

عدك لنبك المؤتمت منه للوطه المرز  
قسم الطالب لمبتدئ

B (30) B (31) D (32)

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.4} = \frac{20\pi}{4} = 5\pi \text{ rad}\cdot\text{s}^{-1}$$

الجواب (C)

قسم الطالب لمترسط

B (3) D (2)

$$\omega_0 = \sqrt{\frac{k}{m}}$$

$$\omega'_0 = \sqrt{\frac{k'}{m'}} = \sqrt{\frac{\frac{k}{2}}{\frac{m}{4}}} = \sqrt{\frac{k}{m}}$$

$$\omega'_0 = \frac{1}{2} \sqrt{\frac{k}{m}} = \frac{1}{2} \omega_0$$

الجواب (A)

A (4) B (5) C (6)

C (7) A (8) B (9)

$$T_0 = \frac{\text{زمن اهتزازات } t}{\text{عدد اهتزازات } n} = \frac{3}{12} = \frac{1}{4} \text{ s}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{\frac{1}{4}} = 8\pi = 25 \text{ rad}\cdot\text{s}^{-1}$$

الجواب (D)

C (11) C (12) A (13)

B (1) C (2) C (3)

D (4) A (5) D (6)

A (7) B (8) A (9)

D (10) B (11) D (12)

A (13)

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.5} = \frac{20\pi}{5} = 4\pi \text{ rad}\cdot\text{s}^{-1}$$

الجواب (D)

D (15) C (16) B (17)

B (18) D (19) A (20)

C (21) C (22) B (23)

D (24) B (25) A (26)

B (27) A (28) D (29)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \quad (29)$$

$$T_0' = 2\pi \sqrt{\frac{m'}{k}} = 2\pi \sqrt{\frac{2m}{k}}$$

$$T_0' = \sqrt{2} \times 2\pi \sqrt{\frac{m}{k}} = \sqrt{2} T_0$$

الجواب (A)

A (32) D (31) C (30)

A (35) B (34) C (33)

C (37) A (36)

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \text{ s} \quad (38)$$

الجواب (D)

D (41) C (40) C (39)

C (44) D (43) B (42)

D (46) A (45)

البنك المؤتمت لبحث النواس المرز  
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C (16) D (15) C (14)

$$T_0 = \frac{\text{زمن الاهتزازات}}{\text{عدد الاهتزازات}} \quad (17)$$

$$t = T_0 \times n = 4 \times 5 = 20 \text{ s}$$

الجواب (A)

$$X_0 = \frac{g}{\omega_0^2} \quad (*) \quad (18)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad.s}^{-1}$$

نوضه بـ (\*):

$$X_0 = \frac{10}{\left(\frac{\pi}{2}\right)^2} = \frac{10}{\frac{\pi^2}{4}} = 4 \text{ m}$$

الجواب (D)

$$T_0 = \frac{t}{n} \Rightarrow n = \frac{t}{T_0} = \frac{20}{4} \quad (19)$$

n = 5 هزات

الجواب (B)

C (22) C (21) A (20)

A (25) B (24) C (23)

$$E = \frac{1}{2} k X_{\text{max}}^2 \Rightarrow k = \frac{2E}{X_{\text{max}}^2} \quad (27)$$

الجواب (C)

D (26)

A (28)

$$\text{في لحظة } t=0 \text{ (6)}$$

$$X = 0.4 \cos 2\pi = -0.4 \text{ m}$$

الجواب (D)

$$A \text{ (9)} \quad B \text{ (8)}$$

$$v = \omega_0 \sqrt{X_{\max}^2 - X^2} \text{ (10)}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{1} = 2\pi \text{ rad}\cdot\text{s}^{-1}$$

$$v = 2\pi \sqrt{25 \times 10^{-4} - 9 \times 10^{-4}}$$

$$v = 2\pi \sqrt{16 \times 10^{-4}} = 2\pi \times 4 \times 10^{-2}$$

$$= 8\pi \times 10^{-2} = 25 \times 10^{-2}$$

$$= 0.25 \text{ m}\cdot\text{s}^{-1}$$

الجواب (B)

$$v = \omega_0 \sqrt{X_{\max}^2 - X^2} \text{ (11)}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad}\cdot\text{s}^{-1}$$

نقوض بـ v:

$$0.04\pi = \frac{\pi}{2} \sqrt{100 \times 10^{-4} - X^2}$$

$$8 \times 10^{-2} = \sqrt{100 \times 10^{-4} - X^2}$$

$$64 \times 10^{-4} = 100 \times 10^{-4} - X^2$$

$$X^2 = 100 \times 10^{-4} - 64 \times 10^{-4} = 36 \times 10^{-4}$$

$$X = 6 \times 10^{-2} \text{ m} = 6 \text{ cm} \text{ (جواب (C))}$$

قسم الطالب الجيد

$$a = -\omega_0^2 X \text{ (*) (7)}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{2} = \pi \text{ rad}\cdot\text{s}^{-1}$$

نقوض بـ (\*)

$$a = -(\pi)^2 (5 \times 10^{-2})$$

$$= -10 \times 5 \times 10^{-2} = -0.5 \text{ m}\cdot\text{s}^{-2}$$

الجواب (A)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \Rightarrow 0.5 = 2\pi \sqrt{\frac{m}{40}} \text{ (2)}$$

نربع الطرفين:

$$0.25 = 40 \frac{m}{40} \Rightarrow m = 0.25 \text{ kg}$$

الجواب (D)

$$F = |-kX| = |-16 \times 2 \times 10^{-2}| \text{ (3)}$$

$$= 0.32 \text{ N}$$

الجواب (B)

$$C \text{ (4)}$$

$$v_{\max} = |\mp \omega_0 X_{\max}| = \frac{2\pi}{T_0} \times X_{\max} \text{ (5)}$$

$$= \frac{2\pi}{1} \times 8 \times 10^{-2} = 16\pi \times 10^{-2}$$

$$= 50 \times 10^{-2} = 0.5 \text{ m}\cdot\text{s}^{-1}$$

الجواب (D)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{0.4}{10}} \text{ (6)}$$

$$= 2\pi \times \frac{2}{10} = 0.4\pi = 1.25 \text{ s}$$

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$$T_0 = 2\pi \sqrt{\frac{m}{k}} \quad (15)$$

