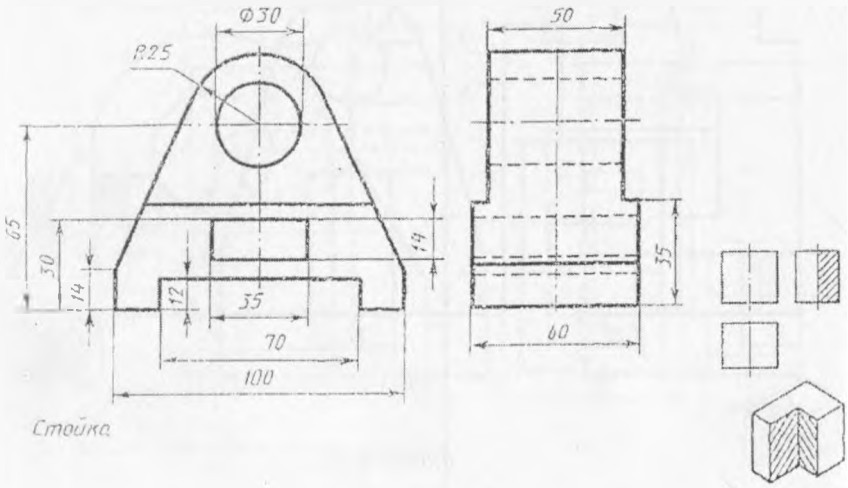


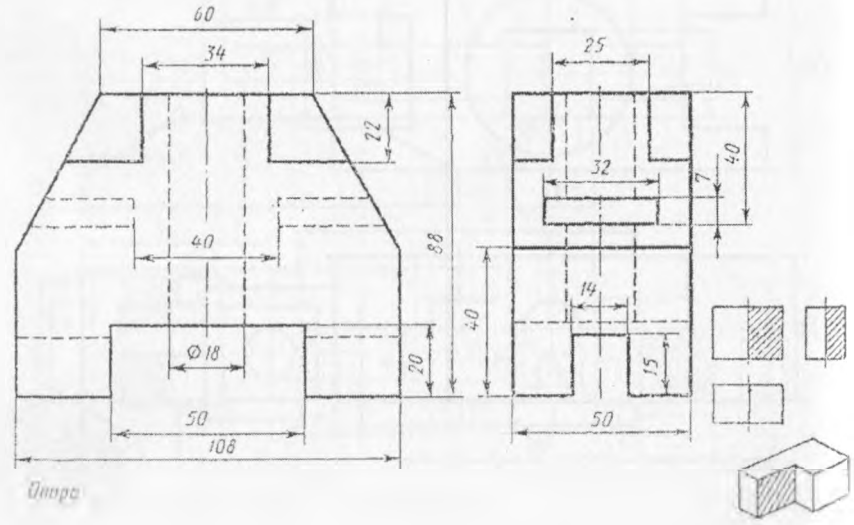
Корпус

Вариант 29



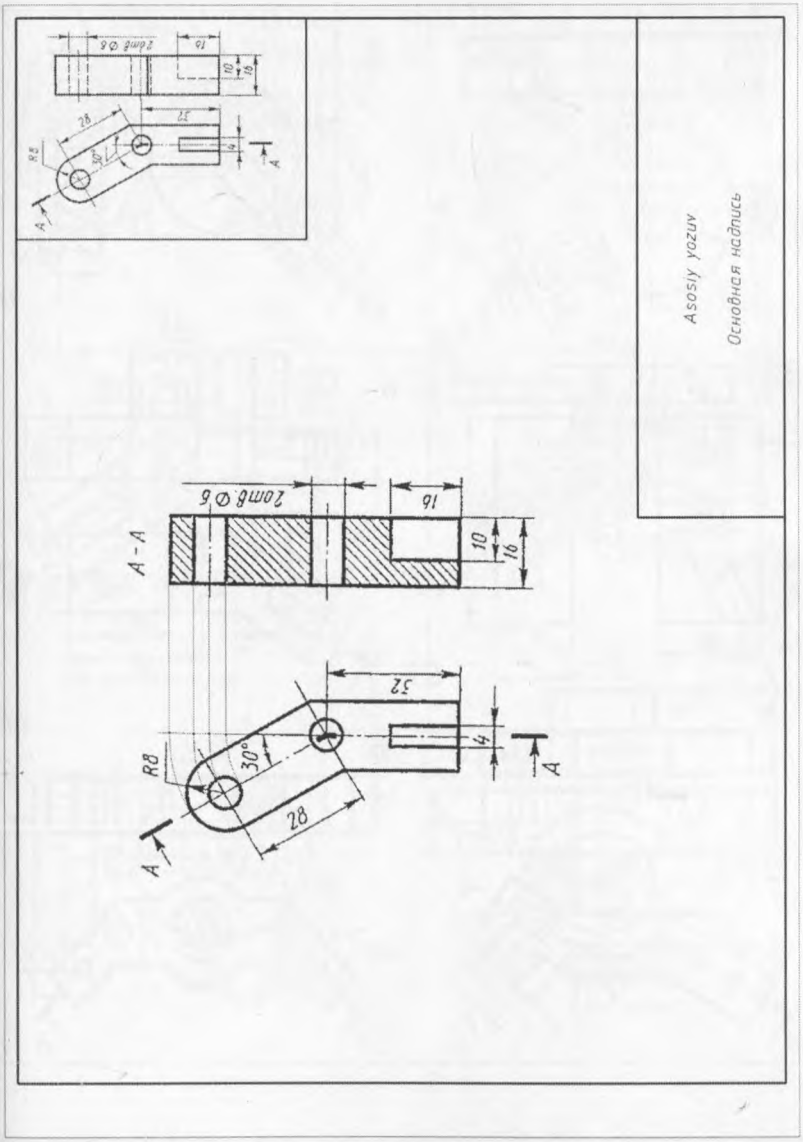
