5.-

$m = 0'5\ Kg$

$E = 6'0\ 10^{-3}\ J$ (enexia máxima)

$F_{max} = 0'3N$

A ecuacion dun movemento harmonico é:

$$y = A \operatorname{sen}(\omega t + \varphi_0)$$

(A, ω, φ_0 → ? ? ?)

$$E_{max} = \frac{1}{2} K A^2 \; ; \; E_K = \frac{1}{2} K (A^2 - y^2)$$

$$\omega^2 = \frac{K}{m}$$

$$|F_{max}| = K \cdot A \Rightarrow F = -K \cdot y$$

$$E_{max} = \frac{1}{2} K A^2 \; ; \; |\vec{F}_m| = K \cdot A$$

$$K = \frac{F_m}{A}$$

$$E_m = \frac{1}{2} \frac{F_m}{A} \cdot A^2 \Rightarrow A = \frac{2E_m}{F_m} = \frac{(2 \times 6'0\ 10^{-3} J)}{0'3N} =$$

$A = 0'04m.$

$\omega^2 = \frac{K}{m}$ $\quad F_m = KA \Rightarrow K = \frac{F_m}{A} = \frac{0'3N}{0'04m} = 7'5 \frac{N}{m}$

$$\omega^2 = \frac{F_m}{A} = \frac{0'3N}{0'04m} = \left(7'5 \frac{N}{m} / 0'5Kg\right)^{1/2} = 3'87 \frac{rad}{s}$$

VALIDANES

$$= \frac{\frac{N}{m}}{Kg} = \frac{\frac{Kg}{m\ s^2}}{Kg} = \frac{1}{s^2} \Rightarrow \left(\frac{1}{s}\right)^{1/2} = \frac{rad}{s}$$

Para determinar φ_0, para $t=0 \Rightarrow y=+A$

$y=+A \Rightarrow \operatorname{sen}(\omega t+\varphi_0)=1 \Rightarrow \operatorname{sen}\varphi_0=1 \Rightarrow$
$\hookrightarrow t=0$

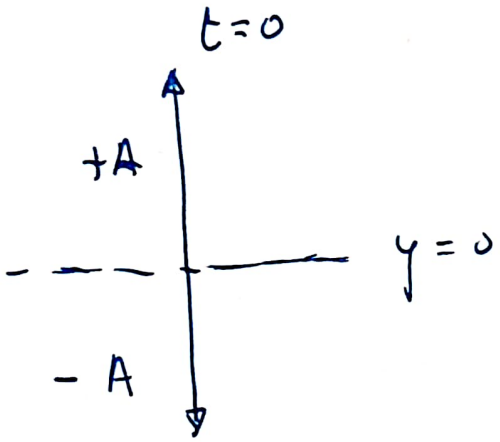
$\Rightarrow \varphi_0=\frac{\pi}{2}$

a)

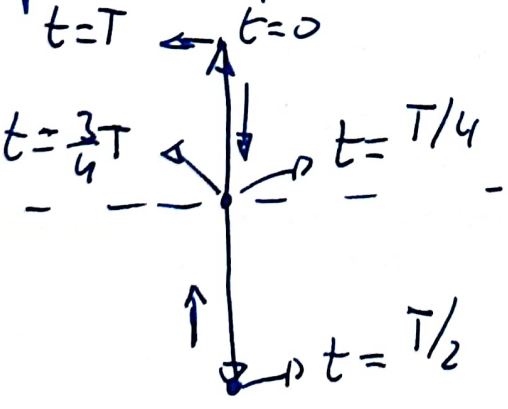
$$y=4'0\,10^{-2}\operatorname{sen}\left(3'87t+\frac{\pi}{2}\right)\ (S.I.)$$

b) E_k? e E_p para $t=\frac{T}{4}$ $\left(t=\frac{T}{4}\right)$

Movemento



o periodo é o tempo que tarda en realizar unha oscilación completa polo tanto o tempo que saindo da parte superior volve a eso punto



$E_c = \frac{1}{2} K(A^2 - y^2)$

para $t = \frac{T}{4} \Rightarrow y = 0$

$E_c = \frac{1}{2} KA^2$ a energía cinética é máxima

polo tanto $E_K = 6'0\,10^{-3}$ J

Si a energía cinética e máxima a potencial é mínima $E_p = 0 \Leftrightarrow y = 0$

Tamén o poderiamos razoar, da seguinte maneira.

$E_K = \frac{1}{2} m v^2$

$E_K = \frac{1}{2} m A^2 \omega^2 \cos(\omega t + \varphi_0)$

$E_K = \frac{1}{2} m A^2 \omega^2 \cos\left(\frac{2\pi}{T} \cdot \frac{T}{4} + \frac{\pi}{2}\right)$

$E_K = \frac{1}{2} m A^2 \omega^2 \cos\left(\frac{\pi}{2} + \frac{\pi}{2}\right)$

$\Downarrow \quad \Downarrow \pi$

$E_K = \frac{1}{2} K A^2 \cos \pi \Rightarrow E_K = \frac{1}{2} KA^2 (-1)$

?

c) $\omega^2 = \frac{K}{m} \Rightarrow 4\pi^2 f^2 = \frac{K}{m} \Rightarrow f^2 = \frac{K}{4\pi^2 m}$

$f_1^2 = \frac{K}{4\pi^2 m_1} \Rightarrow f_2^2 = \frac{K}{4\pi^2 m_2}$

$f_1^2 m_1 = f_2^2 \cdot m_2 \Rightarrow f_2^2 = f_1^2 \cdot \frac{m_1}{m_2}$; $f_2^2 = f_1^2/2$

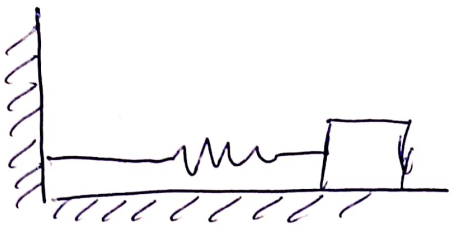
$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi}{3'87 \frac{rad}{s}} = ? \Rightarrow f_1 = \frac{3'87 rad/s}{2\pi} = 0'616\,s^{-1}$

