حل البنك المؤقت لبحث النواس المرن

قسم الطالب المبتدئ

B (س1) C (س2) C (س3)

D (س4) A (س5) D (س6)

A (س7) B (س8) A (س9)

D (س10) B (س11) D (س12)

A (س13)

$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.5} = \frac{20\pi}{5} = 4\pi \ rad.s^{-1}$ (س14)

الجواب (D)

D (س15) C (س16) B (س17)

B (س18) D (س19) A (س20)

C (س21) C (س22) B (س23)

D (س24) B (س25) A (س26)

B (س27) A (س28) D (س29)

B (س30) B (س31) D (س32)

$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.4} = \frac{20\pi}{4} = 5\pi \ rad.s^{-1}$ (س33)

الجواب (C)

قسم الطالب المتوسط

B (س1) D (س2)

$\omega_0 = \sqrt{\frac{k}{m}}$ (س3)

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

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

الجواب (A)

A (س4) B (س5) C (س6)

C (س7) A (س8) B (س9)

$T_0 = \frac{\text{زمن الهزات } t}{\text{عدد الهزات } n} = \frac{3}{12} = \frac{1}{4} s$ (س10)

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

الجواب (D)

C (س11) C (س12) A (س13)

C (س14)

D (س15)

C (س16)

(س17)

$T_0 = \frac{\text{زمن الهزات } t}{\text{عدد الهزات } n}$

$t = T_0 \times n = 4 \times 5 = 20\ s$

(A) الجواب

(س18)

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

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

نعوض بـ (*):

$X_0 = \frac{10}{(\frac{\pi}{2})^2} = \frac{\frac{10}{1}}{\frac{10}{4}} = 4\ m$

(D) الجواب

(س19)

$T_0 = \frac{t}{n} \Rightarrow n = \frac{t}{T_0} = \frac{20}{4}$

$n = 5$ هزات

(B) الجواب

A (س20)

C (س21)

C (س22)

C (س23)

B (س24)

A (س25)

D (س26)

(س27)

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

(C) الجواب

A (س28)

2/

(س29)

$T_0 = 2\pi\sqrt{\frac{m}{K}}$

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

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

(A) الجواب

C (س30)

D (س31)

A (س32)

C (س33)

B (س34)

A (س35)

A (س36)

C (س37)

(س38)

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

(D) الجواب

C (س39)

C (س40)

D (س41)

B (س42)

D (س43)

C (س44)

A (س45)

D (س46)

تم الطالب الجيد

س1 $a = -\omega_0^2 x$ (*)

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

نعوض بـ (*)

$a = -(\pi)^2 (5\times10^{-2})$

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

الجواب (A)

س2 $T_0 = 2\pi\sqrt{\frac{m}{k}} \Rightarrow 0.5 = 2\pi\sqrt{\frac{m}{40}}$

نربع الطرفين:

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

الجواب (D)

س3 $F = |-kx| = |-16\times2\times10^{-2}|$

$= 0.32 \ N$

الجواب (B)

س4 C

س5 $v_{max} = |\mp \omega_0 X_{max}| = \frac{2\pi}{T_0} \times X_{max}$

$= \frac{2\pi}{1} \times 8\times10^{-2} = 16\pi\times10^{-2}$

$= 50\times10^{-2} = 0.5 \ m s^{-1}$

الجواب (D)

س6 $T_0 = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.4}{10}}$

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

الجواب (A)

س7 عند لحظة بدء الحركة $t = 0$

$x = 0.4\cos 2\pi = -0.4 \ m$

الجواب (D)

س8 B

س9 A

س10 $v = \omega_0\sqrt{x_{max}^2 - x^2}$

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

$v = 2\pi\sqrt{25\times10^{-4} - 9\times10^{-4}}$

$v = 2\pi\sqrt{16\times10^{-4}} = 2\pi\times4\times10^{-2}$

$= 8\pi\times10^{-2} = 25\times10^{-2}$

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

الجواب (B)

س11 $v = \omega_0\sqrt{x_{max}^2 - x^2}$

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

نعوض بـ v:

$0.04\pi = \frac{\pi}{2}\sqrt{100\times10^{-4} - x^2}$

$8\times10^{-2} = \sqrt{100\times10^{-4} - x^2}$

نربع الطرفين

$64\times10^{-4} = 100\times10^{-4} - x^2$

$x^2 = 100\times10^{-4} - 64\times10^{-4} = 36\times10^{-4}$

$x = 6\times10^{-2} \ m = 6 \ cm$ الجواب (C)

س 12

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

$$0.8 = 2\pi\sqrt{\frac{0.4}{k}}$$

نربع الطرفين :

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

$$k = \frac{40\times0.4}{0.64} = \frac{16}{64\times10^{-2}} = \frac{1600}{64}$$

$$k = 25\ N\,m^{-1}$$

الجواب (B)

س 13

$$E = \frac{1}{2}kX_{max}^2 \Rightarrow$$

$$k = \frac{2E}{X_{max}^2} = \frac{2\times0.05}{(10\times10^{-2})^2} = \frac{0.1}{0.01}$$

$$k = 10\ N\,m^{-1}$$

الجواب (C)

س 14

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

من المعادلة نلاحظ أن :

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

$$T_0 = 1S \Rightarrow t = \frac{T_0}{12} = \frac{1}{12}\,S$$

نعوضه بـ x :

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

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

$$= 0\ m$$

أي الجسم في مركز الاهتزاز

الجواب (A)

س 15

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

نربع الطرفين :

$$4 = 2\pi\sqrt{\frac{m}{1.25}}$$

$$16 = 40\,\frac{m}{1.25} \Rightarrow m = \frac{16\times1.25}{40}$$

$$m = 0.5\ kg$$

الجواب (D)

س 16

$$E_K = E - E_p \quad (*)$$

$$E = \frac{1}{2}kX_{max}^2 = \frac{1}{2}(4)(16\times10^{-2})^2$$

$$= 2\times256\times10^{-4} = 512\times10^{-4}\ J$$

$$E_p = \frac{1}{2}kx^2 = \frac{1}{2}(4)(12\times10^{-2})^2$$

$$= 2\times144\times10^{-4} = 288\times10^{-4}\ J$$

نعوضه بـ (*)

$$E_K = 512\times10^{-4} - 288\times10^{-4}$$

$$= 224\times10^{-4} = 2.24\times10^{-2}\ J$$

الجواب (C)

س 17

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

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

نعوضه بـ (*) :

$$a = -(2\pi)^2 \times -0.5\times10^{-2}$$

$$= +40\times0.5\times10^{-2} = 0.2\ m\,s^{-2}$$

الجواب (D)

س18) طول القطعة المستقيمة التي يرسمها مركز عطالة الجسم الصلب خلال نصف دور هي

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

الجواب (B)

س19) من $+X_{max}$ حتى $-X_{max}$ يستغرق الجسم الصلب زمناً قدره ($\frac{1}{2} T_0$)

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

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

الجواب (A)

س20)

$$T_0 = 2\pi \sqrt{\frac{m}{k}} \Rightarrow 4 = 2\pi \sqrt{\frac{m}{1}}$$

نربع الطرفين :

$$16 = 40 \frac{m}{1} \Rightarrow m = \frac{16}{40} = 0.4\ kg$$

الجواب (C)

س21) D

س22)

$$F = -kX = -10 \times 2 \times 10^{-2}$$

$$= -0.2\ N$$

الجواب (A)

س24) من $+X_{max}$ حتى $-X_{max}$ يستغرق الجسم زمناً قدره ($\frac{1}{2} T_0$)

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

الجواب (A)

س23)

$$X_0 = \frac{mg}{k} = \frac{160 \times 10^{-3} \times 10}{10}$$

$$= 0.16\ m$$

الجواب (D)

س25) C

س26) لحظة بدء الحركة $t = 0$

$$X = 0.4 \cos 0 = +0.4\ m$$

الجواب (A)

س27) C **س28)** C **س29)** D

س30) D

س31)

$$F = -kX$$

$$F' = -kX' = -k(3X)$$

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

الجواب (C)

س32)

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

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

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

$$E_k' = 4 E_k$$

الجواب (B)

C (س 33

D (س 34

(س 35

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

نبحث عن ثوابت الحركة :

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

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

نحسب φ من شروط البدء :

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

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

نختار الحل الذي يجعل السرعة سالبة لحظة بدء الحركة

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

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

الحل مقبول

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

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

الحل مرفوض

$\Rightarrow \bar{X} = 0.12 \cos(2\pi t + \frac{\pi}{3}) \ (m)$

الجواب (A)