$$4 = 2\pi \sqrt{\frac{m}{1.25}} \quad \text{ترتيب الطرفين}$$

$$16 = 40 \frac{m}{1.25} \Rightarrow m = \frac{16 \times 1.25}{40}$$

$$m = 0.5 \text{ kg} \quad \text{الجواب (D)}$$

$$E_k = E - E_p \quad (*) \quad (16)$$

$$E = \frac{1}{2} k X_{\max}^2 = \frac{1}{2} (4) (16 \times 10^{-2})^2$$

$$= 2 \times 256 \times 10^{-4} = 512 \times 10^{-4} \text{ J}$$

$$E_p = \frac{1}{2} k X^2 = \frac{1}{2} (4) (12 \times 10^{-2})^2$$

$$= 2 \times 144 \times 10^{-4} = 288 \times 10^{-4} \text{ J}$$

نقوضه بـ (\*)

$$E_k = 512 \times 10^{-4} - 288 \times 10^{-4}$$

$$= 224 \times 10^{-4} = 2.24 \times 10^{-2} \text{ J}$$

الجواب (C)

$$a = -\omega_0^2 x \quad (*) \quad (17)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{1} = 2\pi \text{ rad}\cdot\text{s}^{-1}$$

نقوضه بـ (\*):

$$a = -(2\pi)^2 x - 0.5 \times 10^{-2}$$

$$= +40 \times 0.5 \times 10^{-2} = 0.2 \text{ m}\cdot\text{s}^{-2}$$

الجواب (D)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \quad (12)$$

$$0.8 = 2\pi \sqrt{\frac{0.4}{k}} \quad \text{ترتيب الطرفين}$$

$$0.64 = 40 \frac{0.4}{k} \Rightarrow$$

$$k = \frac{40 \times 0.4}{0.64} = \frac{16}{64 \times 10^{-2}} = \frac{1600}{64}$$

$$k = 25 \text{ N}\cdot\text{m}^{-1} \quad \text{الجواب (B)}$$

$$E = \frac{1}{2} k X_{\max}^2 \Rightarrow \quad (13)$$

$$k = \frac{2E}{X_{\max}^2} = \frac{2 \times 0.105}{(10 \times 10^{-2})^2} = \frac{0.1}{0.01}$$

$$k = 10 \text{ N}\cdot\text{m}^{-1} \quad \text{الجواب (C)}$$

$$x = 0.12 \cos\left(2\pi t + \frac{\pi}{3}\right) \quad (14)$$

منه ليعارنه نلاحظ انه:

$$\omega_0 = 2\pi \text{ rad}\cdot\text{s}^{-1} \Rightarrow T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi}$$

$$T_0 = 1 \text{ s} \Rightarrow t = \frac{T_0}{12} = \frac{1}{12} \text{ s}$$

نقوضه بـ x:

$$x = 0.12 \cos\left(2\pi \times \frac{1}{12} + \frac{\pi}{3}\right)$$

$$= 0.12 \cos\left(\frac{\pi}{6} + \frac{\pi}{3}\right) = 0.12 \cos\frac{\pi}{2}$$

$$= 0 \text{ m}$$

أب الجسم في مركز الاقتران

الجواب (A)

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$$X_0 = \frac{mg}{k} = \frac{160 \times 10^{-3} \times 10}{10} \quad (23)$$

$$= 0.16 \text{ m}$$

الجواب (D)

C (25)

$$\Leftrightarrow t=0 \quad \text{لحظة بدء الحركة} \quad (26)$$

$$X = 0.14 \cos 20 = +0.14 \text{ m}$$

الجواب (A)

D (29)    C (28)    C (27)

D (30)

$$F = -kx \quad (31)$$

$$F' = -kx' = -k(3x)$$

$$F' = 3 \cdot (-kx) = 3F$$

الجواب (C)

$$E_k = \frac{1}{2} m v^2 \quad (32)$$

$$E'_k = \frac{1}{2} m v'^2 = \frac{1}{2} m (2v)^2$$

$$= 4 \times \frac{1}{2} m v^2$$

$$E'_k = 4 E_k$$

الجواب (B)

(18) طول العنق المستقيم القوي هو 6 سم  
عظام الجسم العنق طول نصفه 3 سم

$$2 X_{\text{max}} = 2 \times 6 = 12 \text{ cm}$$

الجواب (B)

(19) عند  $X_{\text{max}}$  وقت  $-X_{\text{max}}$  يستغرقه

الجسم لعنق زمنية قدره  $(\frac{1}{2} T_0)$

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{10} = \frac{\pi}{5} \text{ s}$$

$$\Rightarrow \frac{1}{2} T_0 = \frac{\frac{\pi}{5}}{2} = \frac{\pi}{10} = 0.1 \pi \text{ s}$$

الجواب (A)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \Rightarrow 4 = 2\pi \sqrt{\frac{m}{1}} \quad (20)$$

نربع الطرفين:

$$16 = 4\pi^2 \frac{m}{1} \Rightarrow m = \frac{16}{4\pi^2} = 0.4 \text{ kg}$$

الجواب (C)

D (21)

$$F = -kx = -10 \times 2 \times 10^{-2} \quad (22)$$

$$= -0.2 \text{ N} \quad \text{الجواب (A)}$$

(24) عند  $X_{\text{max}}$  وقت  $+X_{\text{max}}$  يستغرقه

الجسم زمنية قدره  $(\frac{1}{2} T_0)$

$$\frac{1}{2} T_0 = 10 \Rightarrow T_0 = 20 \text{ s}$$

الجواب (A)

ب/ قسم الطالب المتفوق

1) من تابع سرعة:  $\omega_0 = 2\pi \text{ rad.s}^{-1}$

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1 \text{ s}$$

$$\Rightarrow t = \frac{3T_0}{4} = \frac{3}{4} \text{ s}$$

$$\Rightarrow v = -0.2 \sin\left(2\pi \times \frac{3}{4} + \frac{\pi}{2}\right)$$

$$= -0.2 \sin 2\pi = 0 \text{ m.s}^{-1} \quad \text{الجواب (A)}$$

$$E_t = E_k + E_p = \frac{1}{4} E_p + E_p \quad (2)$$

$$E_t = \frac{5}{4} E_p$$

$$\frac{1}{2} k X_{\text{max}}^2 = \frac{5}{4} \times \frac{1}{2} k X^2 \Rightarrow$$

$$X^2 = \frac{4}{5} X_{\text{max}}^2 \Rightarrow X = \pm \frac{2}{\sqrt{5}} X_{\text{max}} \quad \text{الجواب (B)}$$

$$0.3 = 0.6 \cos\left(2\pi t + \frac{\pi}{6}\right) \quad (3)$$

$$\Rightarrow \cos\left(2\pi t + \frac{\pi}{6}\right) = \frac{1}{2}$$

$$\Rightarrow 2\pi t + \frac{\pi}{6} = \frac{\pi}{3} \Rightarrow 2\pi t = \frac{\pi}{6}$$

$$\Rightarrow t = \frac{1}{12} \text{ s} \quad \text{(الجواب D)}$$

C (4)

$$t = \frac{1}{6} + \frac{k}{2} \Rightarrow \frac{2}{3} = \frac{1}{6} + \frac{k}{2} \quad (5)$$

$$\frac{k}{2} = \frac{2}{3} - \frac{1}{6} = \frac{3}{6} \Rightarrow k = \frac{6}{6} = 1$$

