

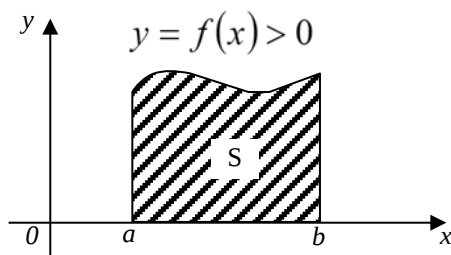
28-AMALIY MASHG‘ULOT

Ish vaqti va bosqichlari	O‘qituvchi faoliyatining mazmuni	Talabalar faoliyatining mazmuni
I-Bosqich O‘quv mashg‘ulotiga kirish (10 daqiqa)	1.1. Mashg‘ulot mavzusi bo‘yicha tushuncha berish. 1.2. Mavzuning avvalgi o‘tilgan mavzu bilan aloqadorligi bo‘yicha tushuncha berish	Tinglaydilar, yozadilar
II-Bosqich Asosiy (65 daqiqa)	2.1. Amaliy mashg‘ulot mavzusiga oid nazariy ma’lumot berish. 2.2. Mavzuga oid amaliy topshiriqlar bajarish.	Tinglaydilar, yozadilar, savollar beradi, bajaradilar.
III-Bosqich Yakunlovchi (5 daqiqa)	3.1. Amaliy mashg‘ulotni yakunlash 3.2. Talabalarga mustaqil bajarish uchun topshiriqlar berish.	Tinglaydilar, yozadilar, savollar beradi, bajaradilar.

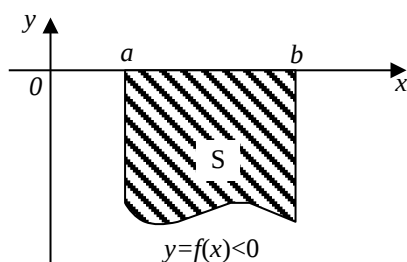
28-MAVZU: INTEGRAL YORDAMIDA EGRI CHIZIQLI TRAPETSIYA YUZI

1. Yassi figuralarning yuzalarini hisoblash.

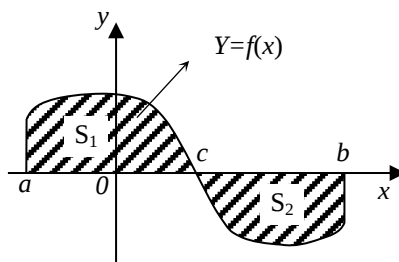
1. Ma’lumki, agar $[a; b]$ kesmada $f(x) \geq 0$ bo’lsa, mazkur funksiyaning mazkur kesma bo‘yicha aniq integrali geometrik jixatdan $x=a$ va $x=b$ to’g’ri chiziqlar, Ox o’qi xamda $y = f(x)$ egri chiziqlar bilan chegaralangan egri chiziqli trapesiyaning yuzini ifodalaydi.



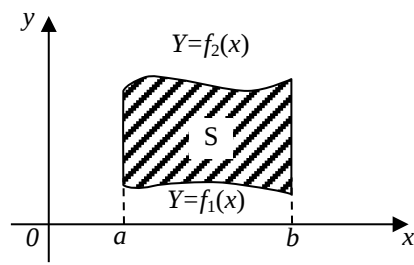
Agar $[a; b]$ kesmada $f(x) \leq 0$ bo’lsa, mazkur egri chiziqli trapesiya Ox o’qidan pastda joylashadi va uning yuzi $S = \int_a^b |f(x)| dx$ formula orqali hisoblanadi.



Agar $y = f(x)$ egri chiziq, Ox o'qi va $x=a$, $x=b$ to'g'ri chiziqlar bilan chegaralangan figura Ox o'qidan yuqorida va pastda joylashgan bo'lsa, uning yuzi $S = S_1 + S_2 = \int_a^c f(x)dx + \int_c^b |f(x)|dx$ formula bilan hisoblanadi

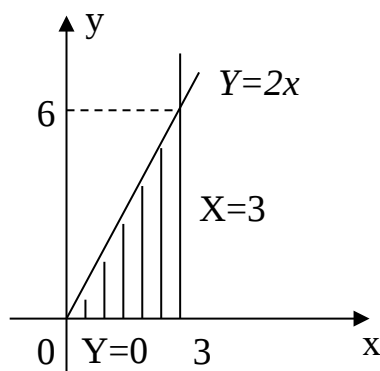


Agar $x=a$, $x=b$ to'g'ri chiziqlar, $y = f_1(x)$ va $y = f_2(x)$ egri chiziqlar ($f_1(x) \leq f_2(x)$) bilan chegaralangan yuzani hisoblash lozim bo'lsa, uni ushbu $S = \int_a^b [f_2(x) - f_1(x)]dx$ formula bilan hisoblanadi.