Стойка

Вариант 30

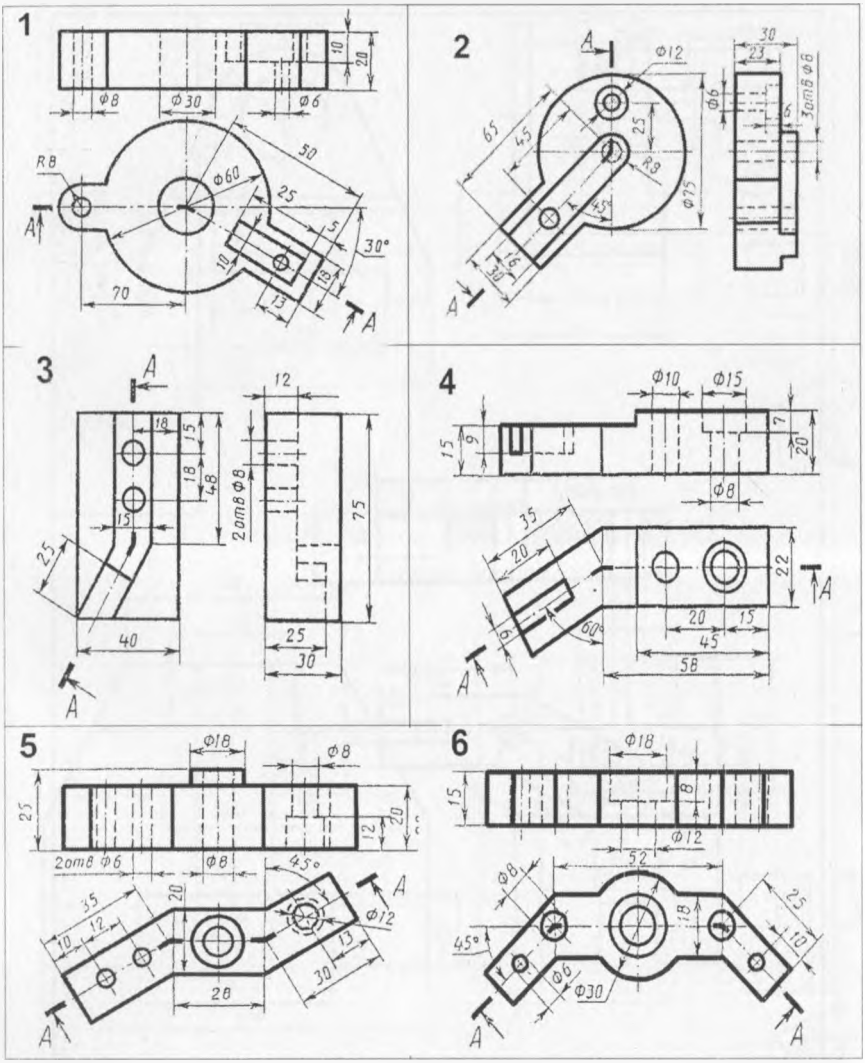


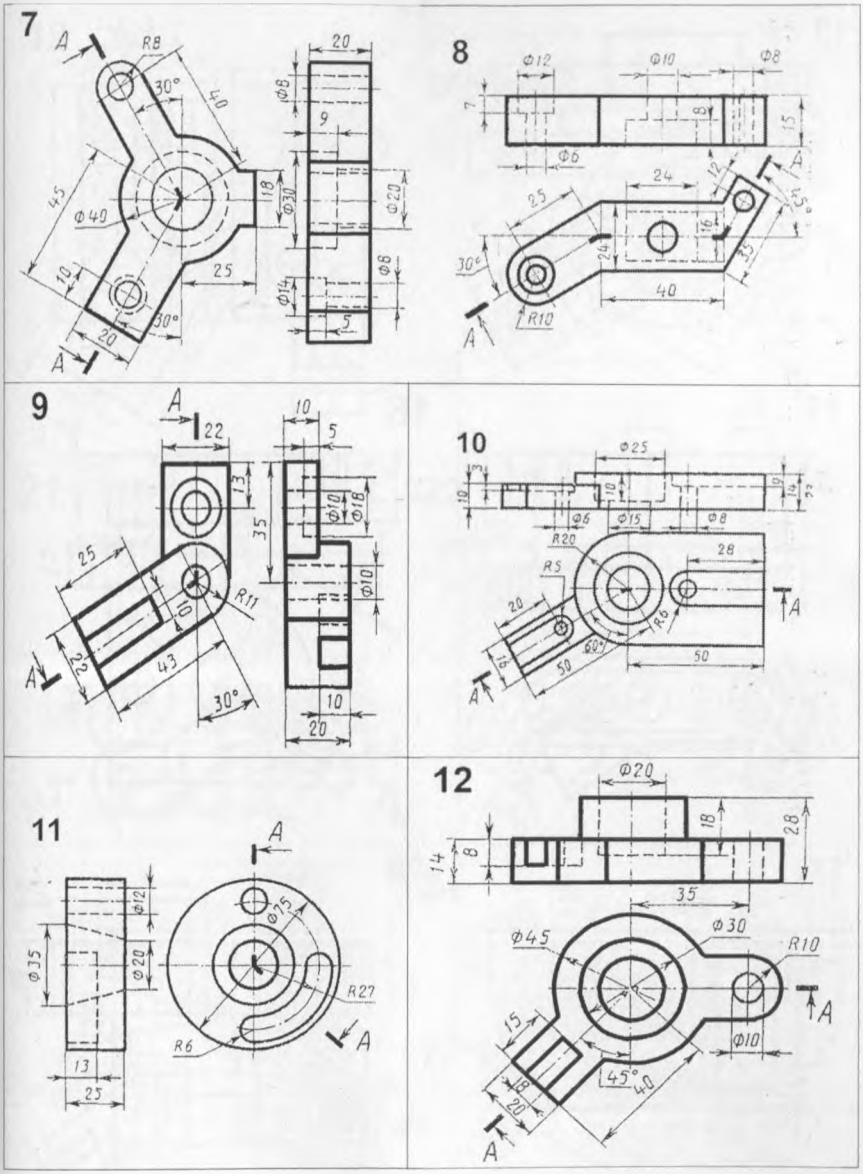
Опора

HGI-22. Bajarish namunasi, ko'rinishlardagi murakkab qirqim



HGI-22. Ko'rinishlar: murakkab qirqim bajarish variantlari.