$f_2 = \frac{0'616\,s^{-1}}{\sqrt{2}} = 0'44\,s^{-1}$

2.-

$m = 0'5\,kg$

$5\,N \Rightarrow 4\,m$; $F = 50\,N \Rightarrow x = 4\,m$



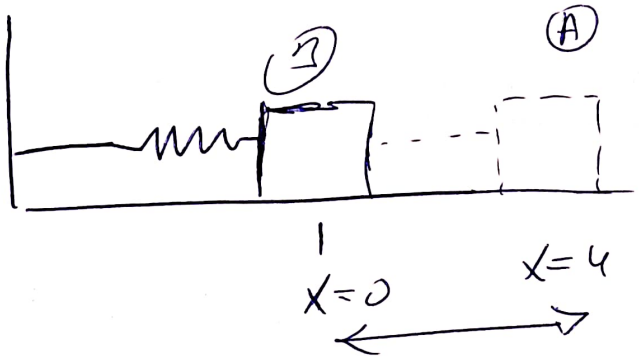
imos calcular K e ω

$$F = -Kx \Rightarrow K = \frac{F}{x} = \frac{50\,N}{0'04\,m} = 125\,\frac{N}{m}$$

$$\omega^2 = \frac{K}{m} \Rightarrow \omega = \left(\frac{125\,N/m}{0'5\,kg}\right)^{1/2} = 15'81\,\frac{rad}{s}$$

$$= \frac{\frac{N}{m}}{\frac{kg}{s^2}} = \frac{\frac{kg\,m}{s^2\,m}}{\frac{kg}{s^2}} \Rightarrow \sqrt{\ } \Rightarrow s^{-1}$$

a)



Energía (A) - Energía en B. o con otro signo

$E_A = 0$

$E_B = \frac{1}{2} K A^2$ | W = a diferencia de energías

$$E_p = \frac{1}{2} K A^2 = \frac{1}{2} 125 \frac{N}{m} (0'04m)^2 = 0'1 J$$

c)

$V = ?$

$x = A \operatorname{sen}(\omega t + \varphi_0)$

posición inicial $x = 4cm$, del apartado b)

$$v = \frac{dx}{dt} = A\omega \cos(\omega t + \varphi_0)$$

$$\cos^2(\omega t + \varphi_0) + \operatorname{sen}^2(\omega t + \varphi_0) = 1$$

$$\cos(\omega t + \varphi_0)^2 = 1 - \operatorname{sen}^2(\omega t + \varphi_0)$$

$$v = A\omega \sqrt{1 - \operatorname{sen}^2(\omega t + \varphi_0)}$$

$$v = \omega \sqrt{A^2 - A^2 \operatorname{sen}^2(\omega t + \varphi_0)}$$

$$v = \omega \sqrt{A^2 - x^2}$$

$$v = 15'81 \frac{rad}{s} \sqrt{(4 \cdot 10^{-2} m)^2 - (2 \cdot 10^{-2} m)^2} = 0'55 \frac{m}{s}$$

c)

$\omega^2 = \frac{K}{m}$; m: constante ; K: constante

o que implica $\omega^2 \Leftrightarrow \omega$ constante

$$\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi} = \frac{15'81 rad/s}{2\pi}$$

$$f = 2'52 s^{-1}$$

3.- $m = 200\,g$ $\qquad E_T = 8\,J$

MHS

$A = 40\,cm.$

$x = -40\,cm$ para $t = 0$

a) K? b) ecuación MHS c) V_{max} e a_{max}.

a) $\omega^2 = \frac{K}{m} \Rightarrow$?

$x = A \operatorname{sen}(\omega t + \varphi_0)$

$t = 0 \Rightarrow \operatorname{sen}(\omega t + \varphi_0) = -1$

$\operatorname{sen} \varphi_0 = -1 \Rightarrow \varphi_0 = \frac{3}{2}\pi$

$E_T = \frac{1}{2} K A^2 \Rightarrow K = \frac{2 E_T}{A^2}$

$K = \frac{2.8\,J}{(0'4\,m)^2} = 500\,N/m.$

$\omega^2 = \frac{K}{m} \Rightarrow \omega^2 = \frac{500\,N/m}{0'2\,kg} = 500\,\frac{rad}{s^2} \Rightarrow$

$\omega = 22'36\,\frac{rad}{s}$

$x = 0'4 \operatorname{sen}\left(22'36\,\frac{rad}{s} \cdot t + \frac{3}{2}\pi\right)$