(B) لحظة المرر الثاني

D (34) C (33)

$$\bar{X} = X_{\text{max}} \cos(\omega_0 t + \bar{\varphi}) \quad (35)$$

نبحث عند شواحي الحركه:

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{1} = 2\pi \text{ rad.s}^{-1}$$

$$X_{\text{max}} = 12 \times 10^{-2} = 0.12 \text{ m}$$

نبحث  $\bar{\varphi}$  من شرط البدء:

$$\left. \begin{array}{l} t=0 \\ \bar{X} = \frac{X_{\text{max}}}{2} \end{array} \right\} \Rightarrow \bar{X} = X_{\text{max}} \cos(\omega_0 t + \bar{\varphi})$$

$$\frac{X_{\text{max}}}{2} = X_{\text{max}} \cos \bar{\varphi}$$

$$\cos \bar{\varphi} = \frac{1}{2} \Rightarrow \bar{\varphi} = \pm \frac{\pi}{3} \text{ rad}$$

نبحث، لكل لذيذ، جعل سرعة سالبه لحظه البدء الحركه

$$v = -\omega_0 X_{\text{max}} \sin(\omega_0 t + \bar{\varphi})$$

$$\varphi = +\frac{\pi}{3} \Rightarrow v = -\omega_0 X_{\text{max}} \sin \frac{\pi}{3} < 0$$

الكل مقبول

$$\varphi = -\frac{\pi}{3} \Rightarrow v = -\omega_0 X_{\text{max}} \sin\left(-\frac{\pi}{3}\right)$$

$$v = +\omega_0 X_{\text{max}} \sin \frac{\pi}{3} > 0$$

الكل مرفوضه

$$\Rightarrow \bar{X} = 0.12 \cos\left(2\pi t + \frac{\pi}{3}\right) \quad (36)$$

الجواب (A)

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$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \text{ s}$$

منها يكون إظهار أن الخطيب موجب

$$0.12 = 0.12 \cos(\pi t - \frac{\pi}{3}) \Rightarrow$$

$$\cos(\pi t - \frac{\pi}{3}) = 1 \Rightarrow$$

$$\pi t - \frac{\pi}{3} = 0 \Rightarrow \pi t = \frac{\pi}{3} \Rightarrow$$

$$t = \frac{1}{3} \text{ s} \Rightarrow t = \frac{T_0}{6} \quad (10)$$

$$\bar{x} = X_{\max} \cos(\omega_0 t + \bar{\varphi}) \quad (9)$$

نبت عند تساوي:

$$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{20}{2}} = \pi \text{ rad.s}^{-1}$$

$$\left. \begin{matrix} t=0 \\ v=0 \end{matrix} \right\} \Rightarrow x = X_{\max} = 0.32 \text{ m}$$

$$\left. \begin{matrix} t=0 \\ x = X_{\max} \end{matrix} \right\} \Rightarrow \begin{matrix} \bar{x} = X_{\max} \cos(\omega_0 t + \bar{\varphi}) \\ X_{\max} = X_{\max} \cos \bar{\varphi} \end{matrix}$$

$$\cos \bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0 \text{ rad}$$

$$\bar{x} = 0.32 \cos \pi t \quad (11)$$

الجواب (c)

$$E_p = E_t - E_k = 3E_k - E_k \quad (10)$$

$$E_p = 2E_k \Rightarrow E_k = \frac{1}{2} E_p$$

$$E_t = E_p + E_k = E_p + \frac{1}{2} E_p$$

$$E_t = \frac{3}{2} E_p \Rightarrow$$

$$E = \frac{1}{2} k X_{\max}^2 \quad (10)$$

$$0.5 = \frac{1}{2} k (0.1 \text{ m})^2$$

$$1 = k \times 0.1 \Rightarrow k = \frac{1}{0.1} = 10 \text{ N.m}^{-1}$$

$$T_0 = 2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{0.16}{10}}$$

$$T_0 = 2 \times \frac{4}{10} = 0.8 \text{ s} \quad (c)$$

منه  $X_{\max}$  + منه  $X_{\max}$  - سبقت الجرم  
الصواب زمن هو  $(\frac{1}{2} T_0)$

$$\frac{1}{2} T_0 = 2 \Rightarrow T_0 = 4 \text{ s}$$

منه  $X_{\max}$  + منه  $X_{\max}$  - يقع الجرم لصلب  
مساوية  $2X_{\max}$  أي:

$$2X_{\max} = 16 \Rightarrow X_{\max} = 8 \times 10^{-2} \text{ m}$$

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \Rightarrow 4 = 2\pi \sqrt{\frac{0.5}{k}}$$