7
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30°
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R10
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22
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35
Φ10
Φ18
25
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R11
43
30°
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Φ25
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R20
R5
28
20
R6
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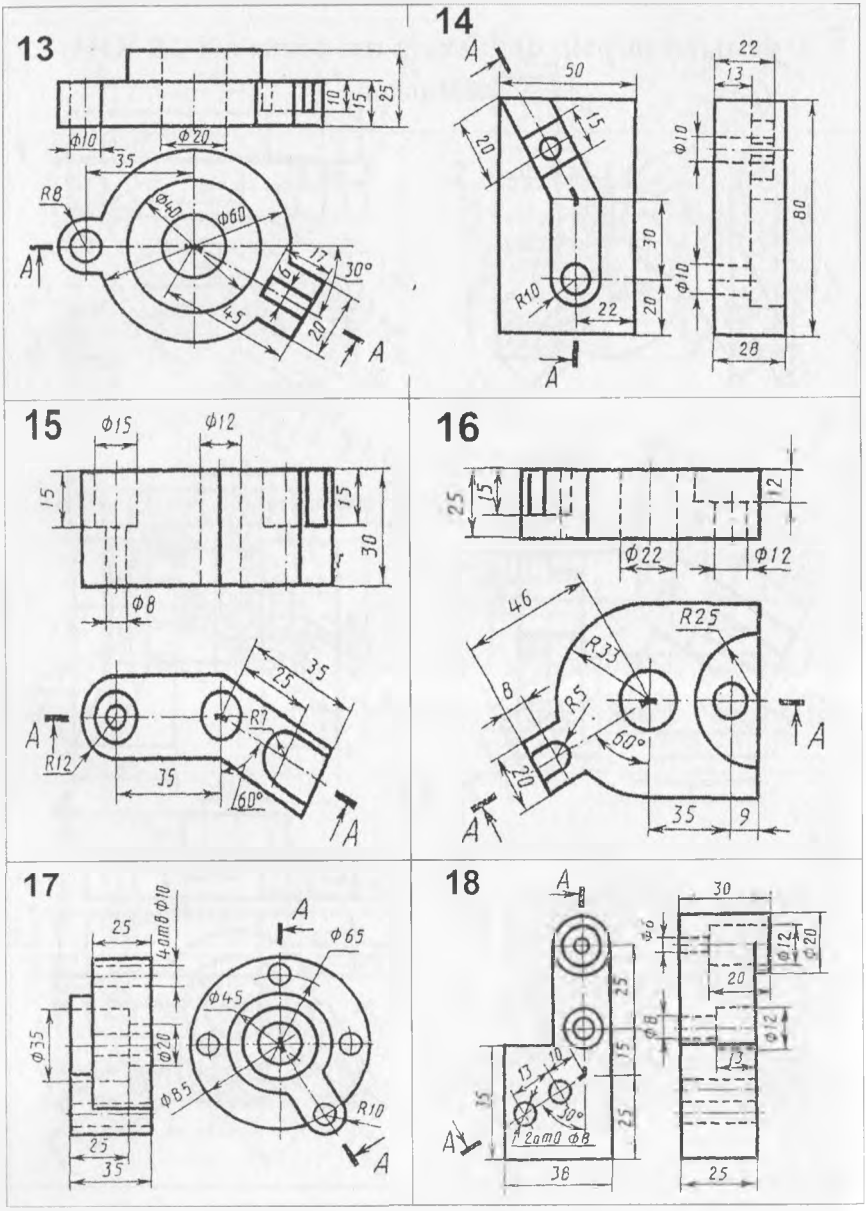
13
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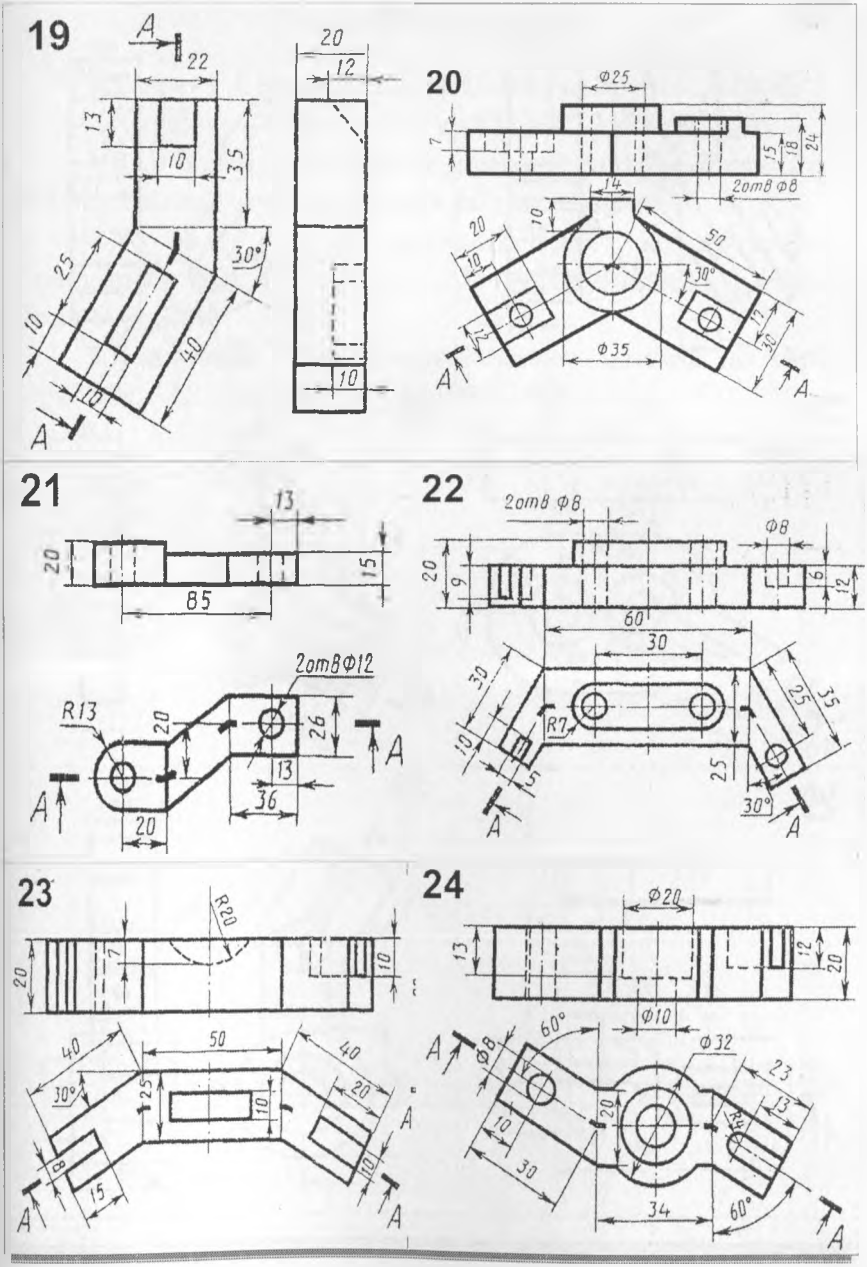
4 отв Ф10
2 отв Ф8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2отв Ø8
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26
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36
20
22
2отв Ø8
Ø8