c) v_{max} e a_{max}

$$v = \frac{dx}{dt} = A\omega \cos(\omega t + \varphi_0)$$

$$v_{max} = A\omega$$

$$a = \frac{dv}{dt} = -A\omega^2 \cos(\omega t + \varphi_0)$$

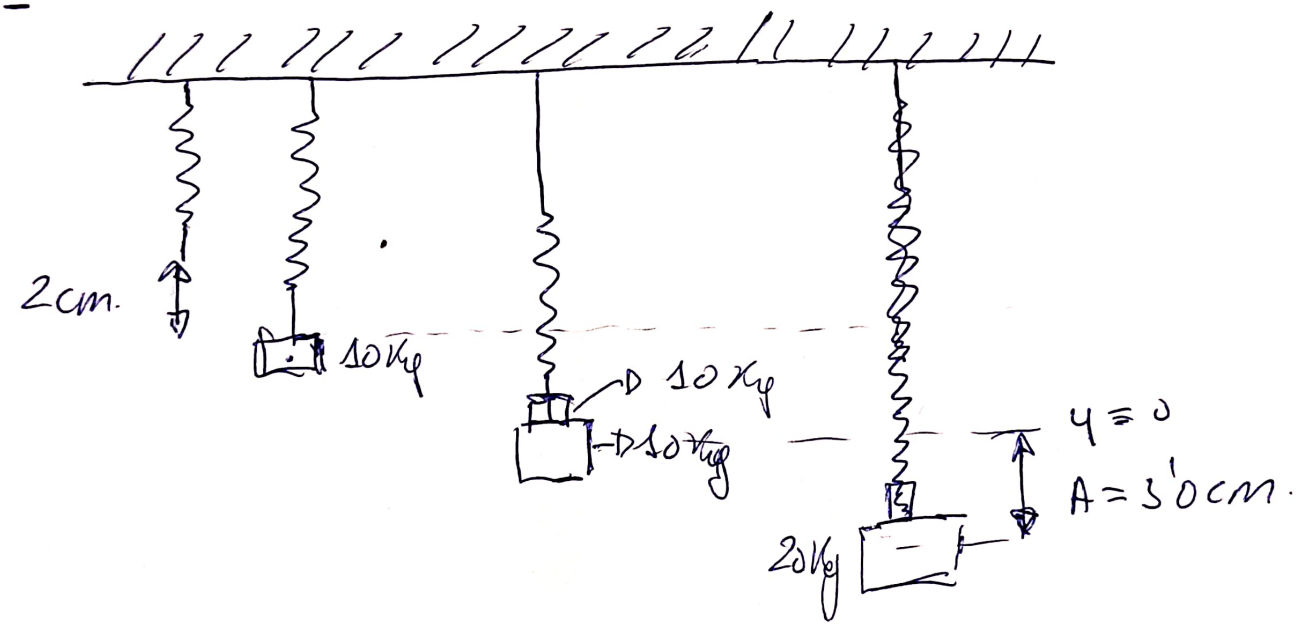
$$a_{max} = \pm A\omega^2$$

sen signo

$$v_{max} = A\omega = 0'4m \cdot 22'36 \frac{rad}{s} = 8'94 \, m/s$$

$$a_{max} = |A\omega^2| = 0'4m \cdot \left(22'36 \frac{rad}{s}\right)^2 = 200 \frac{m}{s^2}$$

4.-



a) K? b) y, v, a ? c) E_c e E_p

a) $F = -Ky \Rightarrow y = 0'2m$; $F = 10Kg \cdot 9'8 \frac{m}{s^2} =$

$F = 98N$

$\rightarrow K = \left|\frac{F}{y}\right| = \frac{98N}{0'02} = 4.900 \frac{N}{m}$

b) $\omega^2 = \frac{K}{m} \Rightarrow \omega = \sqrt{\frac{K}{m}} = \sqrt{\frac{4.900\ N/m}{20Kg}} = 15'65 \frac{rad}{s}$

para $t = 0 \Rightarrow y = -3'0\ cm.$

$y = A\ sen(\omega t + \varphi_0) \Rightarrow \varphi_0 = \frac{3\pi}{2}$

$y = 0'02\ sen\left(15'65t + \frac{3\pi}{2}\right)$ (S.I.)

$\rightarrow v = \frac{dy}{dt} = A\omega\ cos(\omega t + \varphi_0)$

$v = 0'02m \cdot 15'65 \frac{rad}{s} cos\left(15'65t + \frac{3\pi}{2}\right)$

$V = 0'47\ cos\left(15'65t + \frac{3\pi}{2}\right)$ (S.I.)

$a = \frac{dv}{dt} = -A\omega^2 sen(\omega t + \varphi_0)$

$a = -0'02m\left(15'65 \frac{rad}{s}\right)^2 sen\left(15'65t + \frac{3\pi}{2}\right)$

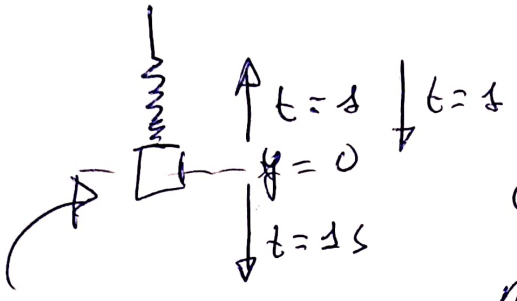
$a = -7'35\ sen\left(15'65 + \frac{3\pi}{2}\right)$

$$F = -K \cdot y = 4\,900 \frac{N}{m} \left(0'03 \operatorname{sen}\left(15'65t + \frac{3\pi}{2}\right)\right)$$

$$F = -147 \operatorname{sen}\left(15'65t - \frac{3\pi}{2}\right) \quad (S.I.)$$

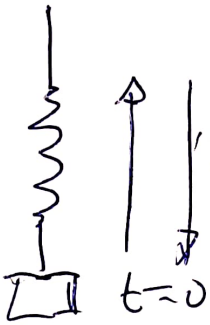
c) E_K e E_p os 2 segundos.

$$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} = \frac{2.\pi \text{ rad.}}{15'65 \frac{\text{rad}}{s}} = 0'4\,s$$



Empeza a oscilar no punto inferior

NON É VALIDO



$t = 4 \Rightarrow T = 4\,s.$

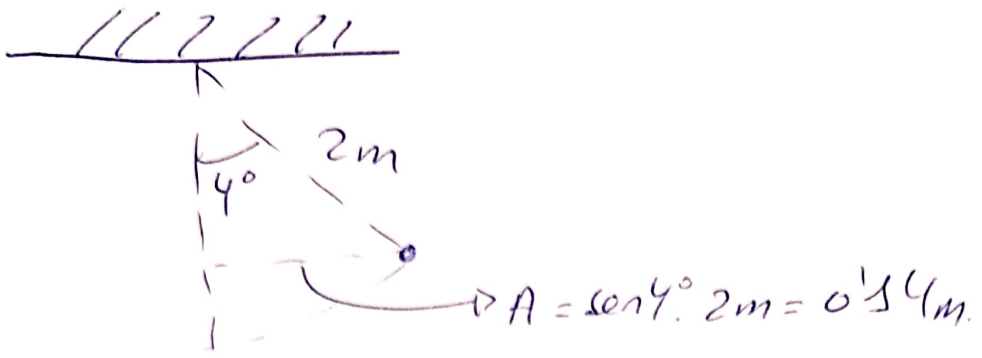
$t = 4$ está na posición superior $V = 0$

