Fizika

1 kurs

MAVZU: Kinematika bo‘limiga doir masalalar yechish.

O‘qituvchi:

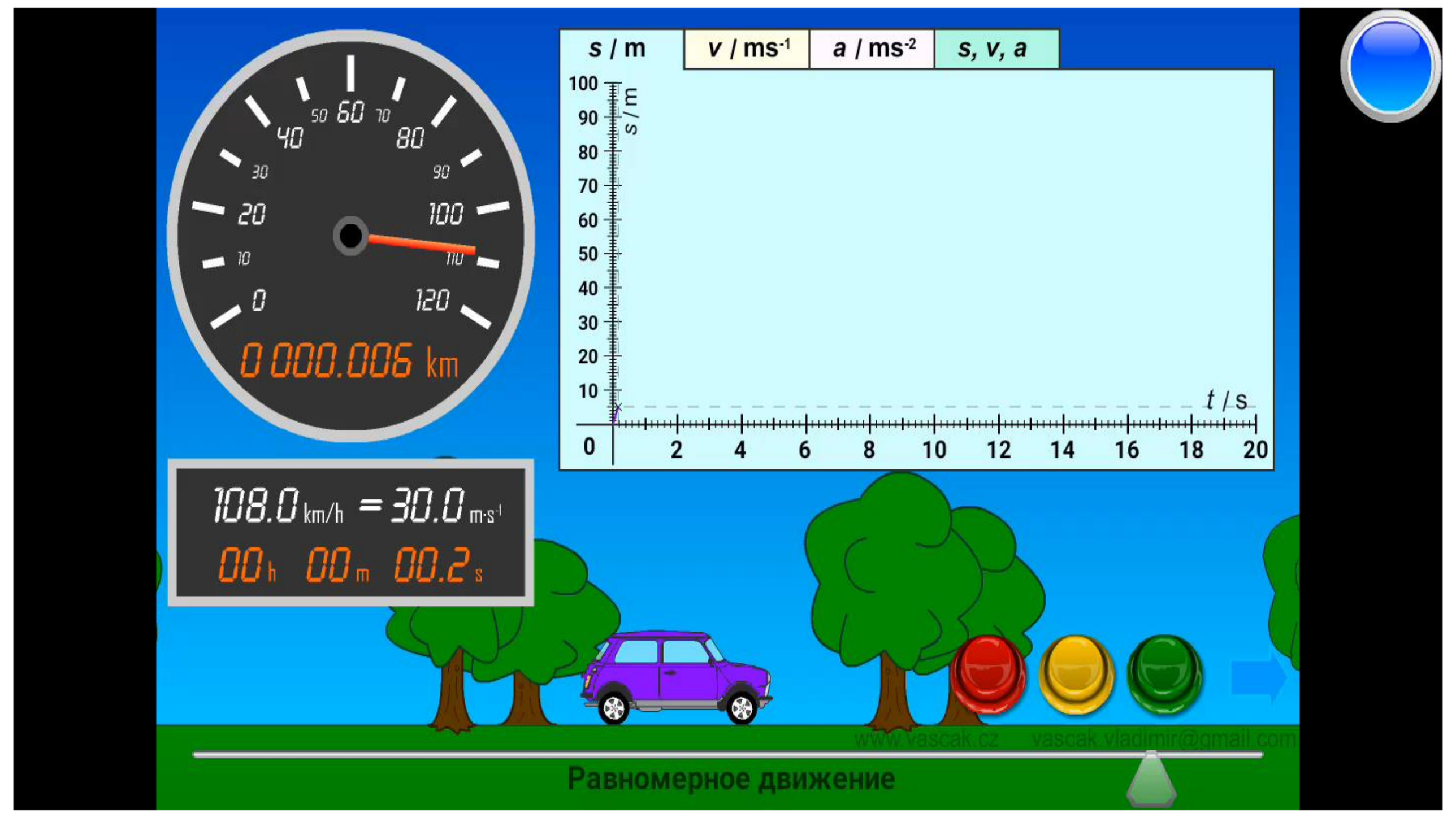
“TIQXMMI” MTU FIZIKA va KIMYO KAFEDRASI

fizika fani o‘qituvchisi O‘rinbayev Sharofiddin Maksudovich

To‘g‘ri chiziqli tekis harakat

To‘g‘ri chiziqli tekis harakat bo‘lishi uchun ikkita shart bajarilishi kerak: 1.Jismning harakat trayektoriyasi to‘g‘ri chiziqdan iborat bo‘ladi. 2.Harakat tezligining kattaligi va yo‘nalishi o‘zgarmaydi.

