حل البنك المؤتمت لبحث نواس الفتل

سلم الطالب المبتدئ

1) C
2) D
3) C
4) D
5) B
6) C
7) D
8) D
9) C
10) C
11) A
12) C
13) B
14) B
15) D
16) B

سلم الطالب المتوسط

1) $T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \Rightarrow$

$0.5 = 2\pi\sqrt{\frac{\frac{3}{4}\times10^{-2}}{k}}$ نربع الطرفين

$\frac{1}{4} = 40\,\frac{\frac{3}{4}\times10^{-2}}{k} \Rightarrow$

$k = 4\times40\times\frac{3}{4}\times10^{-2} = 1.2\ m\,N\,rad^{-1}$

الجواب (A)

2) $\theta = \pi\cos(2\pi t+\pi)$

$\Rightarrow \theta_{max} = \pi\ rad \qquad \omega_0 = 2\pi\ rad.s^{-1}$

$\varphi = \pi\ rad$

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

$\omega = -\omega_0\,\theta_{max}\sin(\omega_0 t+\varphi)$

$\omega = -2\pi\times\pi\sin(2\pi t+\pi)$

$\omega = -20\sin(2\pi t+\pi)$

لحظة المرور الأول بوضع التوازن

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

$\Rightarrow \omega = -20\underbrace{\sin\frac{3\pi}{2}}_{-1} = +20\ rad.s^{-1}$

الجواب (B)

3) $E_p = \frac{1}{2}k\theta^2 = \frac{1}{2}k\,\frac{\theta_{max}^2}{9}$

$= \frac{1}{18}k\,\theta_{max}^2$ (D)

4) (A) $\times$ يتعلق الدور ب θ_{max}

5) B
6) A
7) B
8) C
9) D
10) D

11) $I_\Delta = \frac{1}{12}m l^2 = \frac{1}{12}\times120\times10^{-3}\times64\times10^{-4}$

$= 64\times10^{-6}\ kg.m^2$ (C)

12) A
13) C
14) D

15) $E_k = E_t - E_p$

$= \frac{1}{2}k\theta_{max}^2 - \frac{1}{2}k\theta^2$

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

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

$$= \frac{2}{3} \times \frac{1}{2} k \theta_{max}^2 = \frac{2}{3} E_t$$

الجواب (D)

س16) C

س17)

$$T_0 = 2\pi \sqrt{\frac{I_\Delta}{k}}$$

نربع الطرفين:

$$1 = 2\pi \sqrt{\frac{2\times10^{-3}}{k}}$$

$$1 = 40 \frac{2\times10^{-3}}{k} \Rightarrow k = 40\times2\times10^{-3}$$

$$k = 8\times10^{-2}\ m.N.rad^{-1}$$

الجواب (A)

س18) B س19) C س20) B

س21) B س22) C

س23)

$$T_{0_1} = 2\,T_{0_2}$$

$$2\pi\sqrt{\frac{\cancel{I_\Delta}}{k_1}} = 2\times2\pi\sqrt{\frac{\cancel{I_\Delta}}{k_2}}$$

نربع الطرفين:

$$\frac{1}{k_1} = 4\frac{1}{k_2} \Rightarrow$$

$$k_1 = \frac{1}{4} k_2$$

الجواب (A)

س24) D

س25) لحظة المرور الثانية بوضع التوازن:

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

نلاحظ: $\omega_0 = 5\pi\ rad.s^{-1} \Rightarrow T_0 = \frac{2\pi}{\omega_0}$

$$T_0 = \frac{2\pi}{5\pi} = 0.4\ S \Rightarrow$$

$$t = \frac{3T_0}{4} = 0.3\ S \qquad (B)$$

س26)

$$T_{0_1} = 2\pi\sqrt{\frac{I_\Delta}{k_1}}$$

$$T_{0_2} = 2\pi\sqrt{\frac{I_\Delta}{k_2}}$$

$$\Rightarrow T_{0_1} = 2\pi\sqrt{\frac{I_\Delta}{\frac{1}{4}k_2}} = 2\pi\sqrt{\frac{4I_\Delta}{k_2}}$$

$$T_{0_1} = 2\times2\pi\sqrt{\frac{I_\Delta}{k_2}} = 2T_{0_2}$$

الجواب (A)