ربع الطرفين:

$$16 = 40 \frac{0.5}{k} \Rightarrow k = \frac{40 \times 0.5}{16} = \frac{20}{16}$$

$$k = 1.25 \text{ N.m}^{-1}$$

$$E_k = E_t - E_p = \frac{1}{2} k (X_{\max}^2 - \bar{x}^2)$$

$$= \frac{1}{2} k (X_{\max}^2 - \frac{X_{\max}^2}{25})$$

$$= \frac{1}{2} k (\frac{24}{25} X_{\max}^2) = \frac{12}{25} k X_{\max}^2$$

$$= \frac{12}{25} (1.25) (64 \times 10^{-4})$$

$$= 38.4 \times 10^{-4} \text{ J}$$

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$$\begin{aligned}
 E_k &= E_t - E_p \quad (15) \\
 &= \frac{1}{2} k X_{max}^2 - \frac{1}{2} k X^2 \\
 &= \frac{1}{2} k \left( X_{max}^2 - \frac{X^2}{3} \right) \\
 &= \frac{1}{2} k \left( \frac{2}{3} X_{max}^2 \right) \\
 &= \frac{1}{3} k X_{max}^2 = \frac{2}{3} \times \frac{1}{2} k X_{max}^2
 \end{aligned}$$

$$E_k = \frac{2}{3} E_t \quad (D)$$

$$v = -\omega_0 X_{max} \sin(\omega_0 t + \bar{\varphi}) \quad (16)$$

نثبت عند التوقيت:

$$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{20}{2}} = \pi \text{ rad.s}^{-1}$$

$$\left. \begin{aligned} t=0 \\ v=0 \end{aligned} \right\} \Rightarrow X = X_{max} = 8 \times 10^{-2} \text{ m}$$

$$\left. \begin{aligned} t=0 \\ X = X_{max} \end{aligned} \right\} \Rightarrow \begin{aligned} \bar{x} &= X_{max} \cos(\omega_0 t + \bar{\varphi}) \\ X_{max} &= X_{max} \cos \bar{\varphi} \end{aligned}$$

$$\cos \bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0 \text{ rad}$$

$$v = -\pi \times 8 \times 10^{-2} \sin(\pi t)$$

$$v = -0.25 \sin \pi t$$

لأنه لحظة المرور بوضع التوازن تكونه سرعة عكس بالتاليه:

$$\sin \pi t = -1 \Rightarrow \pi t = \frac{3\pi}{2} + \pi k$$

$$\Rightarrow t = \frac{3}{2} + k$$

ولحظة المرور الثانيه تكونه k=1

$$\begin{aligned}
 \frac{1}{2} k X^2 &= \frac{3}{2} \times \frac{1}{2} k X_{max}^2 \\
 X^2 &= \frac{3}{1} X_{max}^2 \Rightarrow X = \sqrt{3} X_{max}
 \end{aligned}$$

الجواب (D)

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \text{ s} \quad (11)$$

$$\Rightarrow t = \frac{5T_0}{4} = \frac{5}{4} \text{ s} \Rightarrow$$

$$v = -0.12 \sin 2\pi \times \frac{5}{4}$$

$$= -0.12 \sin \frac{5\pi}{2} = -0.12 \text{ m/s}$$

$$v = -v_{max} \quad (C)$$

$$a = -\omega_0^2 X_{max} \cos \omega_0 t \quad (12)$$

$$= -\omega_0^2 X_{max} \cos \left( \frac{2\pi}{T_0} \times \frac{3T_0}{4} \right)$$

$$= -\omega_0^2 X_{max} \cos \frac{3\pi}{2} = 0 \text{ m/s}^2$$

الجواب (A)

$$E_p = \frac{1}{2} k X^2 = \frac{1}{2} k \frac{X_{max}^2}{9} \quad (13)$$

$$= \frac{1}{9} \times \frac{1}{2} k X_{max}^2 = \frac{1}{9} E_t \quad (B)$$

$$E_t = E_p + E_k \quad (14)$$

لأنه عندنا:  $E_k = E_p$

$$E_t = 2E_p \Rightarrow \frac{1}{2} k X^2 = 2 \times \frac{1}{2} k X_{max}^2$$

$$X^2 = \frac{X_{max}^2}{2} \Rightarrow X = \frac{X_{max}}{\sqrt{2}}$$

(D)

منه، شكلا، لا حظ أن: (19)

$$\frac{1}{4} T_0 = 1 \Rightarrow T_0 = 4 \text{ s} \Rightarrow$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad.s}^{-1}$$

$$v_{\text{max}} = +\omega_0 X_{\text{max}} = +0.8\pi$$

$$\frac{\pi}{2} X_{\text{max}} = 0.8\pi \Rightarrow X_{\text{max}} = 1.6 \text{ m}$$

$$\left. \begin{array}{l} t=0 \\ v = -0.8\pi \end{array} \right\} \Rightarrow \begin{array}{l} v = -\omega_0 X_{\text{max}} \sin(\omega_0 t + \varphi) \\ -0.8\pi = -0.8\pi \sin \varphi \end{array}$$

$$\sin \varphi = 1 \Rightarrow \varphi = \frac{\pi}{2} \text{ rad}$$

$$v = -0.8\pi \sin\left(\frac{\pi}{2} t + \frac{\pi}{2}\right) \quad (c)$$

$$a = -\omega_0^2 X_{\text{max}} \cos \omega_0 t \quad (20)$$

$$-\sqrt{\frac{3}{2}} a_{\text{max}} = -a_{\text{max}} \cos \omega_0 t$$

$$\cos \omega_0 t = \sqrt{\frac{3}{2}} \Rightarrow \omega_0 t = \frac{\pi}{6}$$

$$\frac{2\pi}{T_0} \times t = \frac{\pi}{6} \Rightarrow t = \frac{T_0}{12} \text{ s} \quad (A)$$

منه، شكلا، (21)

$$\frac{3}{4} T_0 = \frac{3}{2} \Rightarrow T_0 = 2 \text{ s}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{2} = \pi \text{ rad.s}^{-1}$$

$$a_{\text{max}} = +\omega_0^2 X_{\text{max}} = +0.4$$

$$+10 X_{\text{max}} = 0.4 \Rightarrow X_{\text{max}} = 0.04 \text{ m}$$

$$\Rightarrow t = \frac{1}{2} + 1 = \frac{3}{2} \text{ s} \Rightarrow$$

$$v = -0.25 \sin \frac{3\pi}{2} = +0.25 \text{ m.s}^{-1}$$

$$v = +v_{\text{max}} \quad (B)$$

عند المرور بوضع التوازن (17)

$$\cos 2\pi t = 0 \Rightarrow 2\pi t = \frac{\pi}{2} + \pi k$$

$$2t = \frac{1}{2} + k \Rightarrow t = \frac{1}{4} + \frac{k}{2}$$

ر لحظة، المرور بوضع التوازن  $\Leftrightarrow k=0$

$$t = \frac{1}{4} \text{ s}$$

$$v = -\omega_0 X_{\text{max}} \sin(\omega_0 t + \varphi)$$

$$v = -2\pi \times 0.1 \sin(2\pi t)$$

$$v = -0.2\pi \sin 2\pi t$$

$$= -0.2\pi \sin \frac{2\pi}{4} = -0.2\pi \sin \frac{\pi}{2}$$

$$= -0.2\pi \text{ m.s}^{-1} \quad (A)$$

منه، شكلا، لا حظ أن: (18)