$$S = \vartheta \cdot t \qquad \vartheta = \frac{S}{t} \qquad t = \frac{S}{\vartheta}$$

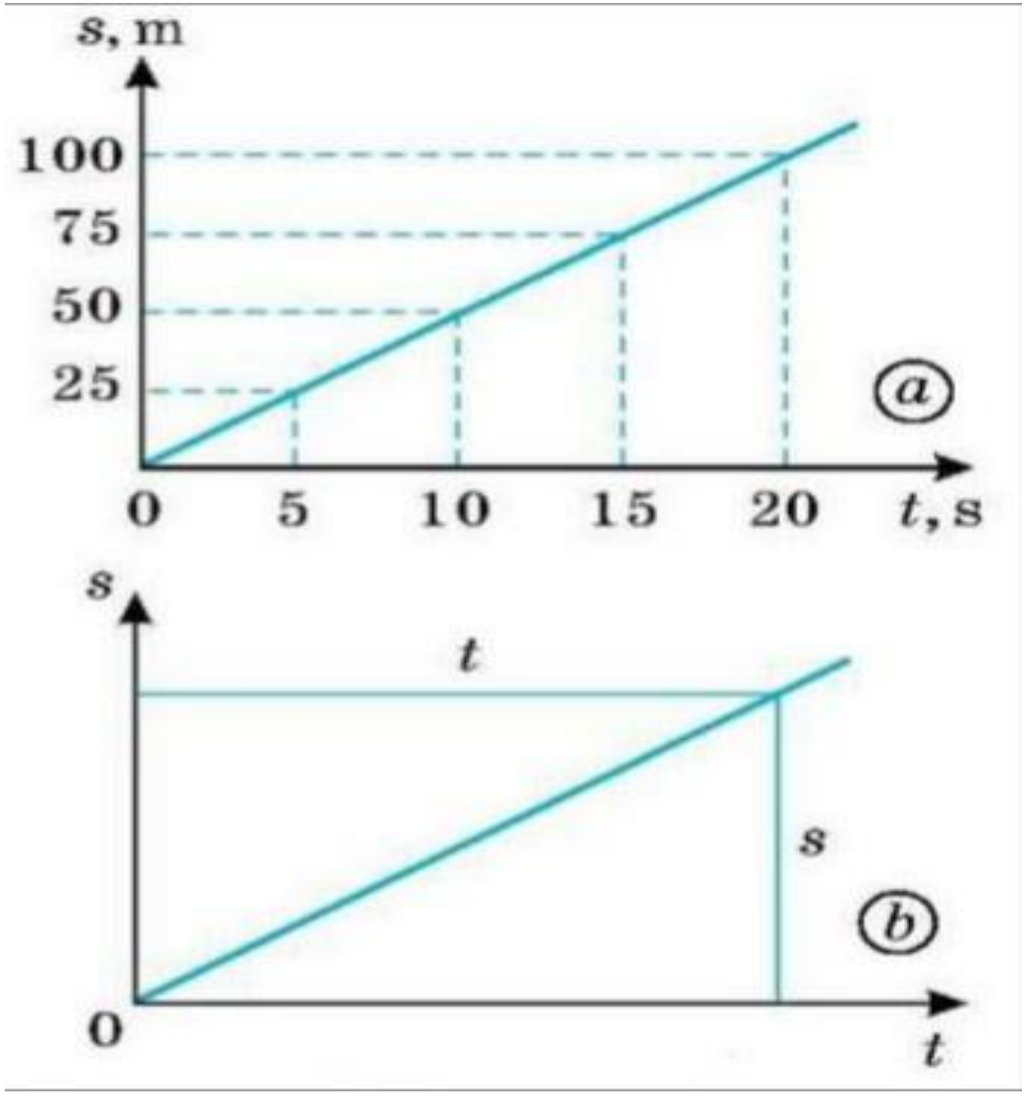

s / m
v / ms-1
a / ms-2
s, v, a
100
90
80
70
60
50
40
30
20
10
0
s / m
t / s
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100
110
120
0 000.006 km
108.0 km/h = 30.0 m·s-1
00 h 00 m 00.2 s
www.vascak.cz
vascak.vladimir@gmail.com
Равномерное движение