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R7
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R20
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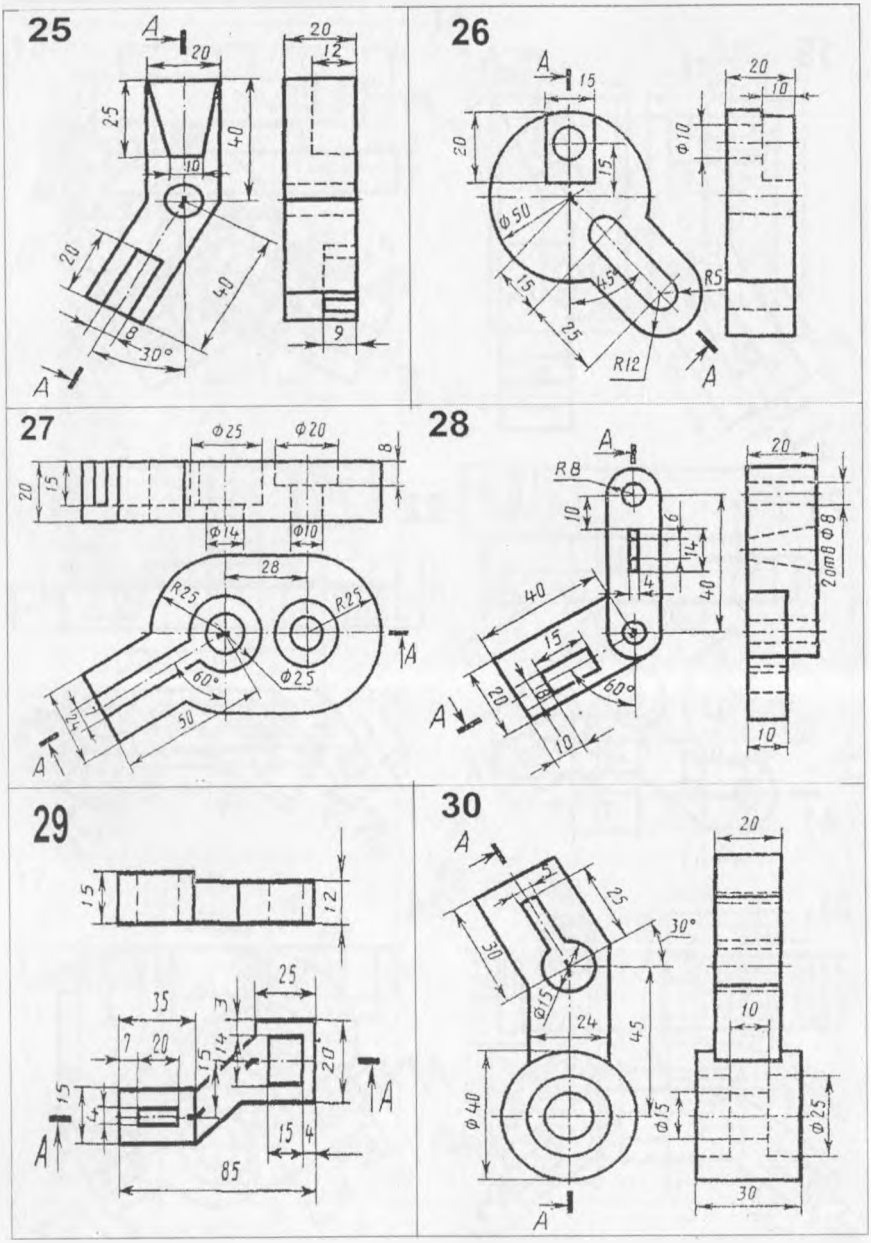
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Adabiyotlar ro'yxati

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(Fanidan topshiriqlar to'plami)
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