$E_K = 0$

$$E_p = E_T = \frac{1}{2} K A^2 = \frac{1}{2} 4.900 \frac{N}{m} (0'03\,m)^2$$

$$E_p = 2'21\,J$$

5.-



$$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T = 2\pi\sqrt{\frac{2m}{9'8 m/s^2}} = 2'84 s$$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{2'84 s} = 2'21 \frac{rad}{s}$$

$$x = A \operatorname{sen}(\omega t + \varphi_0)$$

$$t = 0 \quad x = A \cdot \Rightarrow \varphi_0 = \frac{\pi}{2}$$

$$x = 0'14 \operatorname{sen}\left(2'21 t + \frac{\pi}{2}\right)$$

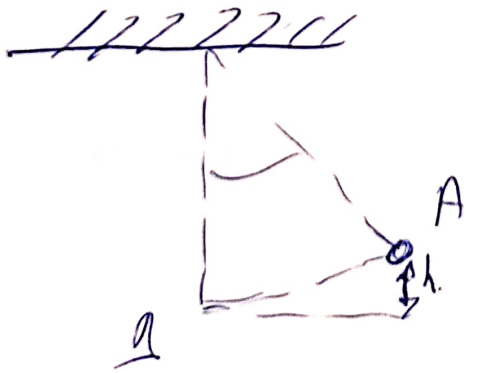
$$v = \frac{dx}{dt} = A\omega \operatorname{sen}(\omega t + \varphi_0)$$

cuando pase pola posición de equilibrio

$V \Rightarrow V_{max}$

$$V_{max} = A\omega = 0'14m \cdot 2'21 \frac{rad}{s} = 0'31 \frac{m}{s}$$

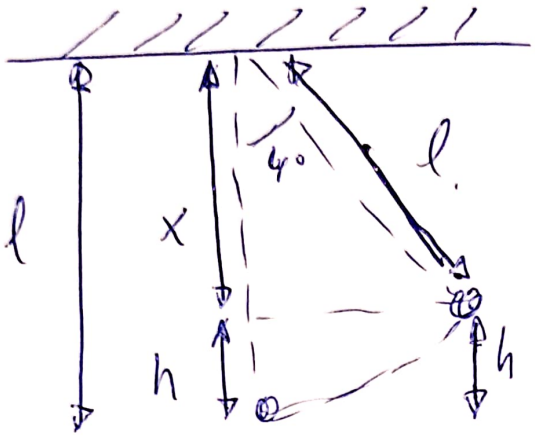
c)



Energia A = Energia B

$$mgh = \frac{1}{2} m v^2$$

h?



$$h = l - x \quad ; \quad x = l \cos 4°$$

$$h = l - l \cos 4° = l(1 - \cos 4°)$$

$$h = 2m(1 - \cos 4°) = 4'87 \cdot 10^{-2} m.$$

$$v = \sqrt{2gh} \Rightarrow v = \sqrt{2 \cdot 9'81 \frac{m}{s^2} \cdot 4'87 \cdot 10^{-2} m} = 0'31 \frac{m}{s}$$

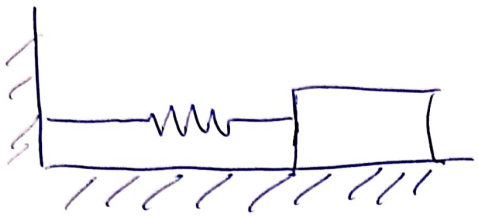
6.- $M = 0'5\ kg$

MHS

$A = 0'2\ m$.

$f = 5\ s^{-1}$

$t = 0 \quad x = A$



$$x = A \operatorname{sen}(\omega t + \varphi_0)$$

$$\varphi_0 = 0 \Rightarrow \operatorname{sen} 0° = 0.$$

$$\omega = 2\pi f \Rightarrow \omega = 10\pi \frac{rad}{s}$$

$$x = 0'2 \operatorname{sen}(10\pi t). \quad (S.I.)$$

Para $t = T/8$ Vie a?, b) Energía mecánica

$$\omega = \frac{2\pi}{T}\ ; \quad \omega t = \frac{2\pi}{T}\frac{T}{8} = \frac{\pi}{4} \ (45°)$$

$$t = \frac{T}{8} = \frac{1}{f \cdot 8} = \frac{1}{40\ s^{-1}} = 0'025\ s$$

$$\operatorname{sen}(10\pi \cdot 0'025\ s) = 0'707 \ // \ \cos(10\pi\, 0'025\ s) = 0'707$$

$\pi \downarrow 3'1416\ldots$

$$v = A\omega \cos(\omega t)$$

$$v = 0'2\ m \cdot 10\pi \frac{rad}{s} \cdot 0'707 = 4'42\ m/s$$

$$a = -A\omega^2 \operatorname{sen}(\omega t)$$

$$a = -0'2 \cdot 100\pi^2\, 0'707 = -139'6\ m/s^2$$

b) $E_m = \frac{1}{2} K A^2$

K ? ; $\omega^2 = \frac{K}{m} \Rightarrow K = \omega^2 \cdot m = \left(10 \frac{rad}{s}\right)^2 \cdot 0'5\ kg$

$K = 10\ \pi^2\ N/m \quad \left(\frac{kg}{s^2} \cdot \frac{m}{m} = \frac{N}{m}\right)$

$E_m = \frac{1}{2} 10\ \pi^2 \frac{N}{m} \cdot (0'2m)^2 = 0'2\ \pi^2 \frac{N}{m} \cdot m^2 = 1'97\ J$

c)

$\omega = 2\pi f \Rightarrow \frac{K^{1/2}}{m^{1/2}} = 2\pi f$

$f = \sqrt{\frac{K}{m}} \cdot \frac{1}{2\pi} \Rightarrow f = \sqrt{\frac{K}{4\pi^2 m}}$

$f_1 = \sqrt{\frac{K}{4\pi^2 m_1}}$

$f_2 = \sqrt{\frac{K}{4\pi^2 m_2}} \quad ; \quad m_2 = 2 m_1$

$f_2 = \sqrt{\frac{K}{4\pi^2 2 m_1}} \; ; \Rightarrow f_2 = \frac{1}{\sqrt{2}} \cdot f_1$

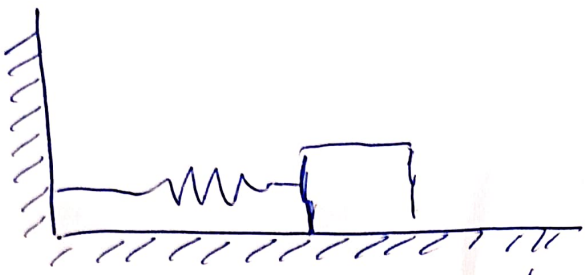
7.-

$m = 100\,g$

$A = 20\,cm. = 0'2\,m.$

$x = -20\,cm. \quad t = 0$

$E_m = 0'5\,J$



a) K? b) ecuación do movemento; c) E_c $x = 15\,cm.$

a) $E_m = \frac{1}{2} K A^2 \Rightarrow \frac{2E_m}{A^2} = K$

$K = \frac{2 \cdot 0'5\,J}{(0'2m)^2} = \frac{2.5\,10^{-1}\,J}{4\,10^{-2}\,m^2} = 25.10\,N/m.$

b) $x = A \operatorname{sen}(\omega t + \varphi_0)$

para $t = 0 \Rightarrow \operatorname{sen}\varphi_0 = -1 \Rightarrow \varphi_0 = \frac{3}{2}\pi$