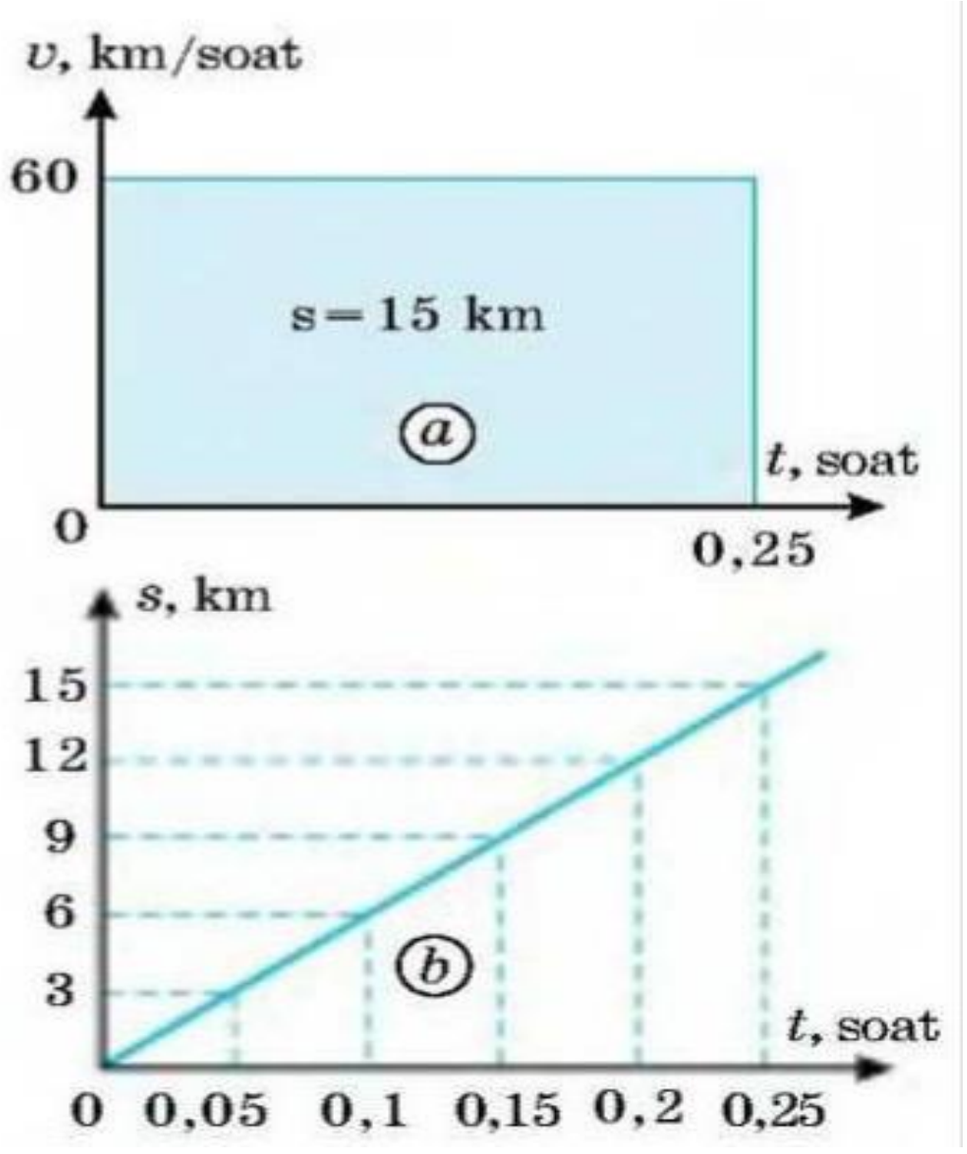
To‘g‘ri chiziqli notekis harakat

Bunday harakatda jismning harakat troyektoriyasi to‘g‘ri chiziqdan iborat bo‘ladi. Harakat tezligining kattaligi o‘zgaradi, lekin yo‘nalishi o‘zgarmaydi.

$$S = \vartheta_{o‘rt} \cdot t \qquad \vartheta_{o‘rt} = \frac{S}{t} \qquad \text{t} = \frac{S}{\vartheta_{o‘rt}}$$