1-Misol. Tenglamalari $y=2x$, $y=0$ va $x=3$ bo'lgan to'g'ri chiziqlar bilan chegaralangan figuraning yuzi hisoblansin.

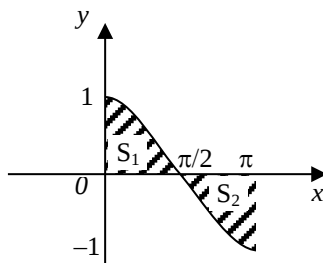
Yechilishi. $S = \int_0^3 2x dx = 2 \int_0^3 x dx = x^2 \Big|_0^3 = 9 \text{ кв. б.}$



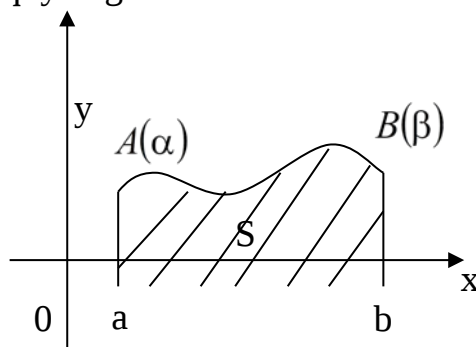
2-Misol. $y=\cos x$, $y=0$ chiziqlar bilan chegaralangan figuraning yuzi hisoblansin, bunda $x \in [0; \pi]$.

Yechilishi.

$$S = S_1 + S_2 = \int_0^{\pi/2} \cos x dx + \int_{\pi/2}^{\pi} |\cos x| dx = \sin x \Big|_0^{\pi/2} + |\sin x| \Big|_{\pi/2}^{\pi} = 1 + 1 = 2 \text{ кв. 6.}$$



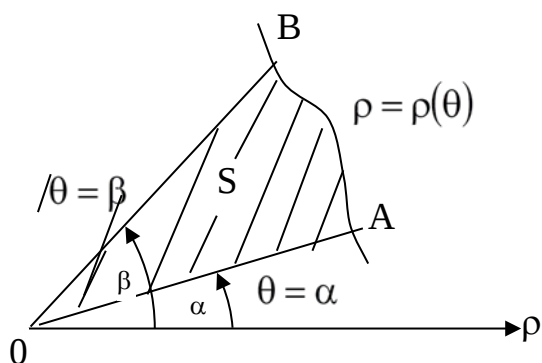
2. a) Agar egri chiziqli trapesiyaning yuzi $x=x(t)$, $y=y(t)$ kabi parametrik shaklda berilgan egri chiziq, $x=a$ va $x=b$ to'g'ri chiziqlar hamda Ox o'q bilan chegaralangan bo'lsa, u yuza quyidagi formula bilan hisoblanadi:



$$S = \int_{\alpha}^{\beta} y(t)x'(t)dt \text{ bunda } \alpha \leq t \leq \beta \text{ va } x(\alpha) = a, x(\beta) = b$$

b) Agar $(\rho; \theta)$ qutb koordinatlari sistemasida biror uzluksiz egri chiziq o'zining $\rho = \rho(\theta)$ kabi tenglamasi orqali berilgan bo'lsa, u xolda $\theta = \alpha$, $\theta = \beta$ qutb burchaklari hamda egri chiziqning AB yoyi bilan chegaralangan AOB sektor yuzi

$$S = \frac{1}{2} \int_{\alpha}^{\beta} \rho^2 d\theta \text{ formula bilan hisoblanadi.}$$

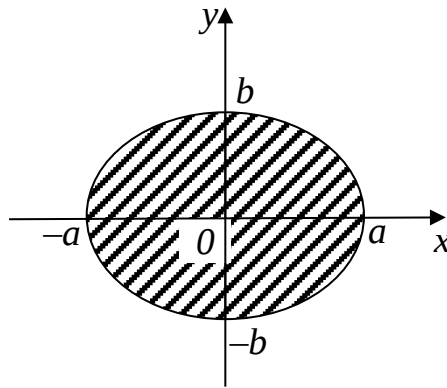


3-Misol. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ellips bilan chegaralangan yuza topilsin.