6/ قسم الطالب المتفوق

(س 1 نواس تابع لبرغي : $\omega_0 = 2\pi \ rad.s^{-1}$

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

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

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

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

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

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

$\frac{1}{2} K X_{max}^2 = \frac{5}{4} \times \frac{1}{2} K x^2 \Rightarrow$

$x^2 = \frac{4}{5} X_{max}^2 \Rightarrow X = \pm \frac{2}{\sqrt{5}} X_{max}$

الجواب (B)

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

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

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

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

B (س 4

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

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

(B) لحظة المرور الثاني

س6

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

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

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

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

$T_0 = 2 \times \frac{\pi}{10} = 0.8\ s$ (c)

س7 من $+X_{max}$ إلى $-X_{max}$ يستغرق الجسم المتحرك زمنا قدره $\frac{1}{2}T_0$

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

من $+X_{max}$ إلى $-X_{max}$ يقطع الجسم المتحرك مسافة $2X_{max}$ أي:

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

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

نربع العلاقتين:

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

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

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

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

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

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

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

س8

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

نختار لحظة انطلاق أعظمي موجب

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

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

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

$t = \frac{1}{3}\ s \Rightarrow t = \frac{T_0}{6}$ (b)

س9

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

نبحث عن الثوابت:

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

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

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

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

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

الجواب (c)

س10

$E_p = E_t - E_k = 3E_k - E_k$

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

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

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

$\frac{1}{2}kX_{max}^2 = \frac{3}{2} \times \frac{1}{2}kx^2$

$x^2 = \frac{2}{3}X_{max}^2 \Rightarrow x = \mp\sqrt{\frac{2}{3}}X_{max}$

الجواب (D)

س11

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

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

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

$= -0.12 \sin\frac{5\pi}{2} = -0.12 \ ms^{-1}$

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

س12

$a = -\omega_0^2 X_{max}\cos\omega_0 t$

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

$= -\omega_0^2 X_{max}\cos\frac{3\pi}{2} = 0 \ ms^{-2}$

الجواب (A)

س13

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

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

س14

$E_t = E_p + E_k$

نلاحظ عندما: $E_k = E_p$

$E_t = 2E_p \Rightarrow \frac{1}{2}kX_{max}^2 = 2 \times \frac{1}{2}kx^2$

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

(D)

س15

$E_k = E_t - E_p$

$= \frac{1}{2}kX_{max}^2 - \frac{1}{2}kx^2$

$= \frac{1}{2}k\left(X_{max}^2 - \frac{X_{max}^2}{3}\right)$

$= \frac{1}{2}k\left(\frac{2}{3}X_{max}^2\right)$

$= \frac{1}{3}kX_{max}^2 = \frac{2}{3} \times \frac{1}{2}kX_{max}^2$

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

س16

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

نبحث عن ω_0 الجواب:

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

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

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

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

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

$v = -0.25\sin\pi t$

نلاحظ المرور بموضع التوازن تكون السرعة عظمى بالتالي:

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

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

$k = 1$ نلاحظ المرور الثاني تكون

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

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

$v = +v_{max}$ (B)

س17) عند المرور بموضع التوازن $x = 0$

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

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

ملاحظة: المرور الأول بموضع التوازن $k = 0$

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

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

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

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

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

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

س18) من السلك نستنتج أن:

$X_{max} = 0.8\ m$

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

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

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

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

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

س19) من السلك نستنتج أن:

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

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

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

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

$t = 0,\ v = -0.8\pi \Rightarrow v = -\omega_0 X_{max}\sin(\omega_0 t + \varphi)$

$-0.8\pi = -0.8\pi \sin\varphi$

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

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

س20) $a = -\omega_0^2 X_{max}\cos\omega_0 t$

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

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

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

س21) من السلك:

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

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

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

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

10/

B (ص 23)

$t=0$, $q=-q_{max}$ $\Rightarrow$ $q = -\omega_0^2 X_{max} \cos(\omega_0 t + \varphi)$

$q_{max} = -q_{max} \cos\varphi$

$\cos\varphi = 1 \Rightarrow \varphi = 0$ rad

$\Rightarrow q = -0.4 \cos \pi t$ (C)

