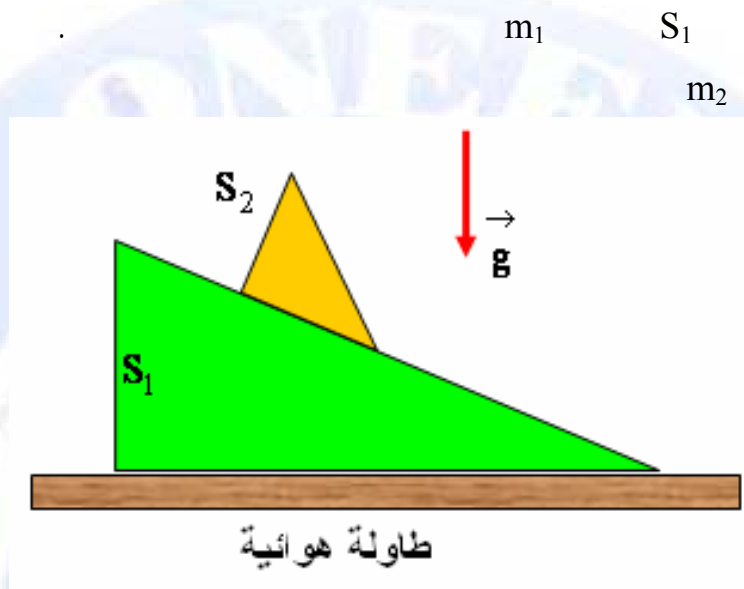


: 1



· S<sub>1</sub> -

· S<sub>2</sub> -

S<sub>1</sub> + S<sub>2</sub> -

: 2

· v<sub>1</sub> = 250 Km/h ( formule 1 )

· 10m/s<sup>2</sup>

2

→  
v<sub>2</sub>

- 1

m = 720 Kg

- 2

→  
a

→  
v<sub>2</sub>

→  
v<sub>1</sub>

:

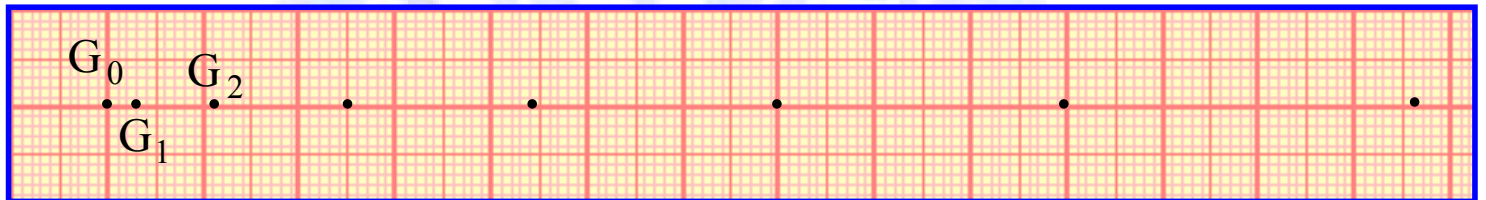
- 3

: 3

$$m = 270\text{g}$$

$$t = 0\text{ s}$$

$$80\text{ ms}$$



– 1

– 2

– 3

$x(10^{-2}\text{ m})$	0,0	0,3	1,1	2,5	4,4	7	10	13,6
$v(10^{-2}\text{ m/s})$								
$a(\text{m/s}^2)$								

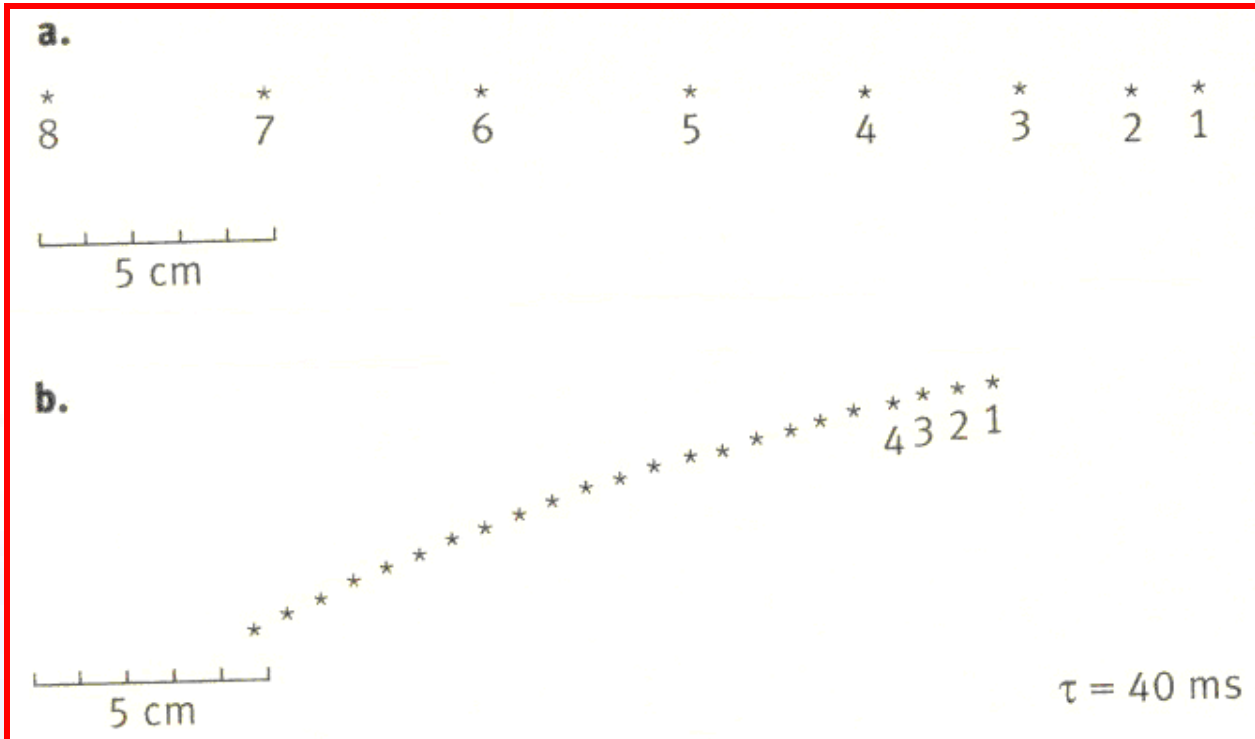
– 4

– 5

– 6

: 4

(b) (a)



(b) (a)

G

- 1

.6 5 4 3

(a)

- 2

(b)