Yechish. Ellipsning parametrik tenglamasini yozib olamiz:
 $x = a \cos t, y = b \sin t$. U xolda

$$S = \int_0^{2\pi} b \sin t (-a \sin t) dt = -ab \int_0^{2\pi} \sin^2 t dt = \frac{ab}{2} \int_0^{2\pi} (\cos 2t - 1) dt = \frac{ab}{2} \left[\frac{\sin 2t}{2} \Big|_0^{2\pi} - t \Big|_0^{2\pi} \right] =$$

$$= -\pi ab. \quad S = |-\pi ab| = \pi ab \text{ кв.б.}$$



4-Misol. $\rho^2 = 2 \cos 2\theta$ lemniskata bilan chegaralangan yuza topilsin.

Yechish. Izlanayotgan yuzaning to'rtidan bir qismiga $0 \leq \theta \leq \frac{\pi}{4}$ burchak mos

keladi. Shuning uchun $S = \frac{1}{2} \int_0^{\pi/4} 2 \cos 2\theta d\theta = 2 \sin 2\theta \Big|_0^{\pi/4} = 2 \text{ кв. б.}$

2. Egri chiziq yoyining uzunligini hisoblash.

1. Agar tekis egri chiziq uzining $yqf(x)$ tenglamasi bilan berilgan bo'lib, $y' = f'(x)$ hosila uzluksiz bo'lsa, u holda egri chiziqning $[a;b]$ kesmaga mos keluvchi yoyining uzunligi $I = \int_a^b \sqrt{1 + y'^2} dx$ formula bilan hisoblanadi.
2. Egri chiziq o'zining $xqx(t)$ va $yqy(t)$ kabi parametrik shakldagi tenglamasi bilan berilgan bo'lsin. Agar $x'(t)$ va $y'(t)$ hosilalar $[\alpha;\beta]$ kesmada uzluksiz bo'lsalar, mazkur egri chiziqning $[\alpha;\beta]$ kesmaga mos keluvchi yoyining uzunligi $I = \int_{\alpha}^{\beta} \sqrt{x'^2(t) + y'^2(t)} dt$ formula orqali hisoblanadi. Bu yerda: $\alpha \leq t \leq \beta$.
3. Aytaylik, egri chiziqning tenglamasi qutb koordinatalari sistemasida $\rho = \rho(\theta)$ tenglama bilan berilgan bo'lsin: U holda uning biror AB yoyining uzunligi $I = \int_{\alpha}^{\beta} \sqrt{\rho^2 + \rho'^2} d\theta$ formula bilan hisoblanadi. Bu yerdagi α va β lar qutb burchaklarining AB yoy uchlariga mos keluvchi qiymatlaridir.

5-Misol. $y = \frac{1}{4}x^2 - \frac{1}{2}\ln x$ funksiya bilan berilgan egri chiziqning absissalari x_1 va x_2 bo'lgan nuqtalari orasidagi yoyining uzunligi hisoblansin.

Yechilishi. $y' = \frac{1}{2}x - \frac{1}{2x}$ ba $y'^2 = \frac{1}{4}x^2 - \frac{1}{2} + \frac{1}{4x^2}$ bo'lganligidan, $1 + y'^2 = \left(\frac{x}{2} + \frac{1}{2x}\right)^2$ dan iboratdir.