س27) A س28) C

س29)

$$E_p = \frac{1}{2}k\theta^2 = \frac{1}{2}k\frac{\theta_{max}^2}{9}$$

$$= \frac{1}{9}\times\frac{1}{2}k\theta_{max}^2 = \frac{1}{9}E_t$$

الجواب (B)

قسم الطالب الجيد

س1)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{K}}$$

$$T_0' = 2\pi\sqrt{\frac{4I_\Delta}{K}} = 2 \times 2\pi\sqrt{\frac{I_\Delta}{K}}$$

$$T_0' = 2T_0 \qquad (D)$$

س2)

$$\alpha = -\omega_0^2\,\theta = -\left(\frac{2\pi}{T_0}\right)^2 \cdot \theta$$

$$\alpha = -\left(\frac{2\pi}{0.5}\right)^2 \times -\frac{\pi}{4}$$

$$\alpha = +160 \times \frac{\pi}{4} = 40\pi = 125\ rad.s^{-2}$$

الجواب (C)

س3)

$$E_k = E_t - E_p$$

$$= \frac{1}{2}K\theta_{max}^2 - \frac{1}{2}K\theta^2$$

$$= \frac{1}{2}K\theta_{max}^2 - \frac{1}{2}K\frac{\theta_{max}^2}{3}$$

$$= \frac{1}{2}K\theta_{max}^2 - \frac{1}{6}K\theta_{max}^2$$

(3) (1)

$$= \frac{2}{6}K\theta_{max}^2 = \frac{1}{3}K\theta_{max}^2$$

الجواب (D)

س4)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{K}} \qquad K = K'\frac{(2r)^4}{\ell}$$

$$K^* = K'\frac{(2r)^4}{2\ell} = \frac{K}{2} \Rightarrow$$

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

$$T_0' = \sqrt{2} \times 2\pi\sqrt{\frac{I_\Delta}{K}} = \sqrt{2}\,T_0 \qquad (B)$$

س5)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{K}} \qquad K = K'\frac{(2r)^4}{\ell}$$

$$K^* = K'\frac{(2r)^4}{\frac{\ell}{4}} = 4K'\frac{(2r)^4}{\ell} = 4K$$

$$\Rightarrow T_0' = 2\pi\sqrt{\frac{I_\Delta}{4K}} = \frac{1}{2} \times 2\pi\sqrt{\frac{I_\Delta}{K}}$$

$$T_0' = \frac{1}{2}T_0 = \frac{1}{2}(4) = 2\ s$$

الجواب (D)

س6)

$$T_{0_2} = 4T_{0_1}$$

$$\cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{K_2}} = 4 \times \cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{K_1}}$$

نربع الطرفين:

$$\frac{1}{K_2} = 16\frac{1}{K_1} \Rightarrow$$

$$K_1 = 16K_2 \Rightarrow \cancel{K'}\frac{\cancel{(2r)^4}}{\ell_1} = 16 \times \cancel{K'}\frac{\cancel{(2r)^4}}{\ell_2}$$

$$\frac{1}{\ell_1} = 16\frac{1}{\ell_2} \Rightarrow \ell_2 = 16\ell_1$$

الجواب (C)

س7)

$$\underset{\text{قرص}}{I_\Delta} = \frac{1}{2}mr^2$$

$$= \frac{1}{2}(200\times10^{-3})(2\times10^{-2})^2$$

$$= 10^{-1}\times4\times10^{-4} = 4\times10^{-5}\ kg.m^2$$

الجواب (D)