$\bar{x} = X_{max} \cos(\omega_0 t + \varphi)$ (ص 22)

$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.1}} = 10$ rad.s^{-1}

في مركز التوازن تكون السرعة عظمى

$v_{max} = -\omega_0 X_{max} = -3$

$-10 X_{max} = -3 \Rightarrow X_{max} = 0.3$ m

حساب φ :

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

$\cos\varphi = 0 \Rightarrow \varphi = \begin{cases} +\frac{\pi}{2} \\ \frac{3\pi}{2} \end{cases}$ rad

نختار الحل الذي يجعل السرعة سالبة في اللحظة $t=0$

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

$\varphi = \frac{\pi}{2}$ rad $\Rightarrow v = -\omega_0 X_{max} \sin\frac{\pi}{2} < 0$ ✓ مقبول

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

$\bar{x} = 0.3 \cos(10t + \frac{\pi}{2})$ (m)

الجواب (B)

عندما يتوقف الجسم لأول مرة $E_k = 0 \Leftarrow v = 0$ (ص 24)

$\Rightarrow E_t = E_p \Rightarrow \frac{1}{2} k X'^2_{max} = \frac{1}{2} k x^2$

$X'_{max} = X = 4$ cm (A)

(ص 25)

$E_p = 0.2 E_k \Rightarrow$

$E_k = \frac{E_p}{0.2} = 5 E_p$

$\Rightarrow E_t = E_p + E_k = E_p + 5E_p$

$E_t = 6 E_p \Rightarrow \frac{1}{2} k X^2_{max} = 6 \cdot \frac{1}{2} k x^2$

$x^2 = \frac{1}{6} X^2_{max} \Rightarrow x = \pm \frac{1}{\sqrt{6}} X_{max}$

الجواب (D)

(ص 26) نلاحظ أنه: $\frac{1}{2} T_0 = 1$ s

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

$t=0$, $v = -v_{max}$ $\Rightarrow$ $v = -\omega_0 X_{max} \sin(\omega_0 t + \varphi)$

$-\omega_0 X_{max} = -\omega_0 X_{max} \sin\varphi$

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

$\Rightarrow v = -0.2\pi \sin(\pi t + \frac{\pi}{2})$

س 27

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

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

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

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

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

$\Rightarrow \bar{x} = 4\times10^{-2}\cos(\pi t + \pi)$ (D)

س 28

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

$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.04}} = \sqrt{\frac{1000}{4}} = \sqrt{250}$

$= 5\pi \text{ rad.s}^{-1}$

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

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

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

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

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

في البداية أقصى موجب (A)

س 29

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

$T_0 = 1S$

عند المرور 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 المرور الثاني $k=1$

$t = \frac{1}{12} + \frac{1}{2} = \frac{7}{12} S$

س 30

عند مرور الجسم لمطلب بوضع التوازن $x=0$

$\Rightarrow \cos 5\pi t = 0 \Rightarrow 5\pi t = \frac{\pi}{2} + \pi k$

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

$t = \frac{1}{10} = 0.1S \in k=0$ ولحظة المرور الأول

الجواب (A)

س 31

من الشكل نجد:

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

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

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

$0 = -\omega_0 X_{max}\sin\bar{\varphi}$

$X_{max} \neq 0$ $\omega_0 \neq 0$ لأن

$\sin\bar{\varphi} = 0 \Rightarrow \varphi = \begin{cases} 0 \\ \pi \end{cases} \text{rad}$

نختار الحل الذي يجعل السرعة سالبة بعد مرور

ثانية أي $\frac{T_0}{4}$ أي $(\frac{3}{4}S)$

$\varphi = 0 \Rightarrow$

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

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

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

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

الحل مرفوض

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

س 32

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

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

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

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

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

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

في وكزاه صفرا: $x = 0$ ∈

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

$= 2.5$ m s^{-1} (D)

س 33

مقدار الاستطالة في حالة الاتزان

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

س 34

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

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

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

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

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

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

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

س 35

$x_1 = X_{max} \cos(\omega_{0_1} t + \bar{\varphi}_1)$

$\omega_{0_1} = \sqrt{\frac{k_1}{m_1}} = \sqrt{\frac{16}{0.4}} = \sqrt{\frac{160}{4}} = \sqrt{40}$