15

- 3

: 5

$\left( \vec{O}; \vec{i} \right)$

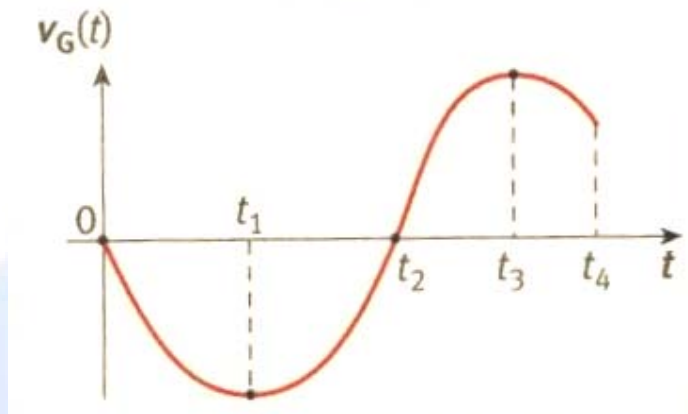
G

:

$$\vec{v}_G(t) = v_G(t) \vec{i}$$

$t_4 \quad t_0$

$v_G(t)$



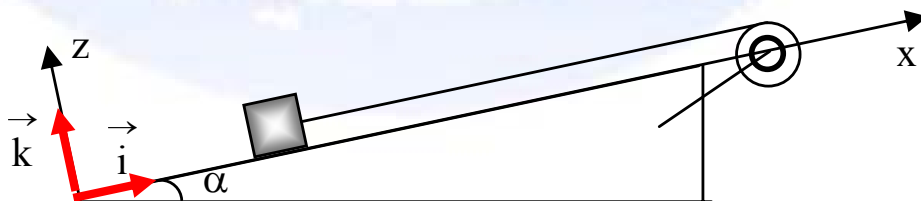
$(\vec{O}; \vec{i})$

$a_G(t)$

$a_G > 0$   
 $a_G < 0$   
 $a_G$   
 $t_4$   $t_0$

$\alpha = 12,0^\circ$

$m = 80 \text{ Kg}$



$\vec{F}$

$\vec{R}$

$R_T$

$a = 2,00 \text{ m/s}^2$

$\vec{R}$

$R_N$

0,25

- 1

$R_N$

- 2

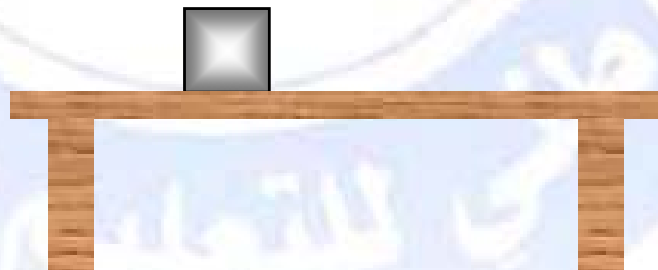
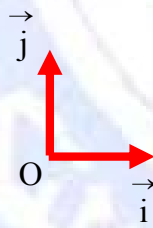
$\vec{F}$