$$X_{\text{max}} = 0.8 \text{ m}$$

$$\frac{1}{2} T_0 = 1 \Rightarrow T_0 = 2 \text{ s} \Rightarrow$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{2} = \pi \text{ rad.s}^{-1}$$

$$\left. \begin{array}{l} t=0 \\ x = +X_{\text{max}} \end{array} \right\} \Rightarrow \begin{array}{l} \bar{x} = X_{\text{max}} \cos(\omega_0 t + \varphi) \\ X_{\text{max}} = X_{\text{max}} \cos \varphi \end{array}$$

$$\cos \varphi = 1 \Rightarrow \varphi = 0 \text{ rad} \Rightarrow$$

$$\bar{x} = 0.8 \cos \pi t \quad (c)$$



المزاج (c)  $\Rightarrow t = \frac{7T_0}{12} s$

عند مرور الجسم لعبق بوضع التوازن  $x=0$   $\Rightarrow \cos 5\pi t = 0 \Rightarrow 5\pi t = \frac{\pi}{2} + \pi k$

$5t = \frac{1}{2} + k \Rightarrow t = \frac{1}{10} + \frac{k}{5}$

دقيقة مرور اشارة  $k=0$   $t = \frac{1}{10} = 0.1 s \in$  ابواب (A)

منه  $\frac{1}{2} T_0 = 1.5 \Rightarrow T_0 = 3s \Rightarrow$

$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{3} \text{ rad.s}^{-1}$

$t=0 \Rightarrow v = -\omega_0 X_{max} \sin(\omega_0 t + \bar{\varphi})$   
 $v=0 \Rightarrow 0 = -\omega_0 X_{max} \sin \bar{\varphi}$   
 لكن  $X_{max} \neq 0$   $\omega_0 \neq 0$

$\sin \bar{\varphi} = 0 \Rightarrow \bar{\varphi} = 0 \text{ rad}$

ننتا، كل الذي يجعل سرعة البتة صفر  
 سرعة  $\frac{T_0}{4}$  أي  $(\frac{3}{4} s)$

$\bar{\varphi} = 0 \Rightarrow v = -\omega_0 X_{max} \sin(\frac{2\pi}{3} \times \frac{3}{4} + 0)$

$v = -\omega_0 X_{max} \sin \frac{\pi}{2} < 0$  مك مقبول

$v = -\omega_0 X_{max} \sin(\frac{2\pi}{3} \times \frac{3}{4} + \pi)$

$= -\omega_0 X_{max} \sin \frac{3\pi}{2} > 0$

$v = -0.4\pi \sin(\frac{2\pi}{3} t)$  (c)

$\omega_0 = \pi \text{ rad.s}^{-1}$  (27)  
 $X_{max} = 4 \times 10^{-2} m$

$t=0 \Rightarrow \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi})$   
 $x = -X_{max} \Rightarrow -X_{max} = X_{max} \cos \bar{\varphi}$

$\cos \bar{\varphi} = -1 \Rightarrow \bar{\varphi} = \pi \text{ rad}$

$\Rightarrow \bar{x} = 4 \times 10^{-2} \cos(\pi t + \pi)$  (D)

$\bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi})$  (28)

$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.04}} = \sqrt{\frac{1000}{4}} = \sqrt{250}$   
 $= 5\pi \text{ rad.s}^{-1}$

$t=0 \Rightarrow \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi})$   
 $x = X_{max} \Rightarrow X_{max} = X_{max} \cos \bar{\varphi}$

$\cos \bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0 \text{ rad}$

$\bar{x} = X_{max} \cos 5\pi t$

$t = 2s \Rightarrow \bar{x} = X_{max} \cos 10\pi = + X_{max}$

(A) في الحظ انك عرفت المزاج

$\omega_0 = 2\pi \text{ rad.s}^{-1} \Rightarrow T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi}$  (29)

$T_0 = 1s$

عند مرور بوضع التوازن  $x=0$

$\cos(2\pi t + \frac{\pi}{3}) = 0 \Rightarrow 2\pi t + \frac{\pi}{3} = \frac{\pi}{2} + \pi k$

$2t = \frac{1}{6} + k \Rightarrow t = \frac{1}{12} + \frac{k}{2}$

لحظة مرور الثاني  $k=1$   $t = \frac{1}{12} + \frac{1}{2} = \frac{7}{12} s$

12

$$\left. \begin{array}{l} t=0 \\ x=x_{max} \end{array} \right\} \Rightarrow \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi})$$

$$X_{max} = X_{max} \cos \bar{\varphi}$$

$$\cos \bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0 \text{ rad}$$

$$x_1 = X_{max} \cos 2\pi t$$

$$t = 0.5 \text{ s} \Rightarrow x_1 = X_{max} \underbrace{\cos \pi}_{-1}$$

$$x_1 = -X_{max}$$

$$x_2 = X_{max} \cos(\omega_2 t + \bar{\varphi}_2)$$

$$\omega_2 = \sqrt{\frac{k_2}{m_2}} = \sqrt{\frac{36}{0.1}} = \sqrt{360}$$

$$= 6\pi \text{ rad}\cdot\text{s}^{-1}$$

ثم حساب  $\bar{\varphi}$  سابقاً

$$x_2 = X_{max} \cos 6\pi t$$

$$t = 0.5 \text{ s} \Rightarrow x_2 = X_{max} \underbrace{\cos 3\pi}_{-1}$$

$$x_2 = -X_{max}$$

$$-X_{max} \text{ أي أنه لي صفاً في موضع } -X_{max} \quad (D)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4\pi} = \frac{1}{2} \text{ rad}\cdot\text{s}^{-1} \quad (36)$$

$$2X_{max} = 12 \Rightarrow X_{max} = 6 \times 10^{-2} \text{ m}$$

$$v_{max} = |\dot{x}| = \omega_0 X_{max}$$

$$= \frac{1}{2} \times 6 \times 10^{-2} = 0.03 \text{ m}\cdot\text{s}^{-1}$$

$$v_{max} = 0.03 = 0.5 X_{max} = 0.06 \omega_0$$

البراب (D)