$\omega^2 = \frac{K}{m} \Rightarrow \omega = \left(\frac{25\,N/m}{0'01\,kg}\right)^{1/2} = 250\,\frac{rad}{s}$

$x = 0'2 \operatorname{sen}(250t + \frac{3}{2}\pi)$

c) E para $x = 15$

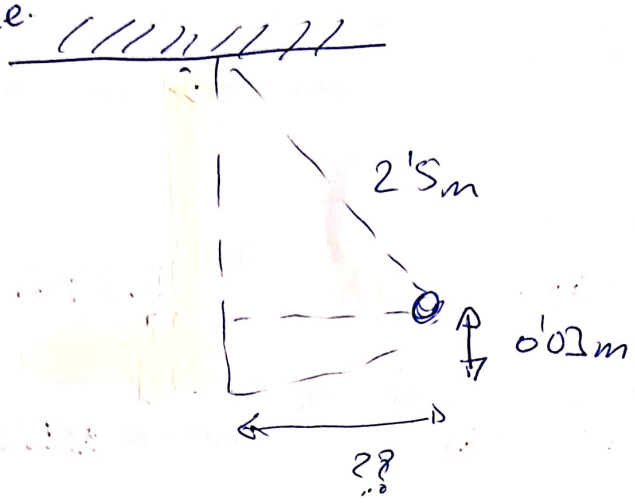
$E_k = \frac{1}{2} K \sqrt{A^2 - x^2}$

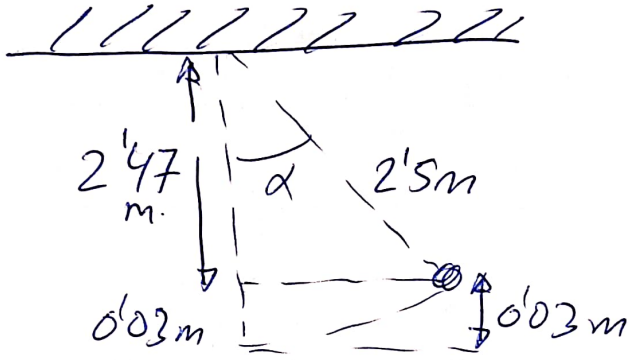
$E_k = \frac{1}{2} 25\,\frac{N}{m} \sqrt{(0'2m)^2 - (0'15m)^2} = 1'65\,J$

8.- $l = 2'5m.$ $g = 9'8 \cdot \frac{m}{s^2}$ $T = 2\pi\sqrt{\frac{l}{g}}$

$h = 0'03m.$

c) Amplitude.





$\cos\alpha = \frac{2'47m.}{2'5m} \Rightarrow \cos\alpha = 0'988$

$\arccos 0'988 = 8'89°$

$\text{sen } 8'89° = 0'154$

$\text{sen } 8'89 = \frac{x}{2'5m.} \Rightarrow x = 0'39m.$

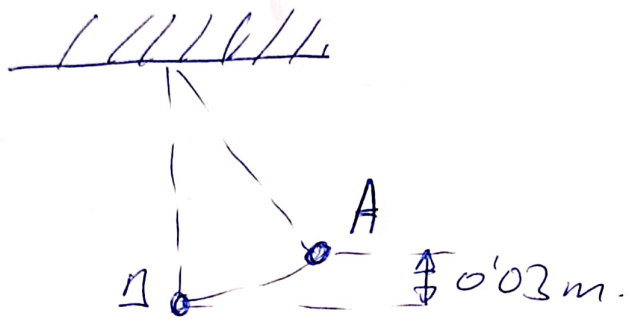
$A = 0'39m.$

b) periodo

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T = 2\pi\sqrt{\frac{2'5m}{9'8 m/s}} = 3'17 s$$

a)

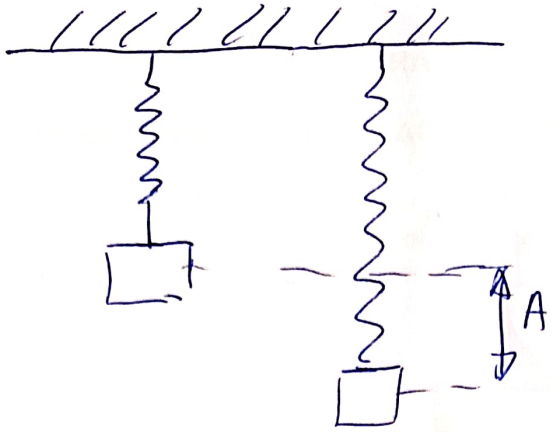


Energia A = Energia B.

$$mgh_A = \frac{1}{2}mv_B^2 \Rightarrow v_B = \sqrt{2gh}$$

$$v_B = \sqrt{2 \cdot 9'8 \frac{m}{s^2} \cdot 0'03 m} = 0'77 m/s$$

9.-



$K = 500 \frac{N}{m}$

$m = 100\,g$

$E_T = 5\,J$

a) A?

b) v_{max}, f

c) gráfica de energía

a) $E = \frac{1}{2} K A^2 \Rightarrow A = \left(\frac{2E_T}{K}\right)^{1/2} = \left(\frac{2 \cdot 5\,J}{500\,N/m}\right)^{1/2} = 0'14\,m.$

b) v_{max} ?