- 3

: 7

$m = 4,00 \text{ Kg}$

$t = 0$

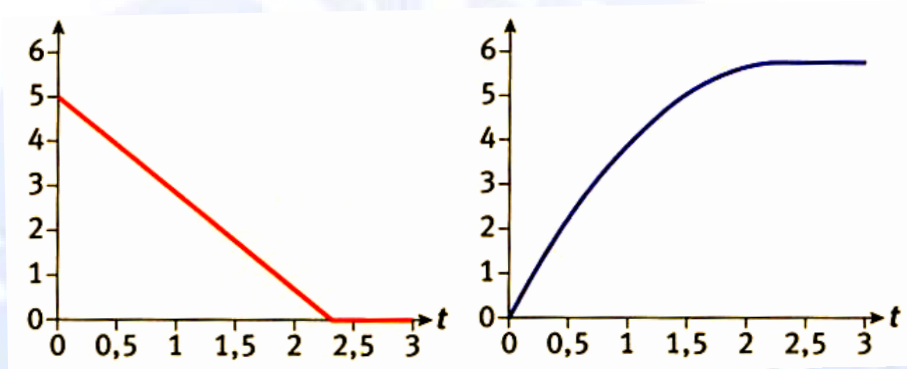


$$\begin{pmatrix} O; \vec{i} \end{pmatrix}$$

$\cdot v(t)$

$x(t)$

$\cdot t_1$



$t_1$

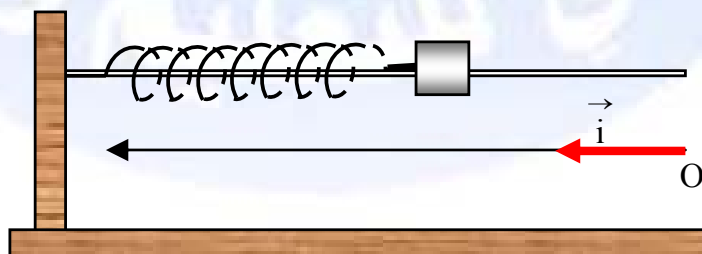
$\vec{R}$

$\vec{R}_y$

$\vec{R}_x$

: 8

250 g



$$\left( \vec{O}; \vec{i} \right)$$

$x_i$

$$\tau = 40\text{ms}$$

	1	2	3	4	5	6	7	8	9	10
X ( cm )	0,0	2,2	4,2	5,9	7,2	7,9	6,3	4,7	2,7	0,5

.8 3

$$\left( \vec{O}; \vec{i} \right)$$

$\vec{a}_x$

$\vec{F}$

- 1

- 2

: 9

.1

$$m = 240 \text{ g}$$

$$t = 0 \text{ s}$$

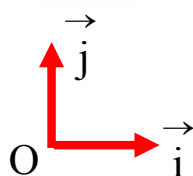
.2

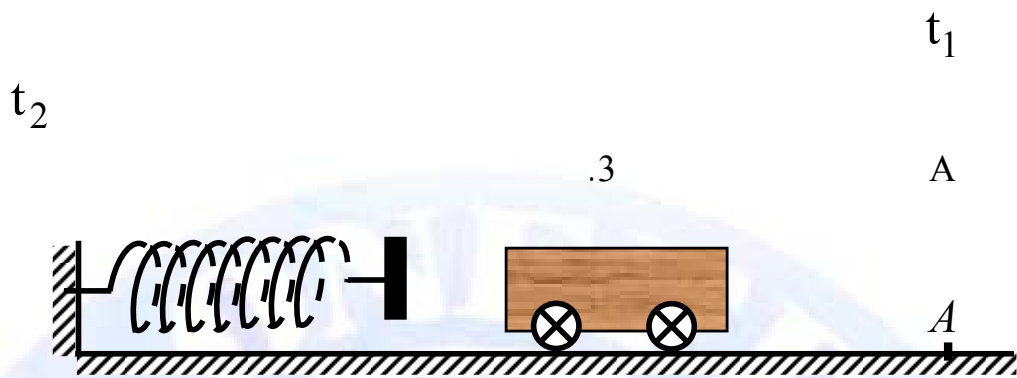


شكل - 1 -



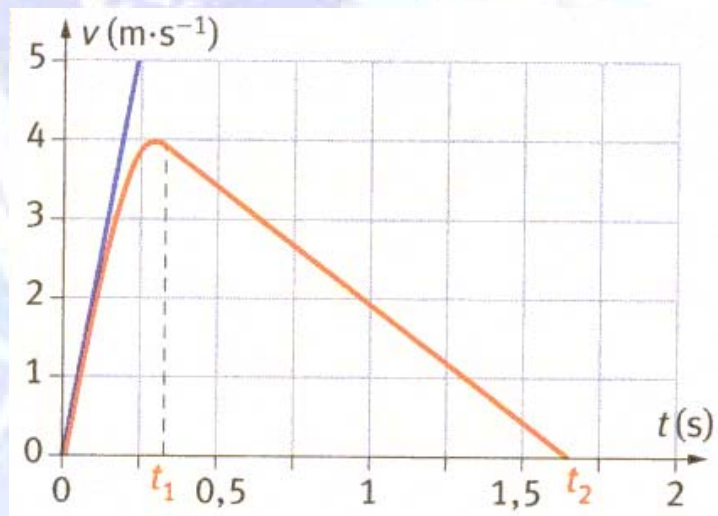
شكل - 2 -





شكل - 3 -

$$\left( O; \vec{i} \right)$$



$t_2$   $t_1$  G - 1

/

$$\left( O; \vec{i} \right) \quad G$$

/

$R_y$   $R_x$  /

$t = 0 \text{ s}$  - 2



$$\left( \vec{O}; \vec{i} \right) \quad \vec{a}_0 \quad a_0 \quad /$$

$$\vec{R} \quad /$$

$$\vec{F} \quad \vec{F}_x$$

– 3

/

/

/

$\vec{R}$

: 10

249

S

206

– 1

S – 2

– 3

– 4

– 5

: 11

. 10759 j

$$.1 \text{ U} \cdot \text{A} = 150.10^6 \text{ Km}$$

– 1

1 ) . a - 2

(. 365

.U.A a - 3

: 12

352 Km

) A

1040 Km ( périgée

) P

. (apogée

. P

A

- 1

- 2

- 3

: 13

$z = 300 \text{ Km}$

.  $T = 1 \text{ h } 32 \text{ min}$

r

- 1

- 2

- 3

$T_1$

- 4

$z_1 = 600 \text{ Km}$

: 14

. 108,2 million Km r

. 224,7 j

- 1

- 2

- 3

$$v^2 = \frac{G \cdot m_s}{r}$$

$$\frac{m_s}{m_s} - 4$$

: 15

$$D = 3,8\text{cm} \quad 0,05\text{g} \quad m = 2,50\text{g}$$

$$v_{lim} = 7,12\text{m/s}$$

$$\rho = 1,3\text{Kg/m}^3 - 1$$

$$F = Kv^2 : - 2$$

$$v(t)$$

$$K \quad v_{lim} \quad mg \quad K$$

$$K$$

- 4

$$a_0$$

$$\tau$$

$$v_1 = 4,25\text{m/s} - 5$$

$$t_1 = 0,500\text{s}$$

$$t_1 \quad a_1$$

$$t_2 = 0,510\text{s}$$

: 16

0 " :

." 10,4 s 100Km/h

- 1

- 2

AB

AB.

: 17

.  $v = 20,10\text{m/s}$

$t_1$

$\vec{F}$

$m = 46,0\text{g}$

.  $K = 4,34.10^{-4}\text{kg/m}$

$F = Kv^2$

$\left(O; \vec{k}\right)$

.  $t_1$

- 1

.  $t_1$

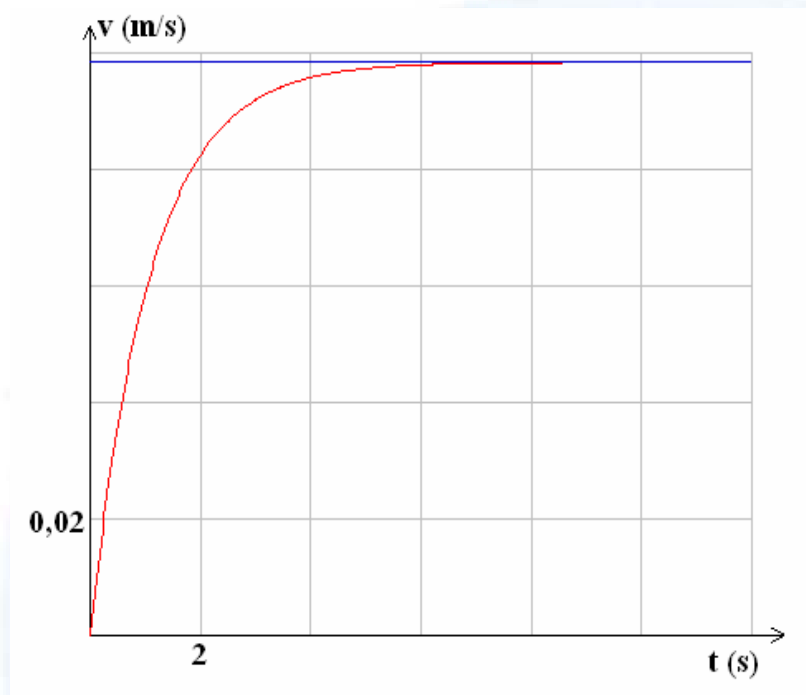
$a_1$

- 2

- 3

$t_2 = t_1 + 0,0200\text{ s}$

: 18



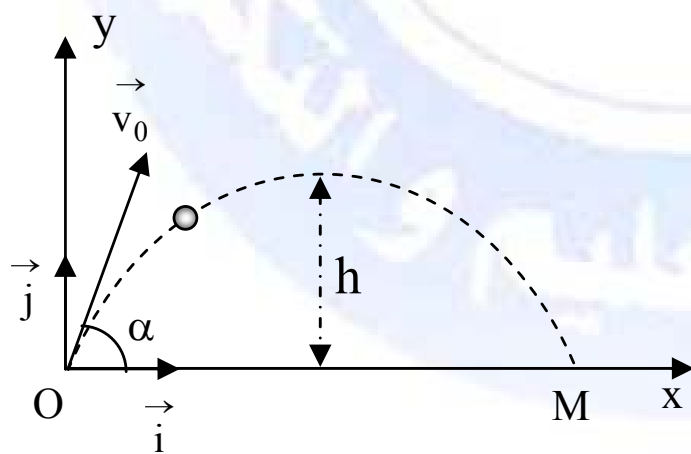
$\tau$

$t = 0$

- 1

- 2

: 19



$G$

$m$

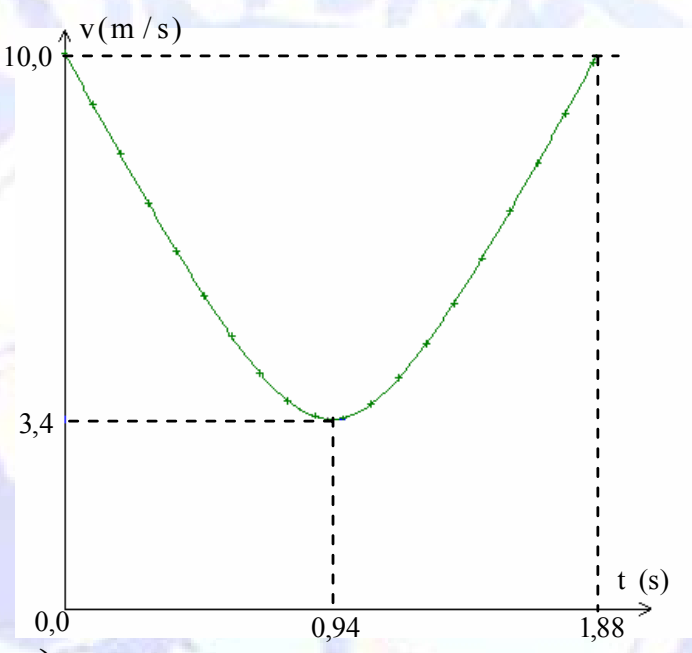
$\vec{v}_0$

$\left( 0; \vec{i}; \vec{j} \right)$

$t = 0$  s

$$\vec{v}_0 = v_{0x} \vec{i} + v_{0y} \vec{j} \qquad \vec{OG}_0 = 0 \cdot \vec{i} + 0 \cdot \vec{j}$$