U holda:

$$l = \int_1^2 \sqrt{1 + y'^2} dx = \int_1^2 \left(\frac{x}{2} + \frac{1}{2x}\right) dx = \left(\frac{x^2}{4} + \frac{1}{2}\ln x\right) \Big|_1^2 = 1 + \frac{1}{2}\ln 2 - \frac{1}{4} = \frac{3}{4} + \frac{1}{2}\ln 2.$$

3. Aylanma sirtlarning yuzi va aylanma jismlarning hajmlarini hisoblash.

1. Aytaylik, egri chiziq $y=f(x)$ tenglama orqali berilgan bo'lsin. Agar bu funksiya $[a;b]$ kesmada uzluksiz differensiallanuvchi bo'lib, egri chiziqning $[a;b]$ ga mos keluvchi AB yoyi Ox o'q atrofida aylantirilsa, u holda hosil bo'ladigan aylanma sirtning yuzi

$$S_x = 2\pi \int_a^b f(x) \sqrt{1 + f'^2(x)} dx$$

formula bilan hisoblanadi.

Agar egri chiziq boshqa hildagi tenglamalari bilan berilgan bo'lsa, u holda mazkur yuzani hisoblash uchun yuqoridagi formuladagi har bir holga mos keluvchi almashtirishlarni bajarish yetarlidir.

2. a) Agar egri chiziqli trapesiya $y=f(x)$ egri chiziq $x=a$ va $x=b$ vertikal to'g'ri chiziqlar hamda Ox o'q bilan chegaralangan bo'lsin. U holda uni Ox va Oy o'qlar atrofida aylantirishdan hosil bo'ladigan aylanma jismlarning xajmlari mos ravishda quyidagi formulalar bilan hisoblanadi.

$$V_x = \pi \int_a^b y^2 dx; \quad V_y = 2\pi \int_a^b xy dx.$$

Bu yerda ham, agar egri chiziq o'zining $y=f(x)$ kabi tenglamasidan boshqa hildagi tenglamalari bilan berilgan bo'lsa, yuqoridagi formulada kerakli almashtirishlar bajariladi.

b) Agar $y_1 = f_1(x)$ va $y_2 = f_2(x)$ ($f_1(x) \leq f_2(x)$) egri chiziqlar, $x=a$ va $x=b$ to'g'ri chiziqlar bilan chegaralangan figuraning Ox va Oy o'qlari atrofida aylanishidan hosil bo'lgan aylanma jismlarning hajmlari mos ravishda.

$$V_x = \pi \int_a^b (y_1^2 - y_2^2) dx \quad \text{va} \quad V_y = 2\pi \int_a^b x(y_2 - y_1) dx \quad \text{kabi formulalar bilan hisoblanadi.}$$

6-Misol. Tenglamasi $y = \frac{1}{2}\sqrt{4x-1}$ bo'lgan egri chiziq yoyining $x_1 = 1$ dan $x_2 = 9$ gacha bo'lgan qismi Ox atrofida aylanishidan hosil bo'lgan aylanma sirt yuzi hisoblansin.

Yechilishi. $y' = \frac{1}{2} \cdot \frac{4}{2\sqrt{4x-1}} = \frac{1}{\sqrt{4x-1}}$ va $\sqrt{1+y'^2} = \sqrt{1+\frac{1}{4x-1}} = \frac{2\sqrt{x}}{\sqrt{4x-1}}$ larni inobatga olsak

$$S_x = 2\pi \int_1^9 \frac{1}{2} \sqrt{4x-1} \cdot \frac{2\sqrt{x}}{\sqrt{4x-1}} dx = 2\pi \int_1^9 \sqrt{x} dx = 2\pi \frac{2}{3} x^{\frac{3}{2}} \Big|_1^9 = \frac{104\pi}{3}.$$

7-Misol. $y^2 = 4+x$ parabola yoyining absissalari $x_1 = -4$ va $x_2 = 2$ bo'lgan nuqtalari orasida joylashgan bo'lagining Ox o'qi atrofida aylanishidan hosil bo'lagi aylanma sirtning yuzi aniqlansin.