32

$$E = \frac{1}{2} k X_{max}^2$$

$$\frac{1}{2} = \frac{1}{2} (10) X_{max}^2 \Rightarrow X_{max}^2 = \frac{1}{10} = 0.1$$

$$X_{max} = \frac{1}{\pi} = \frac{\pi}{\pi^2} = 0.1\pi \text{ m}$$

$$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.16}} = \sqrt{\frac{1000}{16}}$$

$$= \frac{10}{4} \pi = 2.5 \pi \text{ rad}\cdot\text{s}^{-1}$$

$$v = \omega_0 \sqrt{X_{max}^2 - x^2}$$

في لحظة متزايدة  $x=0$

$$v = \omega_0 X_{max} = 2.5 \pi \times 0.1 \pi$$

$$= 2.5 \text{ m}\cdot\text{s}^{-1} \quad (D)$$

مقدار سرعة سطران في حالة التوازن (33)

$$x_0 + \bar{x} = 6 + 2 = 8 \text{ cm} \quad (B)$$

$$\frac{1}{2} T_0 = 10 \Rightarrow T_0 = 20 \text{ s} \quad (34)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{20} = \frac{\pi}{10} \text{ rad}\cdot\text{s}^{-1}$$

$$2X_{max} = 10 \Rightarrow X_{max} = 5 \times 10^{-2} \text{ m}$$

$$\left. \begin{array}{l} t=0 \\ \bar{x} = X_{max} \end{array} \right\} \Rightarrow \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi})$$

$$X_{max} = X_{max} \cos \bar{\varphi}$$

$$\cos \bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0 \text{ rad}$$

$$\bar{x} = 0.05 \cos \frac{\pi}{10} t \quad (D)$$

$$x_1 = X_{max} \cos(\omega_1 t + \bar{\varphi}_1) \quad (35)$$

$$\omega_1 = \sqrt{\frac{k_1}{m_1}} = \sqrt{\frac{16}{0.4}} = \sqrt{\frac{160}{4}} = \sqrt{40}$$

$$= 2\pi \text{ rad}\cdot\text{s}^{-1}$$

13

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \text{ S}$$

$$\Rightarrow t = \frac{5}{6} = \frac{5T_0}{12} \text{ S} \quad (B)$$

$$v = -0.12\pi \sin 2\pi t \quad (41)$$

$$+0.12\pi = -0.12\pi \sin 2\pi t$$

$$\sin 2\pi t = -1 \Rightarrow 2\pi t = \frac{3\pi}{2}$$

$$\Rightarrow t = \frac{3}{4} \text{ S} \quad (A)$$

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1 \text{ S} \quad (42)$$

$$a = -0.12 \cos(2\pi t - \frac{\pi}{3})$$

$$+0.12 = -0.12 \cos(2\pi t - \frac{\pi}{3})$$

$$\cos(2\pi t - \frac{\pi}{3}) = -1 \Rightarrow$$

$$2\pi t - \frac{\pi}{3} = \pi \Rightarrow 2\pi t = \pi + \frac{\pi}{3}$$

$$2\pi t = \frac{4\pi}{3} \Rightarrow t = \frac{4}{6} = \frac{2}{3} \text{ S}$$

$$t = \frac{2T_0}{3} \text{ S} \quad (D)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad.s}^{-1} \quad (43)$$

$$v = \omega_0 \sqrt{X_{max}^2 - X^2}$$

$$v = \frac{\pi}{2} \sqrt{64 \times 10^{-4} - 4 \times 10^{-4}}$$

$$= \frac{\pi}{2} \sqrt{60 \times 10^{-4}} = \frac{\pi}{2} \sqrt{6 \times 10^{-3}}$$

$$= \frac{\pi}{2} \sqrt{\frac{6}{1000}} = \frac{\pi \sqrt{6}}{20\pi} = \frac{\sqrt{6}}{20} \text{ m.s}^{-1}$$

$$\frac{1}{2} T_0 = 2 \Rightarrow T_0 = 4 \text{ S} \quad (37)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad.s}^{-1}$$

$$2 X_{max} = 8 \Rightarrow X_{max} = 4 \times 10^{-2} \text{ m}$$

نجد المطال  $X_{max}$  - استار يكونه أعظية مرصية

$$a = +\omega_0^2 X_{max} = +\left(\frac{\pi}{2}\right)^2 \times 4 \times 10^{-2}$$

$$= \frac{10}{4} \times 4 \times 10^{-2} = 0.1 \text{ m.s}^{-2} \quad (C)$$

$$\bar{x} = 0.12 \cos(2\pi t + \frac{\pi}{2}) \quad (38)$$

$$t = 0 \Rightarrow \bar{x} = 0.12 \cos \frac{\pi}{2} = 0 \text{ m}$$

رؤزة صفر

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1 \text{ S} \Rightarrow t = \frac{T_0}{4} = \frac{1}{4} \text{ S}$$

$$\bar{x} = 0.12 \cos(2\pi \times \frac{1}{4} + \frac{\pi}{2})$$

$$= 0.12 \cos \pi = -0.12 \text{ m}$$

مطال أعظية لالب

أية تبرك  $\text{cm}$  مطب منه رؤزة صفر

المطال اة أعظية لالب ابواب (A)

$$f'_{s_0} = f_{s_0} = W = mg \quad (39)$$

$$= 200 \times 10^{-3} \times 10 = 2 \text{ N} \quad (D)$$

$$x = 0.12 \cos(\pi t + \frac{\pi}{6}) \quad (40)$$

$$-0.12 = 0.12 \cos(\pi t + \frac{\pi}{6})$$

$$\Rightarrow \cos(\pi t + \frac{\pi}{6}) = -1$$

$$\Rightarrow \pi t + \frac{\pi}{6} = \pi \Rightarrow \pi t = \pi - \frac{\pi}{6}$$