(M) (O)  
- 1



$\left( \vec{O}; \vec{i} \right)$  - 2

$\left( \vec{O}; \vec{j} \right)$   
: - 3

$\vec{v}_0$   $v_0$  /  
 $\vec{v}_0$   $v_{0x}$  /

$\cdot v_{0y}$   $\alpha$  - 4  
[0;1,88]s  $v_y(t)$   $v_x(t)$  - 5

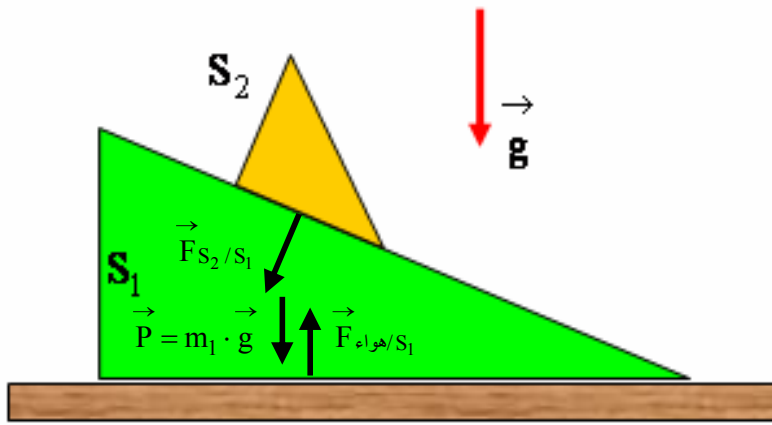
h OM - 6

: 1

:

.  $S_1$

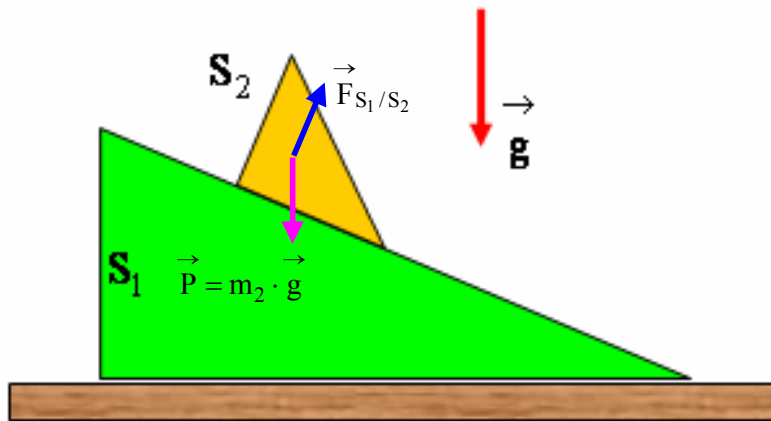
-



طاولة هوائية

.  $S_2$

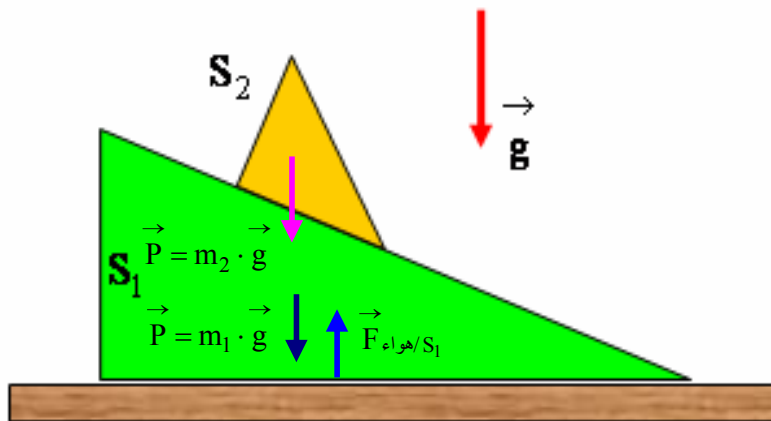
-



طاولة هوائية

.  $S_2 + S_1$

-



طاولة هوائية

: 2

$$a = \frac{v_2 - v_1}{\Delta t} : \quad -1$$

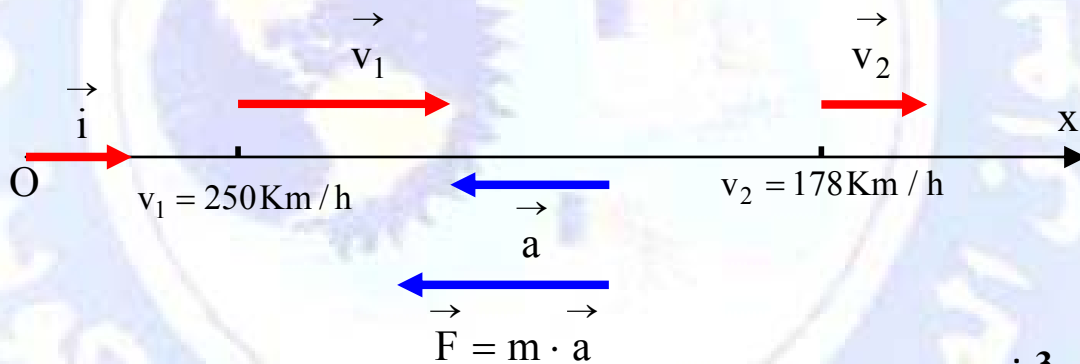
$$v_2 = v_1 + a\Delta t :$$

$$v_2 = 250 \times \frac{1000}{3600} + (-10) \times 2 = 49,44 \text{ m/s} = 178 \text{ Km/h}$$

$$F = m \cdot a : \quad -2$$

$$F = 720 \times (-10) = 7200 \text{ N}$$

: -3



: 3

- 1

- 2

- 3

$$a_i = \frac{v_{i+1} - v_{i-1}}{2\tau}$$

$$v_i = \frac{x_{i+1} - x_{i-1}}{2\tau}$$

$x(10^{-2} \text{ m})$	0,0	0,3	1,1	2,5	4,4	7	10	13,6
$v(10^{-2} \text{ m/s})$	/	6,87	13,75	20,62	28,12	35	41.25	/
$a(\text{m/s}^2)$	/	/	0,86	0,90	0,90	0,82	/	/



– 4

$\vec{F}$

– 5

$\vec{F} = \sum \vec{F}_{\text{ext}} = m \vec{a}$

$\Delta \vec{v}$

– 6

:

– 7

$F = m \cdot a$

:

a

$a = 0,87 \text{ m/s}^2$

:

$F = 0,3 \times 0,87 = 0,261 \text{ N}$

: 4

( b )

( a )

– 1

( b )

– 2

:

	1	2	3	4	5	6	7	8
v ( m/s)	/	0,47	0,68	0,86	1,0	1,1	1,13	/
a ( m/s <sup>2</sup> )	/	/	4,9	4,0	3,0	1,6	/	/

. 15

( b )