Yechilishi. $y = \sqrt{4+x}$, $y' = \frac{1}{2\sqrt{4+x}}$, $y'^2 = \frac{1}{4(4+x)}$ larga asosan

$$\begin{aligned} S_x &= 2\pi \int_{-4}^2 \sqrt{4+x} \sqrt{1+\frac{1}{4(4+x)}} dx = 2\pi \int_{-4}^2 \sqrt{4+x+\frac{1}{4}} dx = 2\pi \int_{-4}^2 \sqrt{x+\frac{17}{4}} dx = \\ &= 2\pi \int_{\frac{1}{2}}^{\frac{5}{2}} 2t^2 dt = \frac{4\pi}{3} t^3 \Big|_{\frac{1}{2}}^{\frac{5}{2}} = \frac{4\pi}{3} \left(\frac{125}{8} - \frac{1}{8} \right) = \frac{4\pi \cdot 124}{3 \cdot 8} = \frac{62\pi}{3} \text{ KB. } \text{б.} \end{aligned}$$

Bu integralni hisoblashda $x+\frac{17}{4} = t^2$, $dx = 2tdt$, $\frac{1}{2} \leq t \leq \frac{5}{2}$ almashtirish bajarildi.

8-Misol. $y = \frac{x^2}{2}$ parabolaning $y = \frac{3}{2}$ to'g'ri chiziq bilan kesilgan bo'lagining Oy o'q atrofida aylanishidan hosil bo'lgan sirt yuzi hisoblansin.

Eslatma. Agarda $x = \varphi(y)$ silliq egri chiziqning yoyi Oy o'q atrofida aylansa, aylanma sirtning yuzi $S_y = 2\pi \int_c^d x \sqrt{1+x'^2} dy$ formuladan topiladi.

Yechilishi. $x = \sqrt{2y}$, $x' = \frac{1}{\sqrt{2y}}$, $x'^2 = \frac{1}{2y}$, $0 \leq y \leq \frac{3}{2}$ largi ko'ra,

$$S_y = 2\pi \int_0^{\frac{3}{2}} \sqrt{2y} \sqrt{1+\frac{1}{2y}} dy = 2\pi \int_0^{\frac{3}{2}} \sqrt{2y+1} dy = 2\pi \int_1^2 t^2 dt = \frac{2\pi}{3} t^3 \Big|_1^2 = \frac{2\pi}{3} (8-1) = \frac{14\pi}{3} \text{ KB. } \text{б.}$$

bu integralni hisoblashda $2y+1 = t^2$, $dy = tdt$, $1 \leq t \leq 2$ almashtirish bajarildi.

9-Misol. $\frac{x^2}{9} + \frac{y^2}{4} = 1$ ellipsning Ox o'qi atrofida aylanishidan hosil bo'lgan jismning hajmi aniqlansin.

Yechilishi. Ellips tenglamasini y^2 ga nisbatan yechamiz va $y=0$ va $x^2=9$, $x_{1,2}=\pm 3$ bo'lgani uchun

$$V_x = \pi \int_{-3}^3 \frac{4}{9} (9 - x^2) dx = \frac{4}{9} \pi \left[9 \int_{-3}^3 dx - \int_{-3}^3 x^2 dx \right] = \frac{9}{4} \pi \left[9x \Big|_{-3}^3 - \frac{x^3}{3} \Big|_{-3}^3 \right] =$$

$$= \frac{4}{9} \pi (27 + 27 - 9 - 9) = \frac{4}{9} \pi 36 = 16\pi \text{ KB.}\bar{6}.$$

10-misol. $x^2 - y^2 = 4$, $y = \pm 2$ chiziqlar bilan chegaralangan yassi figura Oy o'q atrofida aylanadi. Aylanma jismning hajmi aniqlansin.

Yechilishi. $x^2 = 4 + y^2$, $y_1 = -2$ va $y_2 = 2$ lardan

$$V_y = \pi \int_{-2}^2 (4 + y^2) dy = \pi \left[4 \int_{-2}^2 dy + \int_{-2}^2 y^2 dy \right] = \pi \left[4y \Big|_{-2}^2 + \frac{y^3}{3} \Big|_{-2}^2 \right] =$$

$$= \pi \left(8 + 8 + \frac{8}{3} + \frac{8}{3} \right) = \frac{64}{3} \text{ ky}\bar{6}.\bar{6}.$$

4. Aniq integral yordamida fizika va mexanika masalalarini yechish.

1) a) Agar $V = f(t)$ funksiya moddiy nuqtaning biror chiziq bo'ylab harakatining tezligini ifodalasa, u holda $[t_1; t_2]$ vaqt mobaynida bosib o'tilgan yo'l

$S = \int_{t_1}^{t_2} f(t) dt$ formulasi orqali ifodalanadi.