$\vartheta_{o‘rt}$- jismning o‘rtacha tezligi.


s, m
100
75
50
25
0
5
10
15
20
t, s
a
s
t
s
0
t
b

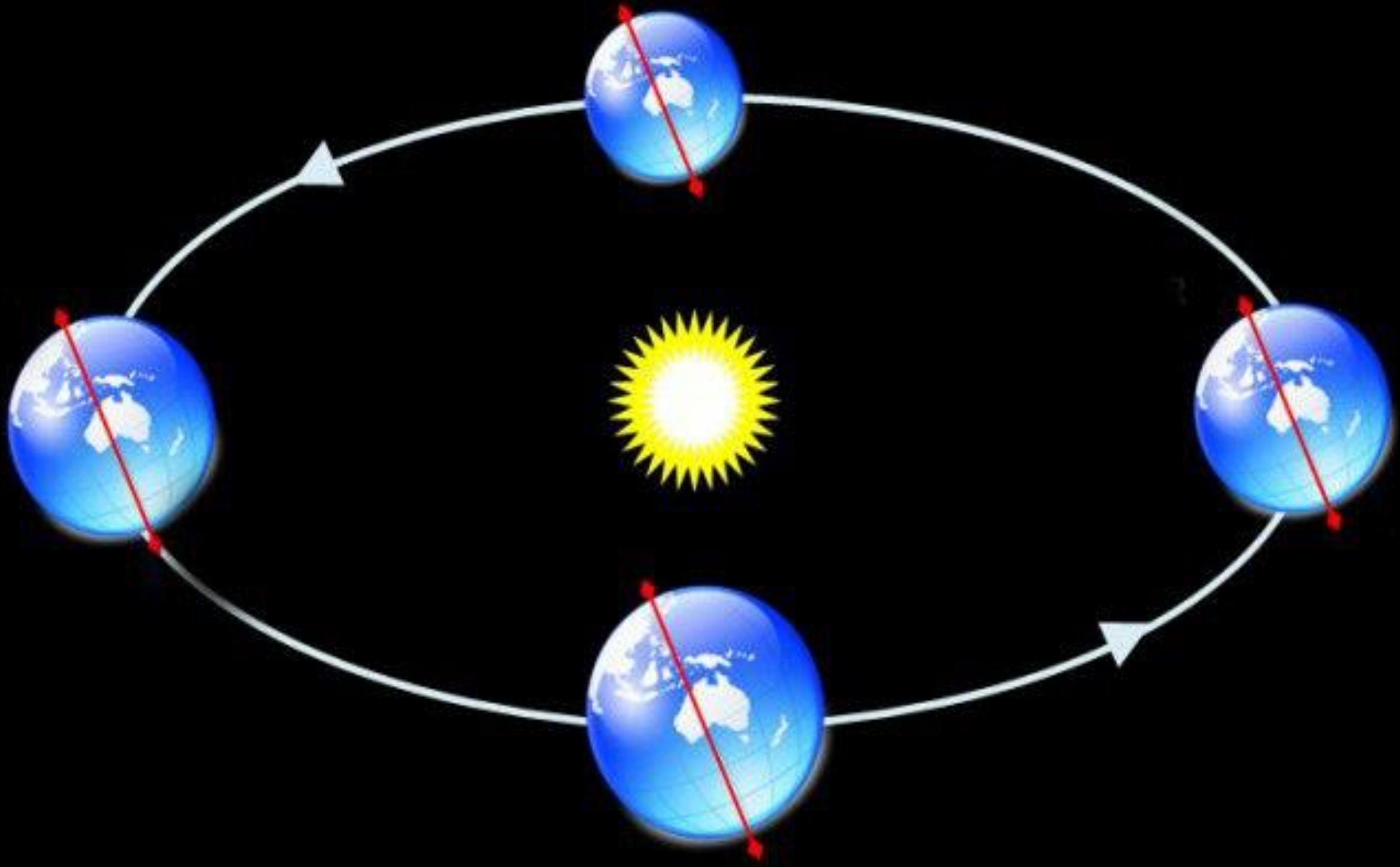

v, km/soat
60
s = 15 km
a
t, soat
0
0,25
s, km
15
12
9
6
3
b
t, soat
0
0,05
0,1
0,15
0,2
0,25

Egri chiziqli tekis harakat

Agar jismning troyektoriyasi egri chiziqdan iborat bo‘lib, uning oniy tezligi vaqt o‘tishi bilan o‘zgarmasa,bunday harakat egri chiziqli tekis harakat deyiladi. Bunday harakatga aylana bo‘ylab tekis harakat misol bo‘ladi.