– 3

: 5

- 1

$$t_3 \quad t_1 \quad \frac{dv}{dt} = 0 \quad a_G = 0 \quad -$$

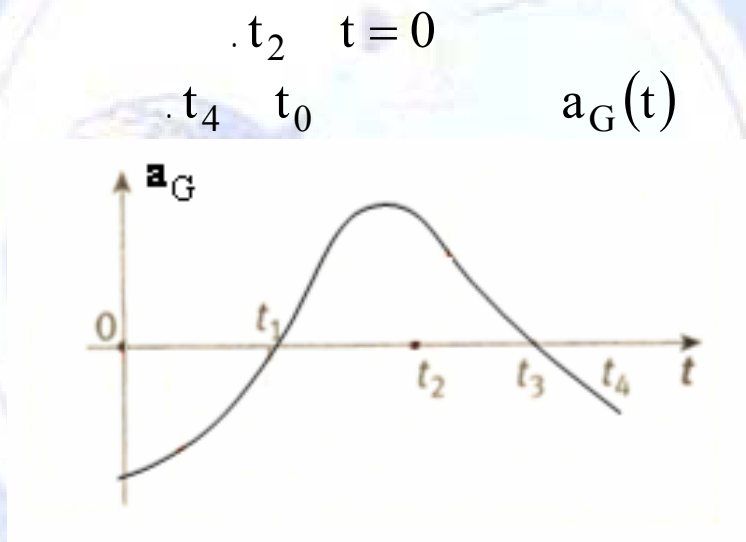
$$t_1 < t < t_3 \quad \frac{dv}{dt} > 0 \quad a_G > 0 \quad -$$

$$0 \leq t < t_1 \quad \frac{dv}{dt} < 0 \quad a_G < 0 \quad -$$

$$t_3 < t \leq t_4$$

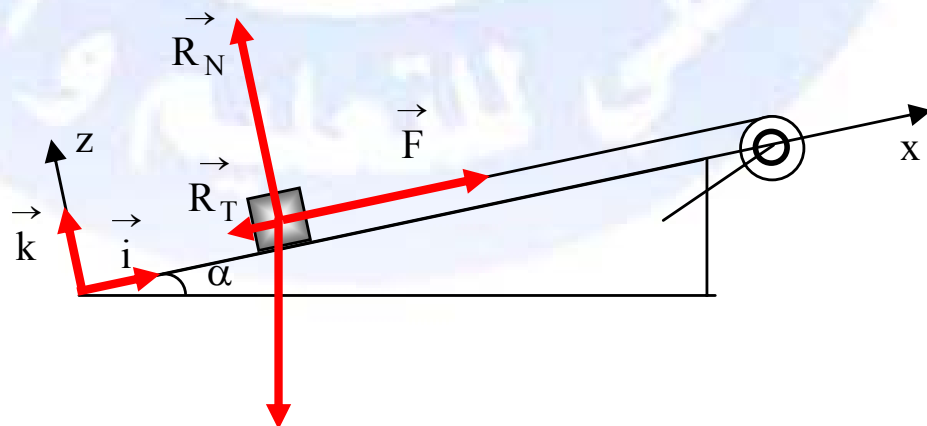
$$a_G$$

- 2



: 6

- 1



$$\vec{P} + \vec{F} + \vec{R}_T + \vec{R}_N = m \cdot \vec{a}$$

$$: \left( O; \vec{k} \right)$$

$$R_N = mg \cos \alpha$$

$$R_N = 80 \times 9,81 \times \cos 12 = 662,2 \text{ N}$$

$$\frac{R_T}{R_N} = 0,25 :$$

$$R_T = 0,25 \times 662,2 = 165,6 \text{ N}$$

$$: \left( O; \vec{i} \right)$$

$$F - R_T = ma$$

$$F = R_T + ma$$

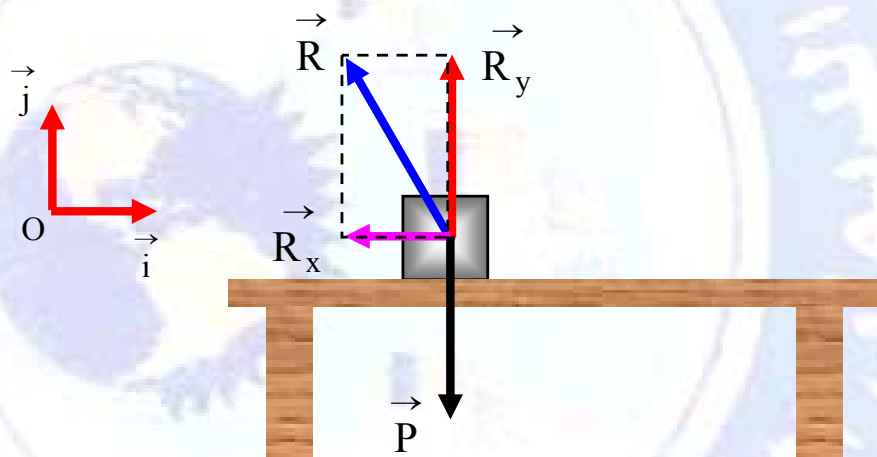
$$F = 165,6 + 80 \times 2 = 325,6 \text{ N}$$

: 7

$x(t)$	2	1	$v(t)$	- 1
			$t_1$	- 2
			:	- 3

$$a = \frac{5 - 0}{0 - 2,3} = -2,2 \text{ m/s}^2$$

- 4



$$\sum \vec{F} = m \vec{a} :$$

- 5

$$\vec{P} + \vec{R} = m \vec{a}$$

$$: \left( \vec{O}; \vec{j} \right) -$$

$$R_y - mg = 0$$

:

$$R_y = 5 \times 9,81 = 49 \text{ N}$$

$$: \left( \vec{O}; \vec{i} \right) -$$

$$-R_x = ma$$

:

$$R_x = -5 \times (-2,2) = 11 \text{ N}$$

: 8

:

- 1

	1	2	3	4	5	6	7	8	9	10
X ( cm )	0,0	2,2	4,2	5,9	7,2	7,9	6,3	4,7	2,7	0,5
V ( m/s)		0,52		0,38			- 0,40		- 0,52	
a ( m/s <sup>2</sup> )			- 1,9					- 1,5		

- 2

:

$$\vec{F} = F_x \cdot \vec{i} = ma_x \cdot \vec{i}$$

:3

-

$$\vec{F} = -0,38 \cdot \vec{i}$$

:8

-

$$\vec{F} = -0,48 \cdot \vec{i}$$

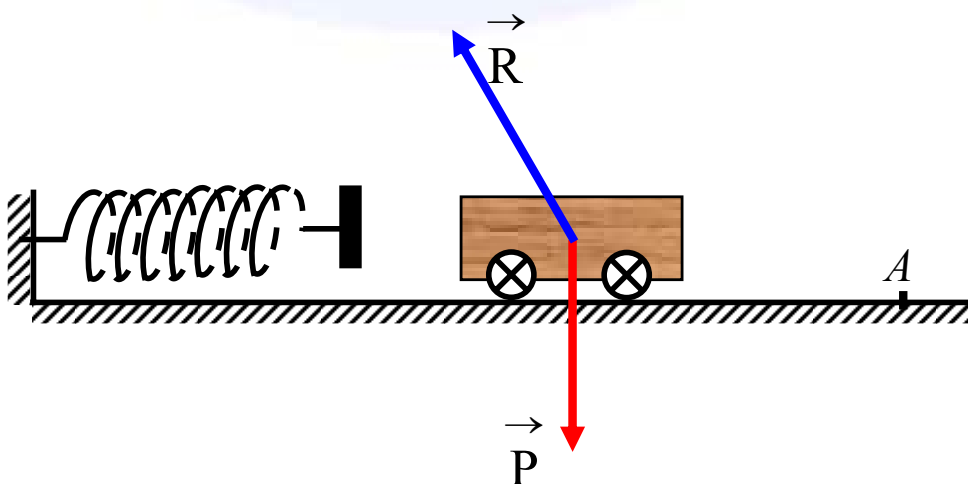
: 9

$$\cdot t_2 \quad t_1 \quad G$$

- 1

:

/



$$v(t) \quad . [0,5 \text{ s}; 1,5 \text{ s}] \quad /$$

:

$$a = \frac{dv}{dt} = \frac{\Delta v}{\Delta t} = \frac{0,4 - 3,4}{1,5 - 0,5} = -3 \text{ m/s}^2$$