11-misol. Moddiy nuqtaning harakat tezligi $V = (6t^2 + 4) \frac{M}{cek}$ bo'lsa, harakat boshlanishidan boshlab 5 sek. mobaynida bosib o'tilgan yo'l hisoblansin.

Yechilishi. Shartga ko'ra, $f(t) = 6t^2 + 4$, $t_1 = 0$ va $t_2 = 5$.

$$S = \int_0^5 (6t^2 + 4) dt = (2t^3 + 4t) \Big|_0^5 = 2 \cdot 5^3 + 4 \cdot 5 = 250 + 20 = 270 \text{ M.}$$

12-misol. Jismning harakat tezligi $V = (18t - 3t^2) \frac{M}{cek}$ bo'lsa, uning harakat boshlanishidan to harakat tugagunga qadar bosib o'tgan yo'li hisoblansin.

Yechilishi. Jismning harakat boshlanishi va tugashi paytidagi tezligi nolga teng. Harakat qaysi paytda tugashini aniqlaymiz, uning uchun $18t - 3t^2 = 0$ tenglamani yechamiz. Bundan: $3t(6 - t) = 0$ va $t_1 = 0$, $t_2 = 6$.

$$S = \int_0^6 (18t - 3t^2) dt = (9t^2 - t^3) \Big|_0^6 = 9 \cdot 6^2 - 6^3 = 36 \cdot 3 = 108 \text{ M.}$$

13-Misol. Agar jism yer sirtining yuzasidan vertikal holatda yuqoriga tomon $V = (29,4 - 9,8t) \frac{M}{cek}$ tezlik bilan otilgan bo'lsa, u holda jism eng ko'pi bilan necha metr balandlikka ko'tariladi?

Yechilishi. Jism eng katta balandlikka t vaqtning shunday bir paytida erishadiki, o'sha paytda $v = 0$ bo'ladi.

Demak, $24,9 - 9,8t = 0$ dan $t = 3\text{cek}$.

$$S = \int_0^3 (29,4 - 9,8t) dt = \left(29,4t - 4,9t^2 \right) \Big|_0^3 = 44,1\text{m}.$$

b) Aytaylik, moddiy nuqta o'zgaruvchan $F(x)$ kuch ta'sirida Ox o'q bo'ylab to'g'ri chiziqli harakat qilayotgan bo'lsin. Moddiy nuqta a holatdan b holatga ko'chganda, ushbu kuchning bajargan ishi $A = \int_a^b F(x) dx$ formula bilan hisoblanadi.

Eslatma. Kuchning bajargan ishini hisoblashga doir masalalarni yechishda, ko'pincha Guk qonunining formulasi $Fqrx$ dan foydalaniladi (r -proporsionallik koeffitsiyenti).

14-Misol. Agar prujina 60 H kuch ostida 0,02m cho'ziladigan bo'lsa, uni 0,12m cho'zish uchun qancha ish bajarilishi kerak bo'ladi?

Yechilishi. Guk qonuniga ko'ra, prujinani x m ga cho'zuvchi kuch $Fqrx$. Agar $xq0,02$ m bo'lsa, $Fq60H$. Demak,

$$r = \frac{60}{0,02} = 3000 \text{ va } F = 3000x. \text{ Natijada:}$$

$$A = \int_0^{0,12} 3000x dx = 1500x^2 \Big|_0^{0,12} = 1500 \cdot 0,0144 = 21,6(\mathcal{K}).$$

15-Misol. Agar prujinaning dastlabki uzunligi 0,1 m ga teng bo'lib, prujinani 0,01 m ga cho'zish uchun 20N kuch kerak bo'lsa, uni 0,12 m dan 0,14 m ga cho'zish uchun qancha ish bajarish kerak bo'ladi?

$$\textbf{Yechilishi.} \kappa = \frac{20}{0,01} = 2000 \text{ va } F = 2000x; a = 0,12 - 0,1 = 0,02 \text{ va } b = 0,14 - 0,1 = 0,04.$$

$$A = \int_{0,02}^{0,04} 2000x dx = 1000x^2 \Big|_{0,02}^{0,04} = 1000(0,0016 - 0,0004) = 1,2(\mathcal{K}).$$