T – aylanish davri, ν **–aylanish chastotasi**

ω **– burchak tezlik,** S_{yoy}**- yoy uzunligi**



MEXANIKANING FIZIK ASOSLARI

Umumiy holda to'g'ri chiziqli harakatning tezligi

$$\upsilon = \frac{ds}{dt}$$

Tezlanishi $$a = \frac{dv}{dt} = \frac{d^2 s}{dt^2},$$

To'g'ri chiziqli tekis harakat bo'lganda

$$\upsilon = \frac{S}{t} = \text{const} \qquad \text{va} \qquad a = 0$$

To'g'ri chiziqli tekis o'zgaruvchan harakat bo'lganda, quyidagi ifodalar kelib chiqadi: $$S = \upsilon_0 t + \frac{at^2}{2} \qquad \upsilon = \upsilon_0 + at \qquad a = const.$$

Bu tenglamalarda a tezlanish harakat tekis tezlanuvchan bo'lsa musbat va tekis sekinlanuvchan bo'lsa manfiy bo'ladi.

Egri chiziqli harakatda to'la tezlanish quyidagiga tengdir:

$$a = \sqrt{a_t^2 + a_n^2}.$$

Bunda a_t - tangensial tezlanish, a_n - normal (markazga intiltirma) tezlanish bo'lib

$$a_t = \frac{d\upsilon}{dt} \qquad \text{va} \qquad a_n = \frac{\upsilon^2}{R}$$

ko'rinishlarda hisoblanadi. Bunda υ – harakatning tezligi va R - trayektoriyaning berilgan nuqtadagi egrilik radiusi.

Umumiy holda aylanma harakatda burchak tezlik

$$\omega = \frac{d\varphi}{dt},$$

burchak tezlanish esa

$$\varepsilon = \frac{d\omega}{dt} = \frac{d^2\varphi}{dt^2}.$$

Tekis aylanma harakatda burchak tezlik quyidagiga tengdir

$$\omega = \frac{\varphi}{t} = \frac{2\pi}{T} = 2\pi\nu,$$

bunda T - aylanish davri, ν- aylanish chastotasi, ya'ni vaqt birligidagi aylanishlar soni.

Burchak tezlik ω chiziqli tezlik υ bilan quyidagi munosabat orqali bog'langan $\upsilon = \omega \cdot R.$

Aylanma harakatda tangensial va normal tezlanishlarni quyidagicha ifodalash mumkin:

$$a_t = \varepsilon R; \qquad a_n = \omega^2 R.$$

Ilgarilanma va aylanma harakatining tenglamalari 6-jadvalda taqqoslangan.

1.1. Avtomobil o'z harakati vaqtining birinchi yarmida *80 km/soat* tezlik bilan, qolgan vaqtida esa *40 km/soat* tezlik bilan harakatlangan. Avtomobil harakatining o'rtacha tezligi topilsin.

1.2. Avtomobil yo'lning birinchi yarmini *80 km/soat* tezlik bilan, qolgan yo'lni esa *40 km/soat* tezlik bilan bosib o'tgan. Avtomobil harakatining o'rtacha tezligi topilsin.

1.3. Paroxod daryoda *A* punktdan *B* punktga $\upsilon_1 = 10$ *km/soat* tezlik bilan, qaytishda esa $\upsilon_2 = 16$ *km/soat* tezlik bilan harakatlanadi. 1) Paroxodning o'rtacha tezligi, 2) daryoning oqim tezligi topilsin.

1.4. $\upsilon_1 = 1$ *m/sek* tezlik bilan oqayotgan daryoda suvga nisbatan $\upsilon_2 = 2$ *m/sek* tezlik bilan harakatlanayotgan qayiqning quyidagi hollarda qirg'oqqa nisbatan tezligi topilsin: 1) qayiq oqim bo'yicha suzganda, 2) qayiq oqimga qarshi suzganda, 3) qayiq oqimga $\alpha = 90^0$ burchak hosil qilib suzganda.