$y = A \cos(\omega t + \varphi_0)$

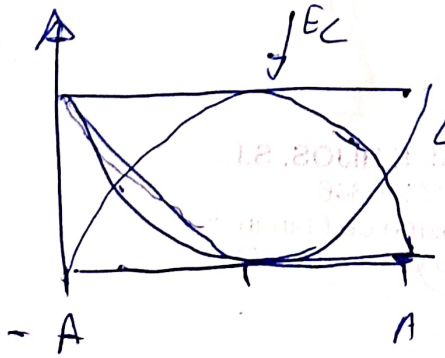
$v = \frac{dy}{dt} = A\omega \cdot \cos(\omega t + \varphi_0)$

$v_{max} = A\omega$;

$\omega^2 = \frac{K}{m} \Rightarrow \omega = \left(\frac{500\,N/m}{0'1\,kg}\right)^{1/2} = 70'71 \frac{rad}{s}$

$\Rightarrow v_{max} = 0'14\,m \cdot 70'71 \frac{rad}{s} = 9'9\,m/s$

c) Energía



10.-

$m = 5\,g$

$f = 1\,Hz$

$A = 10\,cm = 0'1\,m$

para $t=0$ $y = A/2$

a) Ecuación del movimiento

b) E_m

c) E_c máxima? e potencial

a) $\omega = 2\pi . f = 2\pi . 1\,s^{-1} = 2\pi \frac{rad}{s}$

$\text{sen}(\omega t + \varphi_0)$ si $t=0$ $\text{sen}\,\varphi_0 = \frac{1}{2}$

$\varphi = 30^\circ$

$y = 0'1\,\text{sen}\left(2\pi t + \frac{\pi}{6}\right)$ (S.I)

b) E_m ? $\quad E_m = \frac{1}{2} k A^2$

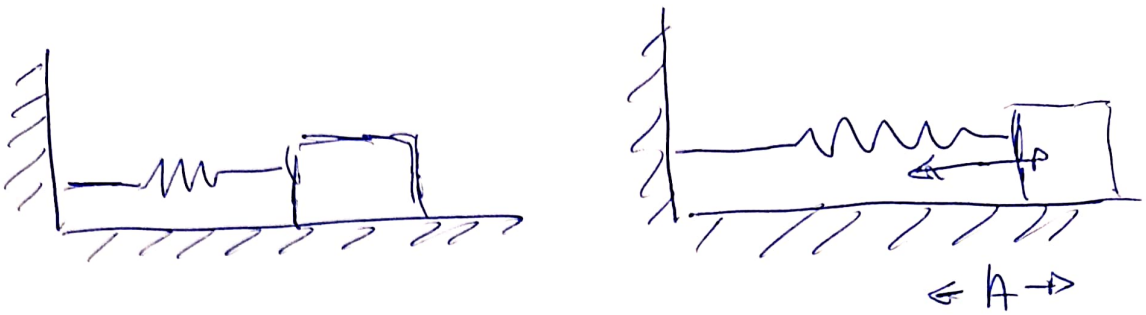
$\omega^2 = \frac{k}{m} \Rightarrow k = \omega^2 . m = \left(2\pi \frac{rad}{s}\right)^2 0'005\,kg$

$k = 0'197\,N/m$

$E_m = \frac{1}{2}\, 0'197 \frac{N}{m} . (0'1\,m)^2 = 1\,10^{-3}\,J$

c)

11.-



$A = 10\,cm.$ $\quad m = 500\,g$

$T = 2\,s$

a) v para $x = 5\,cm.$ b) aceleración para $x = 5\,cm.$

c) $E_m.$

$x = A\,\text{sen}(\omega t + \varphi_0)$

estirase e soltase, para $t = 0$, $A = +A.$

$\text{sen}(\omega t + \varphi_0) = 1 \Rightarrow \text{sen}\,\varphi_0 = 1 \Rightarrow \varphi_0 = \pi/2$

cambio en polo coseno

$x = A\,\text{sen}(\omega t + \pi)$

$x = A\cos(\omega t.$

$\omega = \frac{2\pi\,rad}{2\,s} = \pi\,\frac{rad}{s}.$

$x = 0'1\cos(\pi t).$

$v = \omega\sqrt{A^2 - x^2} \Rightarrow v = \pi\,\frac{rad}{s}\left((0'1\,m)^2 - (0'05\,m)^2\right)$

$v = \pi\,\frac{rad}{s}\left(0'01\,m^2 - 0'0025\,m^2\right)$

$v = \pi\,\frac{rad}{s}\left(7'5\cdot10^{-3}\,m^2\right)^{1/2} = 0'27\,\frac{m}{s}$

Pág 19

b) $a = -\omega^2 \cdot x$

$a = -\pi^2 \frac{rad^2}{s^2} \cdot 0'05\,m = -0'49\ \frac{m}{s^2}$

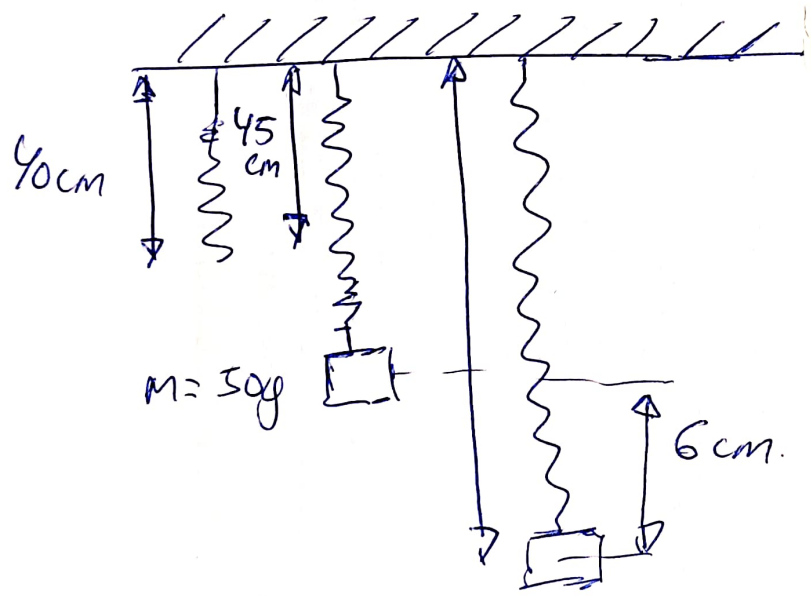
c) $E_m = \frac{1}{2} K A^2$

$\omega^2 = \frac{K}{m} \Rightarrow K = \omega^2 \cdot m = \left(\pi \frac{rad}{s}\right)^2 \cdot 0'1\,kg$

$K = 0'99\ \frac{N}{m}$

$E_m = \frac{1}{2}\, 0'99\ \frac{N}{m} \cdot (0'1\,m)^2 = 5 \cdot 10^{-3}\,J$

12.-



a) k? b) ecuación de M.H.S. c) E_p?