2) Ma'lumki, biror l o'qdan r masofada bo'lgan m massali moddiy nuqtaning l o'qiga nisbatan statik momenti deb, $M_l = mr$ miqdorga aytilar edi. Faraz qilaylik, xOy koordinatalar tekisligida tenglamasi $y = f(x)$ bo'lgan moddiy egri chiziqlarning biror AB yoyi $a \leq x \leq b$ qaralayotgan bo'lsin. Uning har bir nuqtasida zichlik esa $\gamma = \gamma(x)$ kabi funksiya bilan ifodalansin. U holda AB yoyning Ox va Oy o'qlarga nisbatan statik momentlari mos holda quyidagi formulalar bilan hisoblanadi:

$$M_x = \int_a^b \gamma(x) \cdot y \cdot \sqrt{1 + y'^2} dx, \quad M_y = \int_a^b \gamma(x) \cdot x \cdot \sqrt{1 + y'^2} dx,$$

Hususan agar $\gamma(x) = \gamma$ o'zgarmas son bo'lsa (egri chiziq bir jinsli bo'lganda), yuqoridagi formulalar quyidagicha ko'rinishida yoziladilar:

$$M_x = \gamma \int_a^b y dl, M_y = \gamma \int_a^b x dl.$$

Bu yerda, $dl = \sqrt{1+y'^2} dx$ - yoy uzunligining elementi.

16-Misol. $y = x, x = 2, y = 0$ to'g'ri chiziqlar bilan chegaralangan uchburchakning koordinata o'qlariga nisbatan statik momentlari hisoblansin.

Yechilishi. $\gamma = 1$ deb olamiz.

$$M_x = \frac{1}{2} \int_0^2 y^2 dx = \frac{1}{2} \int_0^2 x^2 dx = \frac{1}{2} \cdot \frac{x^3}{3} \Big|_0^2 = \frac{4}{3}; \quad M_y = \int_0^2 xy dx = \int_0^2 x^2 dx = \frac{x^3}{3} \Big|_0^2 = \frac{8}{3};$$

17-Misol. Tenglamasi $x^2 + y^2 = 4$ bo'lgan aylananing yuqori yarim pallasi og'irlik markazining koordinatalari hisoblansin.

Yechilishi. Bu yerda ham $\gamma = 1$ deb olamiz. $y = \sqrt{4-x^2}$ dan

$$y' = -\frac{x}{\sqrt{4-x^2}} \text{ va } M = \sqrt{1+y'^2} = \sqrt{1+\frac{x^2}{4-x^2}} = \frac{2}{\sqrt{4-x^2}}.$$

$$x_0 = \frac{\int_{-2}^2 \frac{2x dx}{\sqrt{4-x^2}}}{\int_{-2}^2 \frac{2 dx}{\sqrt{4-x^2}}} = \frac{-2\sqrt{4-x^2} \Big|_{-2}^2}{2 \arcsin \frac{x}{2} \Big|_{-2}^2} = 0; \quad y_0 = \frac{\int_{-2}^2 2 dx}{\int_{-2}^2 \frac{2 dx}{\sqrt{4-x^2}}} = \frac{4}{2 \arcsin 1} = \frac{4}{\pi};$$

Misollar va masalalar

Berilgan chiziqlar bilan chegaralangan figuralar yuzlarini hisoblang:

3. $\begin{cases} x=2(t-\sin t) \\ y=2(1-\cos t) \end{cases}$ (бир аркаси) ва $y=0$. Ж: 12π (кв. бирл.).

4. $r=2a\cos\varphi$ ва $r=2a\sin\varphi, 0 \leq \varphi \leq \frac{\pi}{2}$.

Ж: $\left(\frac{\pi}{2}-1\right)a^2$ (кв. бирл.).

5. $y=\frac{1}{1+x^2}, y=\frac{x^2}{2}$. Ж: $\frac{\pi}{2}-\frac{1}{3}$ (кв. бирл.).

6. $y=x^2+4x, y=x+4$. Ж: $\frac{125}{6}$ (кв. бирл.).

7. $x^2+y^2=4, x^2+y^2=9, y=x, y=-x\sqrt{3}$. Ж: $\frac{25\pi}{24}$ (кв. бирл.).

8. $x=3t^2, y=3t-t^3$. Ж: $\frac{72\sqrt{3}}{5}$ (кв. бирл.).