$$\pi t = \frac{5\pi}{6} \Rightarrow t = \frac{5}{6} \text{ S}$$

$$E_p = \frac{1}{2} k x^2 = \frac{1}{2} k \frac{x_{max}^2}{4} \quad (47)$$

$$= \frac{1}{8} k x_{max}^2 = \frac{1}{4} \times \frac{1}{2} k x_{max}^2$$

$$E_p = \frac{1}{4} E_t \quad (A)$$

$$E_k = E_t - E_p \quad (48)$$

$$= \frac{1}{2} k x_{max}^2 - \frac{1}{2} k x^2$$

$$= \frac{1}{2} k x_{max}^2 - \frac{1}{2} k \frac{x_{max}^2}{5}$$

$$= \frac{1}{2} k \left( x_{max}^2 - \frac{x_{max}^2}{5} \right)$$

$$= \frac{1}{2} k \left( \frac{4}{5} x_{max}^2 \right)$$

$$= \frac{2}{5} k x_{max}^2 = \frac{1}{2} k x_{max}^2 \times \frac{4}{5}$$

$$E_k = \frac{4}{5} E_t = 0.8 E_t \quad (C)$$

$$E_p = 0.12 E_t \quad (49)$$

$$\frac{1}{2} k x^2 = 0.12 \times \frac{1}{2} k x_{max}^2$$

$$x^2 = \frac{12}{100} x_{max}^2$$

$$x = \pm \frac{\sqrt{12}}{10} x_{max} = \pm \frac{\sqrt{3}}{5} x_{max}$$

الجواب (D)

$$E_k = \frac{1}{2} m v^2 = \frac{1}{2} \times 120 \times 10^{-3} \times \frac{6}{400}$$

$$E_k = 9 \times 10^{-4} \text{ J} \quad (C)$$

$$t=0 \quad \left. \begin{array}{l} \bar{x} = X_{max} \cos(\omega_0 t + \varphi) \\ \bar{x} = -X_{max} \end{array} \right\} \Rightarrow \begin{array}{l} X_{max} \cos \varphi = -X_{max} \\ \cos \varphi = -1 \end{array} \quad (44)$$

$$\cos \varphi = -1 \Rightarrow \varphi = \pi \text{ rad} \cdot \text{s}^{-1} \quad (A)$$

$$t=0 \quad \left. \begin{array}{l} \bar{x} = X_{max} \cos(\omega_0 t + \varphi) \\ \bar{x} = \frac{X_{max}}{2} \end{array} \right\} \Rightarrow \begin{array}{l} X_{max} \cos \varphi = \frac{X_{max}}{2} \\ \cos \varphi = \frac{1}{2} \end{array} \quad (45)$$

$$\cos \varphi = \frac{1}{2} \Rightarrow \varphi = \pm \frac{\pi}{3} \text{ rad}$$

دعنا أن  $\varphi$  الجسم ينتقل من  $\frac{X_{max}}{2}$  إلى  $-X_{max}$  فالتسوية سالبة، وكل الذي يجعل سرعة سالبة  $\varphi = +\frac{\pi}{3} \text{ rad}$

$$(A) \quad \varphi = +\frac{\pi}{3} \text{ rad}$$

$$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.01}} = \sqrt{1000} \quad (46)$$

$$= 10\pi \text{ rad} \cdot \text{s}^{-1}$$

$$t=0 \quad \left. \begin{array}{l} \bar{x} = X_{max} \cos(\omega_0 t + \varphi) \\ \bar{x} = X_{max} \end{array} \right\} \Rightarrow \begin{array}{l} X_{max} \cos \varphi = X_{max} \\ \cos \varphi = 1 \end{array}$$

$$\cos \varphi = 1 \Rightarrow \varphi = 0 \text{ rad}$$

$$\bar{x} = X_{max} \cos 10\pi t$$

$$t = 0.1 \text{ s} \Rightarrow \bar{x} = X_{max} \cos \pi = -X_{max}$$

(B) في تلك الأوقات يكون السالب

✓

عندما يتحرك بطول  $x=0$  (55)

$$\Rightarrow \cos(\pi t + \pi) = 0$$

$$\Rightarrow \pi t + \pi = \frac{\pi}{2} + \pi k$$

$$t + 1 = \frac{1}{2} + k \Rightarrow t = -\frac{1}{2} + k$$

$$t = \frac{1}{2} \text{ s} \Leftarrow k=1$$

نلاحظ أنه:  $T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \text{ s}$

$$\Rightarrow t = \frac{T_0}{4} \quad (10)$$

تنبيه مهم: نلاحظ أنه لطور ابتدائي  $\phi = \pi$  rad

وهذا لا يتفق إلا عند  $t=0$  ،  $x = -x_{\max}$

وهي هذه الحالة  $k$  تنبأ أنه (1) وليس من الصفر

$$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1 \text{ s} \Rightarrow$$

$$t = \frac{T_0}{4} = \frac{1}{4} \text{ s} \Rightarrow$$

$$v = -0.2 \sin\left(2\pi \times \frac{1}{4} - \frac{\pi}{3}\right) = -0.2 \sin\frac{\pi}{6} = -0.1 \text{ m s}^{-1} \quad (A)$$

$$a = -\omega_0^2 x_{\max} \cos \omega_0 t \quad (57)$$

$$a = -\omega_0^2 x_{\max} \cos\left(\frac{2\pi}{T_0} \times \frac{5T_0}{4}\right) = -\omega_0^2 x_{\max} \cos\frac{5\pi}{2} = 0 \text{ m s}^{-2}$$

الجواب (c)

$$\frac{3T_0}{4} = 1 \Rightarrow T_0 = \frac{4}{3} \text{ s} \quad (58)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{\frac{4}{3}} = \frac{6\pi}{4} = \frac{3\pi}{2} \text{ rad.s}^{-1}$$

$$E = \frac{1}{2} k X_{\max}^2 \quad (50)$$

$$0.05 = \frac{1}{2} k (10 \times 10^{-2})^2$$

$$0.05 = 0.5 \times k \times 10^{-2} \Rightarrow$$

$$k = \frac{5 \times 10^{-2}}{5 \times 10^{-3}} = 10 \text{ N m}^{-1}$$

$$E_p = \frac{1}{2} k X^2 = \frac{1}{2} (10) (2 \times 10^{-2})^2 = 5 \times 4 \times 10^{-4} = 2 \times 10^{-3} \text{ J}$$

$$E_k = E_t - E_p = 5 \times 10^{-2} - 0.2 \times 10^{-2} = 4.8 \times 10^{-2} \text{ J} \quad (c)$$

A (51)