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

س 12

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

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

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

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

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

$x_1 = -X_{max}$

$x_2 = X_{max} \cos(\omega_{0_2} t + \bar{\varphi}_2)$

$\omega_{0_2} = \sqrt{\frac{k_2}{m_2}} = \sqrt{\frac{36}{0.1}} = \sqrt{360}$

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

ثم حساب $\bar{\varphi}$ سابقاً

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

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

$x_2 = -X_{max}$

أي أنها تتجه في الوضع $-X_{max}$ (D)

س 36

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

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

$v_{max} = |\pm \omega_0 X_{max}|$

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

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

الجواب (D)

س 37

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

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

$2X_{max} = 8 \Rightarrow X_{max} = 4\times10^{-2}\ m$

في البداية $-X_{max}$ ، لذا يكون أعظمي موجب

$a = +\omega_0^2 X_{max} = +\left(\frac{\pi}{2}\right)^2 \times 4\times10^{-2}$

$= \frac{10}{4}\times4\times10^{-2} = 0.1\ m.s^{-2}$ (C)

س 38

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

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

مركز الاهتزاز

$T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1\,s \Rightarrow t = \frac{T_0}{4} = \frac{1}{4}\,s$

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

$= 0.12\underbrace{\cos\pi}_{-1} = -0.12\ m$

البداية أعظمي سالب

أي يتحرك الجسم الصلب من مركز الاهتزاز نحو

المطال الأعظمي السالب الجواب (A)

س 39

$f'_{s0} = f_{s0} = W = mg$

$= 200\times10^{-3}\times10 = 2N$ (D)

س 40

$x = 0.12\cos\left(\pi t + \frac{\pi}{6}\right)$

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

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

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

$\pi t = \frac{5\pi}{6} \Rightarrow t = \frac{5}{6}\,s$

13

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

$\Rightarrow t = \frac{5}{6} = \frac{5T_0}{12}\ s$ (B)

س 41

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

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

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

$\Rightarrow t = \frac{3}{4}\,s$ (A)

س 42

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

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

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

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

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

$2\pi t = \frac{4\pi}{3} \Rightarrow t = \frac{4}{6} = \frac{2}{3}\,s$

$t = \frac{2T_0}{3}\ s$ (D)

س 43

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

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

$v = \frac{\pi}{2}\sqrt{64\times10^{-4} - 4\times10^{-4}}$

$= \frac{\pi}{2}\sqrt{60\times10^{-4}} = \frac{\pi}{2}\sqrt{6\times10^{-3}}$

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

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

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

س 44

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

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

$$\cos\bar{\varphi} = -1 \Rightarrow \bar{\varphi} = \pi \text{ rad.s}^{-1} \qquad (A)$$

س 45

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

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

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

وبما أنه الجسم يتنقل من $\frac{X_{max}}{2}$ إلى $-X_{max}$

فالسرعة سالبة في كل الذي يجعل السرعة سالبة $\bar{\varphi} = +\frac{\pi}{3}$ rad

(A)

س 46

$$\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{10}{0.01}} = \sqrt{1000}$$

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

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

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

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

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

$$t = 0.1 \text{ s} \Rightarrow \bar{x} = X_{max} \underbrace{\cos\pi}_{-1} = -X_{max}$$

(B) في هذه الحالة عظمى بالسالب

س 47

$$E_p = \frac{1}{2} k x^2 = \frac{1}{2} k \frac{X_{max}^2}{4}$$

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

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

س 48

$$E_k = E_t - E_p$$

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

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

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

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

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

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

س 49

$$E_t = 0.12 E_p$$

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

$$x^2 = \frac{1}{0.12} X_{max}^2 = \frac{100}{12} X_{max}^2$$

$$x = \mp \frac{10}{2\sqrt{3}} X_{max} = \mp \frac{5}{\sqrt{3}} X_{max}$$

الجواب (C)