/

$$\vec{P} + \vec{R} = m \cdot \vec{a}$$

$$: \quad \left( \vec{O}; \vec{i} \right) \quad -$$

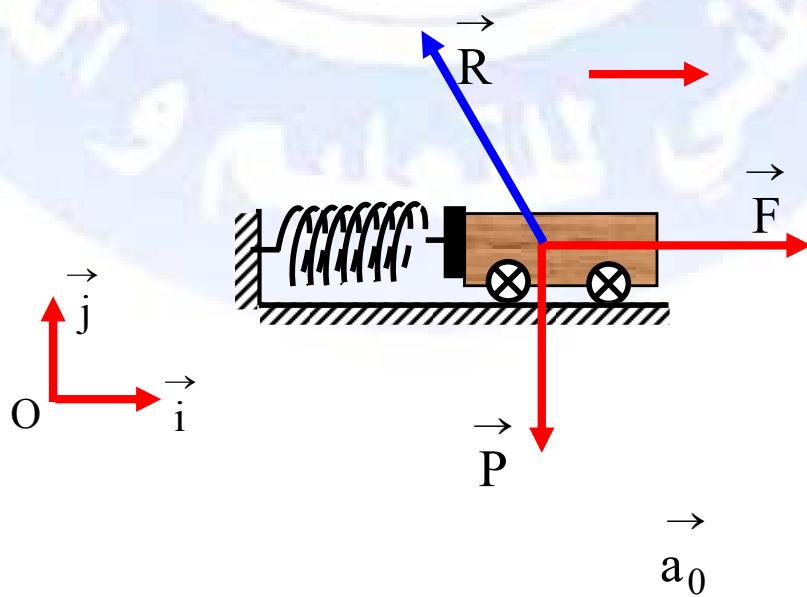
$$R_x = -ma = 0,24 \times (-3) = 0,75 \text{ N}$$

$$: \quad \left( \vec{O}; \vec{j} \right) \quad -$$

$$R_y = mg = 0,24 \times 9,81 = 2,35 \text{ N}$$

$$t = 0 \text{ s} \quad - 2$$

/



$$a_0 = \frac{dv}{dt} = \frac{\Delta v}{\Delta t} = \frac{(5 - 0)}{(0,25 - 0)} = 20,0 \text{ m/s}^2$$

$$\vec{F} + \vec{P} + \vec{R} = m \cdot \vec{a}_0 :$$

$$: \left( \vec{O}; \vec{i} \right)$$

$$F_x - R_x = ma_0$$

$$F_x = ma_0 + R_x = 0,24 \times 20 + 0,75 = 5,55 \text{ N}$$

$$v(t)$$

$$\frac{dv}{dt} = 0 :$$

$$a = \frac{dv}{dt} = 0 :$$

$$t_3 = 0,30 \text{ s} :$$

$$\vec{F} + \vec{P} + \vec{R} = m \cdot \vec{a} :$$

$$: \left( \vec{O}; \vec{i} \right)$$

$$F_x - R_x = 0$$

$$F_x = R_x = 0,75 \text{ N}$$

: 10

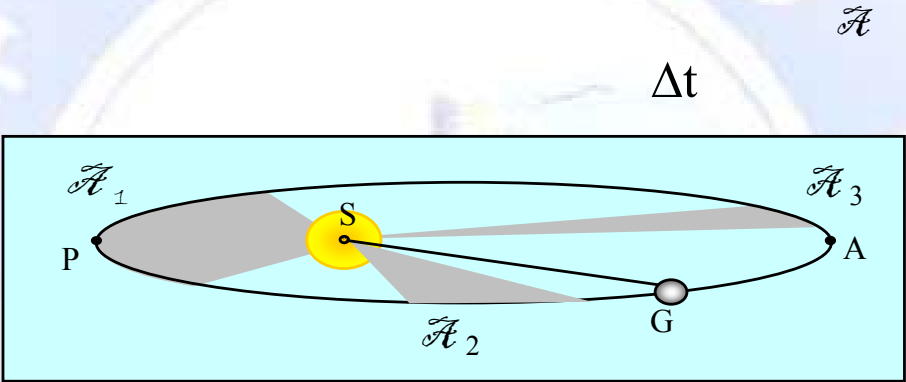
– 1

S – 2

: – 3

$$a = \frac{249 + 206}{2} = 228.10^6 \text{ Km}$$

: – 4



– 5

( périhélie)

.( aphélie)

: 11

: – 1

$$\frac{T^2}{a^3} = K_S$$

$K_S$

$a$

(s)

$T$

$s^2/m^3$

$$\frac{T_S^2}{a_S^3} = K_S :$$

– 2



$$\frac{T_T^2}{a_T^3} = K_S :$$

$$a_S = a_T \left( \frac{T_S}{T_T} \right)^{2/3} :$$

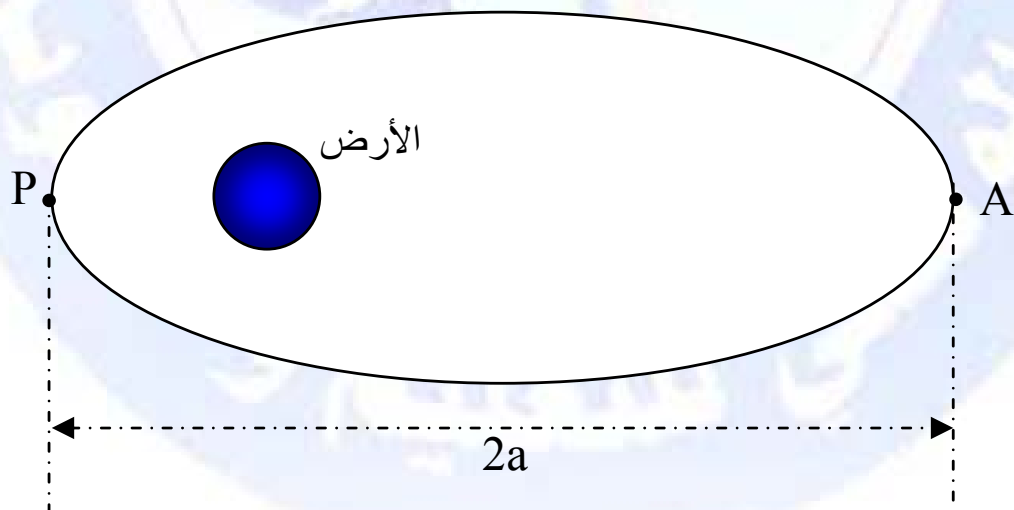
$$a_S = 150.10^6 \times \left( \frac{10759}{365} \right)^{2/3} = 1431.10^6 \text{ Km}$$

$$: \text{ U.A} \quad a \quad - 3$$

$$a_S = \frac{1431.10^6}{150.10^6} = 9,54 \text{ U.A}$$

$$: 12$$

$$: - 1$$



$$. \quad ( \quad ) \quad - 2$$

$$: - 3$$

$$2a = 352 + 1040 = 1392 \text{ Km}$$

$$: 13$$

: - 1

$$r = 6400 + 300 = 6700 \text{ Km}$$

: - 2

$$T = 1 \times 3600 + 32 \times 60 = 5520 \text{ s}$$

$$a^3 \quad - 3$$

: - 4

$$T^2 = Ka^3 :$$

$$T_1^2 = Ka_1^3$$

:

$$T_1 = T \left( \frac{R_T + z_1}{R_T + z} \right)^{3/2} = 5520 \times \left( \frac{6400 + 600}{6700} \right)^{3/2} = 5894 \text{ s} = 1 \text{ h } 38'$$