Ilgarilanma harakat	Aylanma harakat

Tekis harakat

$S = \upsilon \cdot \mathrm{t}$	$\varphi = \omega t$
$\upsilon = const$	$\omega = const$
$a = 0$	$\varepsilon = 0$

Tekis o'zgaruvchan harakat

$S = \upsilon_0 t + \frac{at^2}{2}$	$\varphi = \omega_0 t + \frac{\varepsilon t^2}{2}$
$\upsilon = \upsilon_0 + at$	$\omega = \omega_0 + \varepsilon t$
$a = const$	$\varepsilon = const$

Notekis harakat

$s = f(t)$	$\varphi = f(t)$
$\upsilon = \frac{ds}{dt}$	$\omega = \frac{d\varphi}{dt}$
$a = \frac{dv}{dt} = \frac{d^2 s}{dt^2}$,	$\varepsilon = \frac{d\omega}{dt} = \frac{d^2 \varphi}{dt^2}$

1.5. Samolyot havoga nisbatan $\upsilon_1=800\ km/soat$ tezlik bilan uchmoqda. G'arbdan sharqqa tomoni $\upsilon_2=15\ m/sek$ tezlik bilan shamol esib turibdi. Samolyot yerga nisbatan qanday tezlik bilan uchishi va 1) janubga, 2) shimolga, 3) g'arbga, 4) sharqqa siljishi uchun meridianga nisbatan qanday uchburchak tashkil qilib uchishi topilsin.

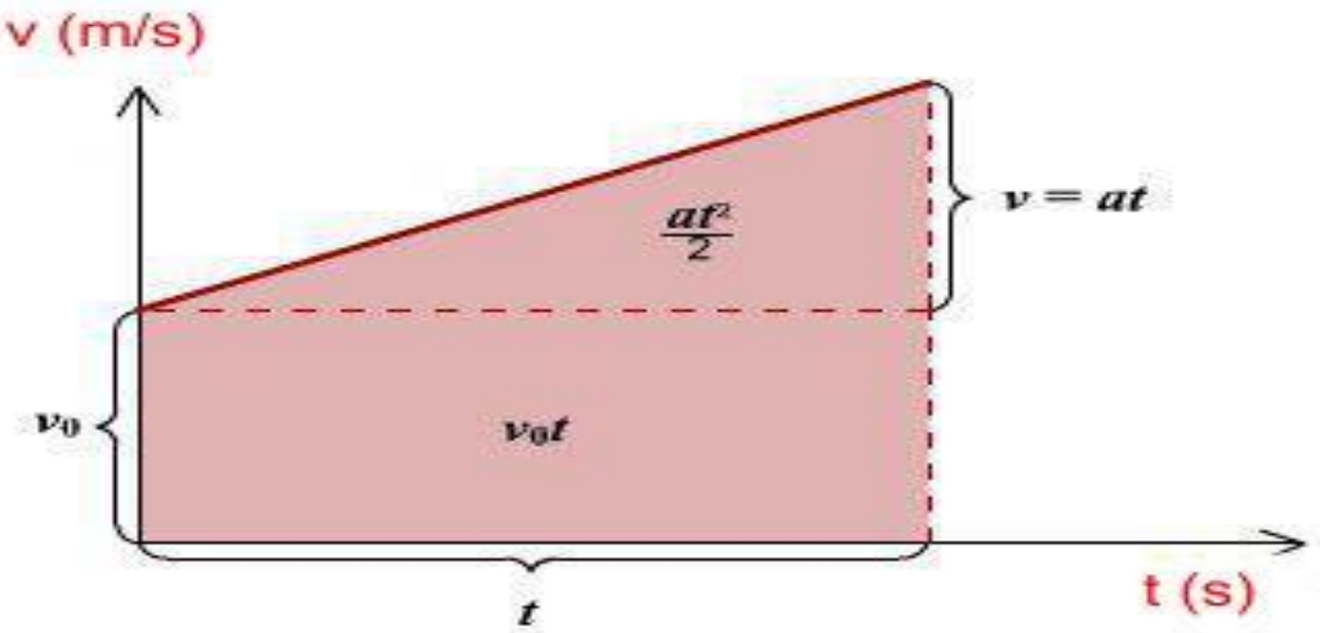
1.6. Samolyot *A* punktdan sharq tomondagi *300 km* uzoqlikda joylashgan *B* punktga uchmoqda. Quyidagi hollarda samolyotning bu masofani uchib o'tish vaqti topilsin: 1) shamol bo'lmaganda, 2) shamol janubdan shimolga esganda va 3) shamol g'arbdan sharqqa esganda. Shamolning tezligi $\upsilon_1=20\ m/sek$, samolyotning tezligi $\upsilon_2=600\ km/soat$.