س 50

س 50

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

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

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

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

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

$$= 5 \times 4 \times 10^{-4} = 2 \times 10^{-3} \ J$$

$$E_k = E_t - E_p = 5 \times 10^{-2} - 0.2 \times 10^{-2}$$

$$= 4.8 \times 10^{-2} \ J \qquad (C)$$

س 51 A

س 52 كل $\frac{1}{2}$ هزة يرسم الجسم لعلى مسار أطوله $2X_{max}$

40 cm " " " " 20 هزة

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

$$\Rightarrow X_{max} = 0.5 \ cm \qquad (D)$$

س 53 كل $\frac{T_0}{2}$ يرسم الجسم لعلى مسار أطوله $2X_{max}$

$8X_{max}$ " " " " 10 كل

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

$$T_0 = 2 \times 2.5 = 5 \ S \qquad (B)$$

س 54 كل نصف هزة يقطع الجسم لعلى $\frac{T_0}{2}$ ويقطع مسافة $2X_{max}$

$\bar{x}$ 4 S " 10 هزة

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

س 55 عندما ينفذ الجسم لعلى $x = 0$

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

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

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

$$t = \frac{1}{2} S \Leftarrow k = 1$$

ونلاحظ أنه : $T_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2 \ S$

$$\Rightarrow t = \frac{T_0}{4} \qquad (D)$$

تنبيه مهم : نلاحظ أنه لطور الابتدائي $\varphi = \pi \ rad$

وهذا يتحقق اذا بدأ الجسم لعلى $t = 0$ $x = -X_{max}$

وفي هذه الحالة k تأخذ أحد القيم (1) والتي هذه القيم الصفر

س 56

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

$$t = \frac{T_0}{4} = \frac{1}{4} S \Rightarrow$$

$$v = -0.2 \sin(2\pi \times \frac{1}{4} - \frac{\pi}{3})$$

$$= -0.2 \sin\frac{\pi}{6} = -0.1 \ m.s^{-1} \qquad (A)$$

س 57

$$a = -\omega_0^2 X_{max} \cos \omega_0 t$$

$$a = -\omega_0^2 X_{max} \cos \frac{2\pi}{T_0} \times \frac{5T_0}{4}$$

$$= -\omega_0^2 X_{max} \cos \frac{5\pi}{2} = 0 \ m.s^{-2}$$

الجواب (C)

س 58

$$3\frac{T_0}{4} = 1 \Rightarrow T_0 = \frac{4}{3} S$$

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

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

$\bar{x} = 0 \quad 0 = X_{max}\cos\bar{\varphi}$

$\in X_{max} \neq 0$

$\cos\bar{\varphi} = 0 \Rightarrow \bar{\varphi} = \begin{cases} \frac{\pi}{2} \\ \frac{3\pi}{2} \end{cases}$ rad

نختار الحل الذي يجعل المطال أعظمي سالب بعد زمنة مدته $\left(\frac{T_0}{4}\right)$ أي

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

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

$x = X_{max}\underbrace{\cos\pi}_{-1} = -X_{max}$ مقبول

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

$\bar{x} = X_{max}\underbrace{\cos 2\pi}_{+1} = X_{max}$ مرفوضة

$\Rightarrow \bar{x} = 0.6\cos\left(\frac{3\pi}{2}t + \frac{\pi}{2}\right)$ (1)

(59)

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

$X_{max} = 8\times10^{-2}$ m

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

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

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

نختار الحل الذي يجعل السرعة سالبة لحظة بدء الزمن

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

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

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

16

(60)

$E_k = E_t - E_p$

$= \frac{1}{2}kX_{max}^2 - \frac{1}{2}kx^2$

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

$= \frac{15}{32}kX_{max}^2$

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

$= \frac{1}{32}kX_{max}^2$

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

$E_k = 15E_p$ (A)

(61)

$E_k = E_t - E_p = \frac{1}{2}kX_{max}^2 - \frac{1}{2}kx^2$

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

$= \frac{8}{18}kX_{max}^2$

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

$= \frac{1}{18}kX_{max}^2$

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

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

(ج 62)

$\frac{1}{2}T_0 = 2 \Rightarrow T_0 = 4\ S$

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

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

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

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

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

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

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

الجواب (د)

(ج 63) عند المرور بموضع التوازن $x = 0$

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

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

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

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

بما أن $\varphi = \pi$ هذا يعني أنه من أجل

$t = 0$ ، $x = -X_{max}$ وفي هذه الحالة

k تأخذ أصغر قيمة لها (1) وليست الصفر وبالتالي

لحظة المرور الثاني $\Leftarrow k = 2$

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

الجواب (ب)