$F = -Kx \Rightarrow$

$k = \frac{F}{x} = \frac{0'050\,kg \cdot 9'8\,m/s^2}{0'05\,m} = 9'8\ \frac{N}{m}$

Pàx20

b)

$A = 0'06\,m.$

para $t=0 \quad y=-A$

$\operatorname{sen}(\omega t + \varphi_0) = -1 \Rightarrow \varphi_0 = \frac{3}{2}\pi$

($t=0$)

$\omega^2 = \frac{k}{m} \Rightarrow \omega = \sqrt{\frac{k}{m}} = \left(\frac{9'8\,N/m.}{0'05\,kg}\right)^{1/2} = 14\,\frac{rad}{s}$

$y = A \operatorname{sen}\left(14\,\frac{rad}{s}.t + \frac{3}{2}\pi\right)$

c)

$W = -E_p$

$W = \vec{F}.d\vec{r} : |\vec{F}|.|d\vec{y}|.\cos\theta$

($d\vec{r} \rightarrow dy$; $\theta = 0^\circ = 180$)

$W = \int |\vec{F}||d\vec{y}| \; ; \; W = \int_0^y k.y\,dy$

$W = \left[\frac{1}{2}ky^2\right]_0^y \Rightarrow W = \frac{1}{2}ky^2$

13.-

0'01 kg MHS $y = 5\cos(2t + \pi/6)$ S.I.

a) y, v, a para $t = 1\,s$

b) E_p para $y = 2\,m$

c) E_p negativo. ?

a)

$$y = 5\cos\left(2\,\frac{rad}{s}\cdot 1\,s + \frac{\pi}{6}\right) = -4'08\ m.$$

$$y = A\cos(\omega t + \varphi_0)$$

$$v = \frac{dy}{dt} = -A\omega\,\mathrm{sen}(\omega t + \varphi_0)$$

$$v = -5\,m\,2\,\frac{rad}{s}\,\mathrm{sen}\left(2\,\frac{rad}{s}\cdot 1\,s + \pi/6\right) = -5'9\,\frac{m}{s}$$

$$a = \frac{dv}{dt} = -A\omega^2\cos(\omega t + \varphi_0)$$

$$a = -5\,m\cdot\left(2\,\frac{rad}{s}\right)^2\cdot\cos\left(2\,\frac{rad}{s}\cdot 1\,s + \pi/6\right)$$

$$a = -16'3\ \frac{m}{s^2}$$

Se se considera eixe $y \to \vec{j}$ para todos resultados

b) $E_p = \frac{1}{2} k y^2$; $y = 2\,cm$; $y = 0'02\,m$.

$\omega^2 = \frac{k}{m} \Rightarrow k = \omega^2 \cdot m$.

$k = \left(2\,\frac{rad}{s}\right)^2 \cdot 0'01\,Kg = 0'04\,\frac{N}{m}$

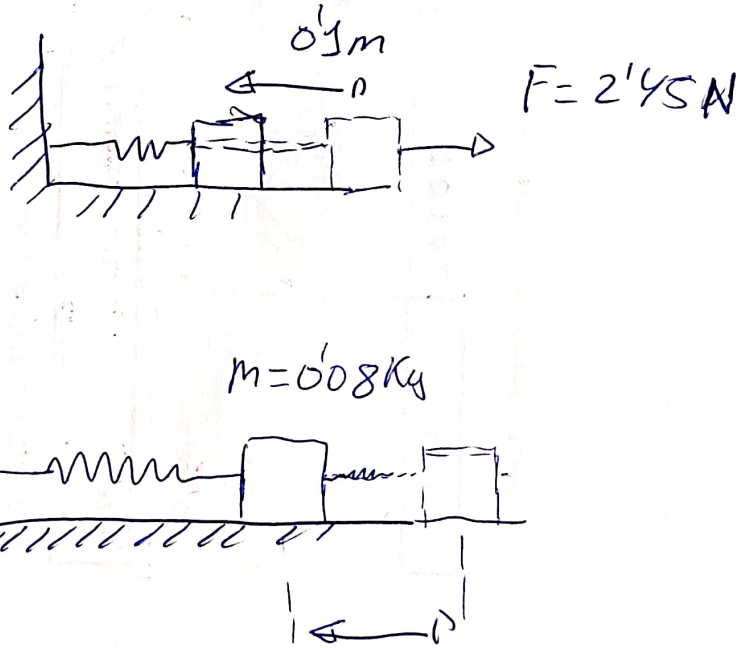
$E_p = \frac{1}{2}\, 0'04\,\frac{N}{m} \cdot (2m)^2 = 0'08\,J$

c) $E_p = \frac{1}{2} k y^2$

$\Rightarrow y^2$ sempre positiu $\Rightarrow E_p$

$\Rightarrow E_p$ sempre positiva.

14.-



$t = 0$

a) K? ; T? b) E_T, E_p, E_c $x = 0'075\,m$.

$$F = K \cdot x \Rightarrow x = \frac{F}{x} = \frac{2'45N}{0'1m} = 24'5 \frac{N}{m}$$

$$A = 0'15m.$$

$$\omega^2 = \frac{K}{m} \Rightarrow \omega^2 = \left(\frac{24'5 N/m}{0'08 Kg}\right)^{1/2} = 17'5 \frac{rad}{s}$$

$$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi rad}{17'5 \frac{rad}{s}} = 0'36s$$