1.7. Qayiq suvga nisbatan *7,2 km/soat* tezlik bilan qirg'oqqa tik yo'nalishda harakat qilmoqda. Oqim qayiqni *150 m* pastga sudradi. Daryoning kengligi *0,5 km*. 1) Daryo oqimining tezligi va 2) Qayiqning daryodan o'tishi uchun sarf qilingan vaqt topilsin.

1.8. Vertikal yuqoriga otilgan jism *3 sek* dan keyin yerga qaytib tushdi. 1)Jismning boshlang'ich tezligi qanday bo'lgan? 2) Jism qanday balandlikka ko'tarilgan? Havoning qarshiligi hisobga olinmasin.

1.9. Tosh *10 m* balandlikka otilgan. 1) Tosh qancha vaqtdan keyin yerga qaytib tushadi? 2) Agar toshning boshlang'ich tezligi ikki marta oshirilsa, u qancha balandlikka ko'tariladi? Havoning qarshiligi hisobga olinmasin.

$$s_x = v_{0x}t + \frac{a_x t^2}{2}$$



Mustaqillik prinsipi

Jism qatnashayotgan harakatlar mustaqil bo‘lib, ularning harakat tezligi (tezlanishi) bir-biriga bog‘liq emas. Bunga harakatning mustaqillik prinsipi deyiladi.

$$\overrightarrow{S_{um.}} = \overrightarrow{S_1} + \overrightarrow{S_2} + \overrightarrow{S_3} + \cdots + \overrightarrow{S_n}$$

$$\overrightarrow{\vartheta_{um.}} = \overrightarrow{\vartheta_1} + \overrightarrow{\vartheta_2} + \overrightarrow{\vartheta_3} + \cdots + \overrightarrow{\vartheta_n}$$

$$\overrightarrow{a_{um.}} = \overrightarrow{a_1} + \overrightarrow{a_2} + \overrightarrow{a_3} + \cdots + \overrightarrow{a_n}$$

$$\vec{S} = \overrightarrow{S_0} + \overrightarrow{\vartheta_{um.}} \cdot t + \frac{\vec{a} \cdot t^2}{2}$$

1-masala

Motorli qayiq daryoda manzilga yetib borish uchun 1,8 soat, qaytib kelish uchun esa 2,4 soat vaqt sarfladi. Agar sol jo‘natilsa, manzilga qancha vaqtda yetib boradi?

Berilgan:

$t_1 = 1{,}8$ soat

$t_2 = 2{,}4$ soat

Topish kerak: $t_0 - ?$

Formula va yechish:

$(\vartheta_q + \vartheta_0) \cdot t_1 = S\ ,\ \ (\vartheta_q - \vartheta_0) \cdot t_2 = S$

$S = \vartheta_0 \cdot t_0$

$(\vartheta_q + \vartheta_0) \cdot t_1 = (\vartheta_q - \vartheta_0) \cdot t_2$

$(\vartheta_q + \vartheta_0) \cdot 1{,}8 = (\vartheta_q - \vartheta_0) \cdot 2{,}4$

$1{,}8\vartheta_q + 1{,}8\vartheta_0 = 2{,}4\vartheta_q - 2{,}4\vartheta_0$

$4{,}2\vartheta_0 = 0{,}6\vartheta_q,\ \ \vartheta_q = 7\vartheta_0$ dan $(\vartheta_q + \vartheta_0) \cdot t_1 = S \Rightarrow$

$\Rightarrow (7\vartheta_0 + \vartheta_0) \cdot 1{,}8 = S \Rightarrow S = 14{,}4\vartheta_0$

$t_0 = \frac{S}{\vartheta_0} = \frac{14{,}4\vartheta_0}{\vartheta_0} = 14{,}4$ soat. **Javob: t_0 =14,4 soat**