52 كل  $\frac{1}{2}$  فترة يرسم الجسم لسلك ماراً أفقياً  $2X_{\max}$

20 فترة " " " "  $40 \text{ cm}$

$$\Rightarrow 2X_{\max} = \frac{40 \times 0.5}{20} = 1$$

$$\Rightarrow X_{\max} = 0.5 \text{ m} \quad (D)$$

53 كل  $\frac{T_0}{2}$  يرسم الجسم لسلك ماراً أفقياً  $2X_{\max}$

8  $X_{\max}$  " " " "  $10 \text{ s}$

$$\Rightarrow \frac{T_0}{2} = \frac{10 (2X_{\max})}{8X_{\max}} = 2.5$$

$$T_0 = 2 \times 2.5 = 5 \text{ s} \quad (B)$$

54 كل نصف فترة يتغير الجسم لسلك  $\frac{T_0}{2}$  ويقطع ماراً  $2X_{\max}$

10 فترة " " " "  $4 \text{ s}$

$$\bar{x} = \frac{2X_{\max}(10)}{0.5} = 40 (X_{\max}) \quad (A)$$

16

$$E_k = E_t - E_p$$

$$= \frac{1}{2} k X_{max}^2 - \frac{1}{2} k x^2$$

$$= \frac{1}{2} k \left( X_{max}^2 - \frac{X_{max}^2}{16} \right)$$

$$= \frac{15}{32} k X_{max}^2$$

$$E_p = \frac{1}{2} k x^2 = \frac{1}{2} k \frac{X_{max}^2}{16}$$

$$= \frac{1}{32} k X_{max}^2$$

$$\frac{E_k}{E_p} = \frac{\frac{15}{32} k X_{max}^2}{\frac{1}{32} k X_{max}^2} = 15 \Rightarrow$$

$$E_k = 15 E_p \quad (A)$$

$$E_k = E_t - E_p = \frac{1}{2} k X_{max}^2 - \frac{1}{2} k x^2$$

$$= \frac{1}{2} k \left( X_{max}^2 - \frac{X_{max}^2}{9} \right)$$

$$= \frac{8}{18} k X_{max}^2$$

$$E_p = \frac{1}{2} k x^2 = \frac{1}{2} k \frac{X_{max}^2}{9}$$

$$= \frac{1}{18} k X_{max}^2$$

$$\frac{E_p}{E_k} = \frac{\frac{1}{18} k X_{max}^2}{\frac{8}{18} k X_{max}^2} = \frac{1}{8}$$

$$E_p = \frac{1}{8} E_k \quad (A)$$

60

$$t=0 \quad \left. \begin{array}{l} \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi}) \\ \bar{x} = 0 \end{array} \right\} \Rightarrow 0 = X_{max} \cos \bar{\varphi}$$

$\Leftrightarrow X_{max} \neq 0$

$$\cos \bar{\varphi} = 0 \Rightarrow \bar{\varphi} = \left\langle \frac{\pi}{2}, \frac{3\pi}{2} \right\rangle \text{ rad}$$

نختار، لكل لزي، بجعل لظلال اعظمي سالب

$$\frac{T_0}{4} = \frac{\frac{4}{3}}{\frac{1}{4}} = \frac{1}{3} \text{ s}$$

$$\varphi = \frac{\pi}{2} \Rightarrow \bar{x} = X_{max} \cos \left( \frac{3\pi}{2} \times \frac{1}{3} + \frac{\pi}{2} \right)$$

$$x = X_{max} \cos \frac{\pi}{2} = -X_{max} \quad \text{مقبول}$$

$$\varphi = \frac{3\pi}{2} \Rightarrow \bar{x} = X_{max} \cos \left( \frac{3\pi}{2} \times \frac{1}{3} + \frac{3\pi}{2} \right)$$

$$\bar{x} = X_{max} \cos 2\pi = X_{max} \quad \text{مرفوضه}$$

$$\Rightarrow \bar{x} = 0.6 \cos \left( \frac{3\pi}{2} t + \frac{\pi}{2} \right) \quad (10)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad.s}^{-1}$$

$$X_{max} = 8 \times 10^{-2} \text{ m}$$

$$t=0 \quad \left. \begin{array}{l} \bar{x} = X_{max} \cos(\omega_0 t + \bar{\varphi}) \\ \bar{x} = \frac{X_{max}}{2} \end{array} \right\} \Rightarrow \frac{X_{max}}{2} = X_{max} \cos \bar{\varphi}$$

$$\cos \bar{\varphi} = \frac{1}{2} \Rightarrow \bar{\varphi} = \pm \frac{\pi}{3} \text{ rad}$$

نختار، لكل لزي، بجعل لسرعة سالب لحظة بدء الزمن

$$\varphi = \frac{\pi}{3} \text{ rad} \Rightarrow v = -\omega_0 X_{max} \sin \frac{\pi}{3} < 0 \quad \text{مقبول}$$

$$\varphi = -\frac{\pi}{3} \Rightarrow v = -\omega_0 X_{max} \sin \left( -\frac{\pi}{3} \right) > 0 \quad \text{مرفوضه}$$

$$x = 0.08 \cos \left( \frac{\pi}{2} t + \frac{\pi}{3} \right) \quad (D)$$

59

(52)

$$\frac{1}{2} T_0 = 2 \Rightarrow T_0 = 4 \text{ s}$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad} \cdot \text{s}^{-1}$$

$$2X_{\text{max}} = 24 \Rightarrow X_{\text{max}} = 0.12 \text{ m}$$

$$k = \omega_0^2 m = \left(\frac{\pi}{2}\right)^2 \times 0.1 = \frac{10}{4} \times 0.1$$

$$= \frac{1}{4} \text{ N m}^{-1}$$

$$E_k = E_t - E_p = \frac{1}{2} k (X_{\text{max}}^2 - x^2)$$

$$= \frac{1}{2} \times \frac{1}{4} (144 \times 10^{-4} - 36 \times 10^{-4})$$

$$= \frac{1}{8} \times 108 \times 10^{-4} = 13.5 \times 10^{-4} \text{ J}$$

الجواب (ج)

عند المرور بموضع التوازن  $x=0$  (53)

$$\Rightarrow \cos(2\pi t + \pi) = 0 \Rightarrow$$

$$2\pi t + \pi = \frac{\pi}{2} + n\pi$$

$$2t + 1 = \frac{1}{2} + n \Rightarrow$$

$$2t = -\frac{1}{2} + n \Rightarrow t = -\frac{1}{4} + \frac{n}{2}$$

بما أن  $\varphi = \pi$  فإننا نتحقق من أجل

$$t=0, \quad x = -X_{\text{max}}$$

كشأنه (1) أولية من الصفر وبالنسبة

للوقت المرور الثاني  $\Leftrightarrow k=2$ 

$$t = -\frac{1}{4} + \frac{2}{2} = 0.75 \text{ s}$$

الجواب (د)