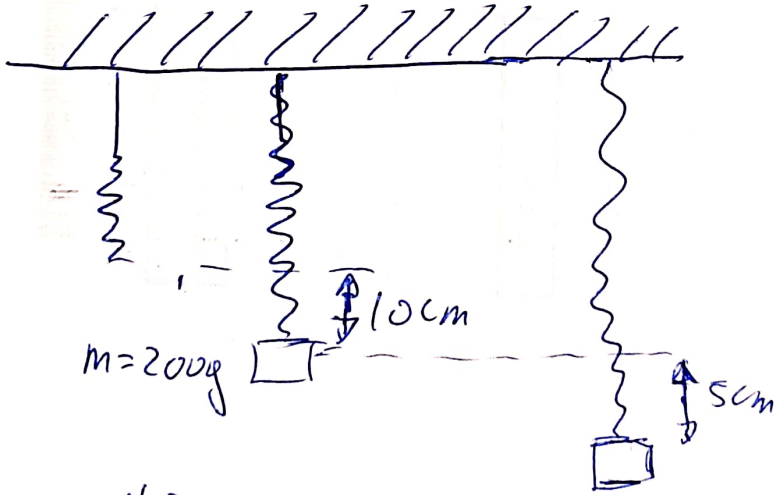
b)

$$E_T = \frac{1}{2} k A^2 = \frac{1}{2} 24'5 \frac{N}{m} \cdot (0'15m)^2 = 0'28 J$$

$$E_p = \frac{1}{2} k x^2 = \frac{1}{2} 24'5 \frac{N}{m} (0'075m)^2 = 0'069 J$$

$$E_k = 0'28 J - 0'069 J = 0'211 J$$

15.-



$g = 9'80 m/s^2$ $\quad t = 0$

a) y? b) E_c e E_p $y = 3cm$.

a)

$A = 0'05\,m$

$F = -ky \Rightarrow k = \left|-\frac{F}{y}\right| = \frac{F}{y} = \frac{0'2\,kg \cdot 9'80\,m/s^2}{0'1\,m} = 19'6\,\frac{N}{m}$

$\omega^2 = \frac{k}{m} \Rightarrow \omega = \left(\frac{19'6\,N/m}{0'2\,kg}\right)^{1/2} = \left(98\,\frac{rad}{s^2}\right)^{1/2} = 9'9\,\frac{rad}{s}$

$y = 0'05\,m\ \text{sen}\left(9'9t + \frac{3}{2}\pi\right)$

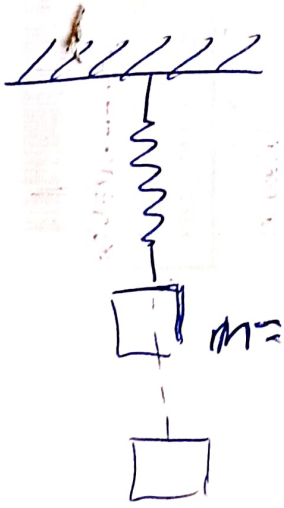
b)

$E_p = \frac{1}{2} k \cdot y^2 = \frac{1}{2}\,19'6\,\frac{N}{m} \cdot (0'03\,m)^2 = 8'82 \cdot 10^{-3}\,J$

$E_T = \frac{1}{2} k A^2 = \frac{1}{2}\,19'6\,\frac{N}{m^2}\,(0'05\,m)^2 = 0'0245\,J\ (2'45 \cdot 10^{-2}\,J)$

$\Rightarrow E_k = E_T - E_p = 0'0245 - 8'82 \cdot 10^{-3}\,J = 0'0157\,J\ (15'7 \cdot 10^{-2}\,J)$

16.-



$f = 4\,Hz$

$E_t = 1\,J$

$m = 0'5\,kg$

$E_t = \frac{1}{2} k A^2$

a) k? A? b) E_c, E_p en $y = A/4$

a) $\omega^2 = \frac{K}{m} \Rightarrow K = \omega^2 \cdot m$

$K = (2\pi f)^2 \cdot m = (2\pi \text{ rad } 4.5\text{-}1)^2 \cdot 0'1 \text{ kg} = 63'17 \frac{N}{m}$

$\frac{kg}{s^2} \cdot \frac{m}{m} = \frac{N}{m}$

$E_T = \frac{1}{2} K A^2 \Rightarrow A = \left(\frac{2E_T}{K}\right)^{1/2} = \left(\frac{2 \cdot 1 J}{63'17 N/m}\right)^{1/2} = 0'18 m.$

b)

E_c e E_p en $y = \frac{A}{4}$

$E_p = \frac{1}{2} K y^2 ; \quad E_p = \frac{1}{2} K \left(\frac{A}{4}\right)^2 = \frac{1}{2} K \frac{A^2}{16}$

$$\begin{cases} E_p = \frac{E_T}{16} \\ E_c = E_T - E_p \end{cases}$$

$E_p = \frac{1 J}{16} = 0'0625 J \; (6'25 \cdot 10^{-2} J$

$E_c = 1 - 0'0625 J = 0'9375 J$

17.- MHS

$m = 3 \cdot 10^{-3}\ kg$. $f = 0'5\ Hz$; $A = 0'05\ m$; $t = 0 \Rightarrow x = 0$

a) V e a para $t = 3\ s$ b) E_c e E_p para $t = 3\ s$

$\omega = 2\pi \cdot f = 0'2\pi\ \frac{rad}{s}$

$x = A\ sen(\omega t + \varphi_0)$ $x = 0 \Rightarrow t = 0$

$x = A\ sen\ \varphi_0 \Rightarrow sen\ \varphi_0 = 0$; $\varphi_0 = 0$

$x = A\ sen\ \omega t$

$v = A\omega\ cos\ \omega t$; $a = -A\omega^2 sen\ \omega t$

$v|_{t=3s} = 0'05m \cdot 0'2\pi\ \frac{rad}{s}\ cos\ (0'6\pi) = -0'097\ m/s$

$a)_{t=3s} = -0'05\ (0'2\pi\ \frac{rad}{s})^2 \cdot sen\ (0'6\pi) = -0'019\ m/s$

b)

$\omega^2 = \frac{K}{m} \Rightarrow K = \omega^2 \cdot m = (0'2\pi\ \frac{rad}{s})^2 \cdot 3 \cdot 10^{-3}\ kg =$

$= 1'18 \cdot 10^{-3}\ N/m$

$E_c = \frac{1}{2} m v^2$

$E_T = E_m = \frac{1}{2} K A^2$

$E_c = \frac{1}{2}\ 3 \cdot 10^{-3}\ kg\ (-0'097\ m/s)^2 = 1'41 \cdot 10^{-7}$

$E_T = \frac{1}{2}\ 1'18 \cdot 10^{-3}\ (0'05m)^2 = 1'48 \cdot 10^{-6}\ J$

$E_p = E_T - E_c = 1'33 \cdot 10^{-6}\ J$ ($1'33 \cdot 10^{-6}\ J$