: 14

$$T = \frac{2\pi}{\omega} : - 1$$

$$\omega = \frac{v}{r} :$$

:

$$T = \frac{2\pi r}{v}$$

:

$$v = \frac{2\pi \times 108,2 \cdot 10^6}{224,7 \times 24 \times 3600} = 35,0 \text{ Km/s}$$

- 2

:

- 3

$$\vec{F}_{S/P} = m \cdot \vec{a}$$

:

$$\vec{F}_{S/P} = \frac{Gm_S m}{r^2} \cdot \vec{n}$$

$$\frac{Gm_S}{r^2} \cdot \vec{n} = \frac{v^2}{r} \cdot \vec{n} :$$

:

$$v^2 = \frac{Gm_S}{r}$$

.  $m_S$ 

- 4

:

$$m_S = \frac{r \cdot v^2}{G} = \frac{108,2 \cdot 10^9 \times 35000}{6,65 \cdot 10^{-11}} = 2,00 \cdot 10^{30} \text{ Kg}$$

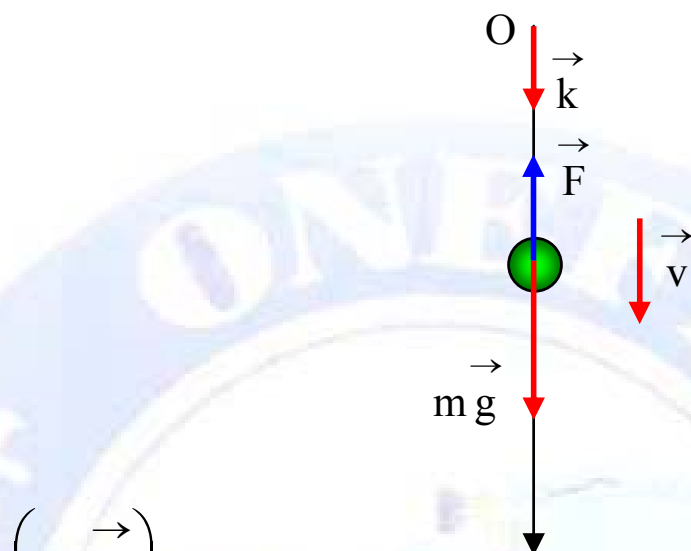
: 15

:

- 1

$$m = \rho \cdot V = 1,3 \times \frac{4}{3} \pi \left( \frac{3,8 \cdot 10^{-2}}{2} \right)^3 = 0,037 \text{ g}$$

- 2  
/



$(O, \vec{k})$

$$\vec{a} = \frac{d\vec{v}}{dt} \cdot \vec{k}$$

$$\vec{v} = v \cdot \vec{k}$$

$$\vec{F} = -Kv^2 \cdot \vec{k} :$$

$$\vec{P} = mg \cdot \vec{k} :$$

$$m \vec{a} = \vec{P} + \vec{F} :$$

:  $(O; \vec{k})$

$$m \frac{dv}{dt} = mg - Kv^2$$

. v(t)

- 3  
/

:  $\frac{dv}{dt} = 0 :$

$$mg - Kv_{lim}^2 = 0$$

:

$$K = \frac{mg}{v_{lim}^2}$$

$$[K] = \frac{[m] \times [g]}{[v] \times [v]} = \frac{kg \times \frac{m}{s^2}}{\frac{m^2}{s^2}} = kg/m$$

:K

/

$$K = \frac{2,5 \cdot 10^{-3} \times 9,81}{7,12^2} = 4,84 \cdot 10^{-4} \text{ Kg/m}$$

- 4

/

$$: \quad ma_0 = mg \quad : \quad \left( O; \vec{k} \right)$$

$$a_0 = g = 9,81 \text{ m/s}^2$$

$$: \quad v_{lim} = a_0 \tau :$$

/

$$\tau = \frac{v_{lim}}{a_0} = \frac{7,12}{9,81} = 0,73 \text{ s}$$

- 5

/

$$a_1 = \frac{(mg - Kv_1^2)}{m} = \frac{(2,5 \cdot 10^{-3} \times 9,81 - 4,84 \cdot 10^{-4} \times 4,25^2)}{2,5 \cdot 10^{-3}}$$

$$a_1 = 6,31 \text{ m/s}^2$$

: /

$$v_2 = v_1 + a_1 \Delta t$$

:

$$v_2 = 4,25 + 6,31 \times 0,01 = 4,31 \text{ m/s}$$

: 16

:

- 1

$$a = \frac{\Delta v}{\Delta t} = \frac{(100 - 0)}{10,7} \times \frac{1000}{3600} = 2,6 \text{ m/s}^2$$

:

$$a = \frac{dv}{dt} = \text{cst} :$$

- 2

$$v = at + C_1 :$$

$$dv = a dt$$

$$. C_1 = 0$$

$$t = 0$$

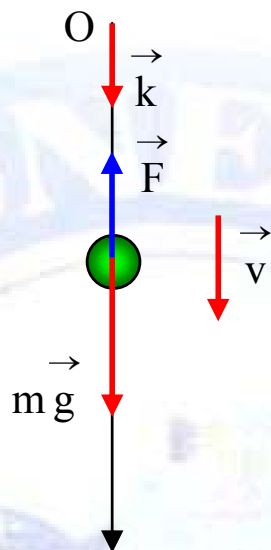
$$v = at :$$

. B A

$$v^2 - v_0^2 = 2a(AB)$$

:

$$AB = \frac{v^2}{2a} = \frac{\left(100 \times \frac{1000}{3600}\right)^2}{2 \times 2,6} = 148,4 \text{ m}$$



:  
:  $\vec{P}$

$$P = mg = 46 \cdot 10^{-3} \times 9,81 = 0,45 \text{ N}$$

:

$$F = K v_1^2 = 4,34 \cdot 10^{-4} \times 20,10^2 = 0,18 \text{ N}$$

 $a_1$ 

- 2

$$m \vec{a} = \vec{P} + \vec{F} :$$

$$ma_1 = P - F : \left( O ; \vec{k} \right)$$

:

$$a_1 = \frac{P - F}{m}$$

:

$$a_1 = \frac{0,45 - 0,18}{46 \cdot 10^{-3}} = 5,7 \text{ m/s}^2$$

:

– 3

$$v_2 = v_1 + a_1 \Delta t$$

:

$$v_2 = 20,1 + 5,7 \times 0,02 = 20,20 \text{ m/s}$$

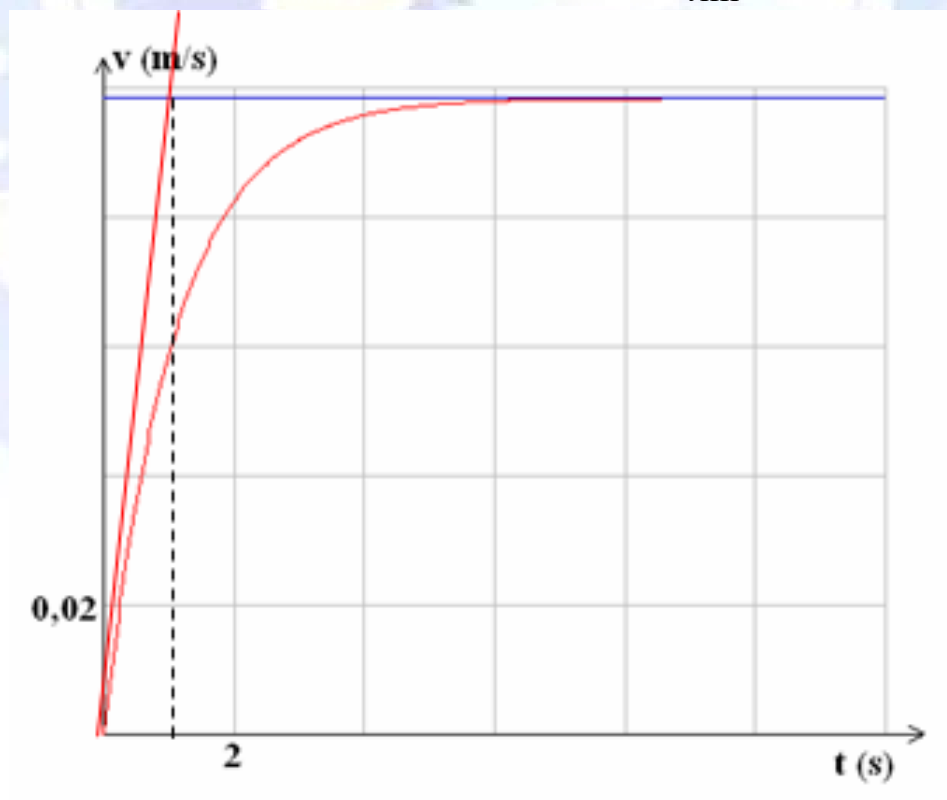
: 18

$$v_{\ell im} = 9,84 \cdot 10^{-2} \text{ m/s}$$

– 1

$\tau$

$$v = v_{\ell im} = 9,84 \cdot 10^{-2} \text{ m/s}$$





:

$$\tau = 1,1 \text{ s}$$

:

- 2

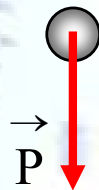
$$a_0 = \frac{V_{lim}}{\tau}$$

:

$$a_0 = \frac{9,84 \cdot 10^{-2}}{1,1} = 8,9 \cdot 10^{-2} \text{ m/s}^2$$

: 19

- 1



$$\sum \vec{F}_{ext} = m \cdot \vec{a} :$$

- 2

$$\vec{P} = m \cdot \vec{a} :$$

$$: \left( O; \vec{i} \right)$$

-

$$0 = m \cdot a_x$$

:

$$a_x = \frac{dv_x}{dt} = 0$$

$$\left( O; \vec{i} \right)$$

$$\left( \vec{0}; \vec{j} \right)$$

$$-mg = m \cdot a_x$$

:

$$a_y = \frac{dv_y}{dt} = -g$$

$$\left( \vec{0}; \vec{i}; \vec{j} \right)$$

$$\vec{a} = 0 \cdot \vec{i} + (-g) \cdot \vec{j}$$

:

- 3

$$v_0 \quad /$$

$$v_0 = 10 \text{ m/s}$$

$$v_{x0} \quad /$$

$$\vec{v}_y$$

$$v_x = v_{0x} \quad \left( \vec{0}; \vec{i} \right)$$

:

$$v_x = v_{0x} = 3,4 \text{ m/s}$$

:

$\alpha$

- 4

$$v_{0x} = v_0 \cos \alpha$$

:

$$\cos \alpha = \frac{3,4}{10} = 0,34$$

$$\alpha \simeq 70^\circ :$$

$$: v_{0y} = v_0 \sin \alpha :$$

$$v_{0y} = 10 \times \sin 70 = 9,4 \text{ m/s}$$

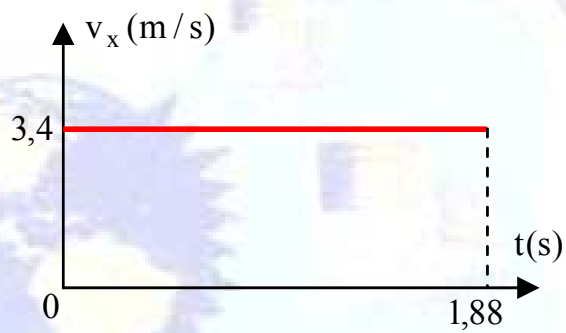
$$: -5$$

$$\left( O; \vec{i} \right)$$

$$: v_x(t)$$

-

:



$$\left( O; \vec{j} \right)$$

$$: v_y(t)$$

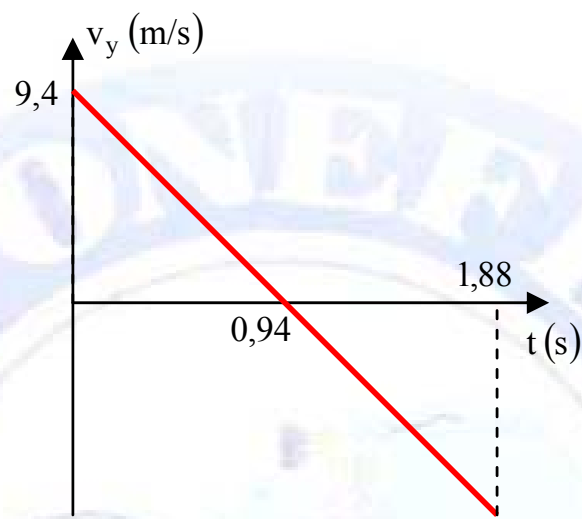
-

:

$$\frac{dv_y}{dt} = -g = \text{cst}$$

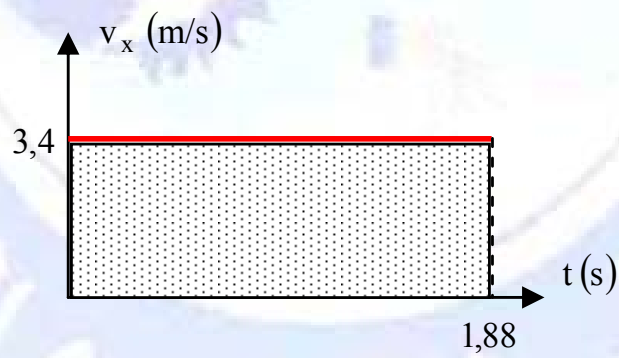
$v_y(t)$

$t = 0,94 \text{ s}$



– 6

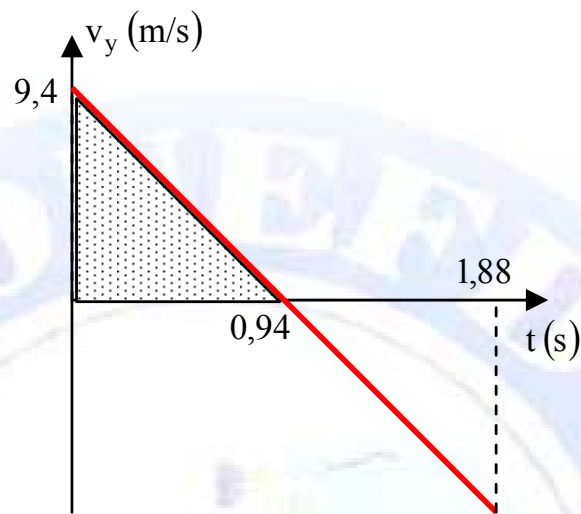
OM



$$OM = 3,4 \times 1,88 = 6,4 \text{ m}$$

:

h



$$h = \frac{1}{2} \times 9,4 \times 0,94 = 4,4 \text{ m}$$