س8)

$$\theta = 0.1\cos 2\pi t$$

$$\theta_{max} = 0.1\ rad \qquad \omega_0 = 2\pi\ rad.s^{-1}$$

$$\varphi = 0\ rad$$

لدينا:

$$\omega = -\omega_0\,\theta_{max}\sin(\omega_0 t + \varphi)$$

$\omega = -2\pi \times 0.1 \sin 2\pi t$

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

لحظة المرور الأول بوضع التوازن

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

$\omega = -0.2\pi \sin 2\pi \times \frac{1}{4}$

$= -0.2\pi \sin \frac{\pi}{2} = -0.2\pi\ rad.s^{-1}$

الجواب (A)

س9)

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

عندما يكون المطال أعظمي موجب فإن:

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

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

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

س10)

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} = 2\pi\sqrt{\frac{2m_1 r_1^2}{k}}$

$T_0 = 2\pi\sqrt{\frac{2\times 0.2\times(0.1)^2}{0.1}}$

$T_0 = 2\pi\sqrt{0.04} = 2\pi\times 2\times 10^{-1}$

$T_0 = 1.25\ s$ (A)

س11)

$\theta = \theta_{max}\cos(\omega_0 t + \varphi)$

نبحث عن الثوابت:

$\theta_{max} = 1\ rad$

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

نحسب $\bar{\varphi}$ من شروط البدء:

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

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

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

$\theta = 1\cos \pi t$ (B)

س12)

$\omega_{max} = |\mp \omega_0 \theta_{max}|$

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

الجواب (C)

س13)

$\alpha = -\omega_0^2\theta$

$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.5} = 4\pi\ rad.s^{-1}$

$\alpha = -(4\pi)^2\times(-0.1) = 16\ rad.s^{-2}$

الجواب (D)

س14)

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

$= \frac{1}{2}(0.1)(0.2)^2 = 2\times 10^{-3}\ J$

الجواب (C)

س15)

$\alpha = -\omega_0^2\theta$

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

$\alpha = -(\pi)^2\times\frac{\pi}{4} = -10\times\frac{\pi}{4}$

$\alpha = -2.5\pi\ rad.s^{-2}$

الجواب (C)

16)
$T_o = 2\pi\sqrt{\frac{I_\Delta}{k}}$ $\quad k = k'\frac{(2r)^4}{\ell}$

$k^* = k'\frac{(2r)^4}{\frac{\ell}{2}} = 2k'\frac{(2r)^4}{\ell} = 2k$

$T_o' = 2\pi\sqrt{\frac{I_\Delta}{2k}} = \frac{1}{\sqrt{2}} \times 2\pi\sqrt{\frac{I_\Delta}{k}}$

$T_o' = \frac{1}{\sqrt{2}} \times T_o$ الجواب (B)

17)
$I_\Delta = \frac{1}{2} m r^2$

$2\times10^{-3} = \frac{1}{2}\times100\times10^{-3}\, r^2$

$2 = 50 r^2 \Rightarrow r^2 = \frac{1}{25} \Rightarrow$

$r = \frac{1}{5} = 0.2\ m \Rightarrow 2r = 0.4\ m$

الجواب (B)

18)
$T_{o_1} = 2\pi\sqrt{\frac{I_\Delta}{k_1}}$ | $T_{o_2} = 2\pi\sqrt{\frac{I_\Delta}{k_2}}$

$k_1 = k'\frac{(2r)^4}{\ell_1}$ | $k_2 = k'\frac{(2r)^4}{\ell_2}$

$k_1 = k'\frac{(2r)^4}{4\ell_2} = \frac{k_2}{4} \Rightarrow$

$T_{o_1} = 2\pi\sqrt{\frac{I_\Delta}{\frac{k_2}{4}}} = 2\pi\sqrt{\frac{4I_\Delta}{k_2}}$

$T_{o_1} = 2\times2\pi\sqrt{\frac{I_\Delta}{k_2}} = 2T_{o_2}$

الجواب (B)

19) ثابت فتل السلكين k^*:

$k^* = k_1 + k_2 = k'\frac{(2r)^4}{\frac{\ell}{2}} + k'\frac{(2r)^4}{\frac{\ell}{2}}$

$k^* = 4k'\frac{(2r)^4}{\ell} = 4k$

$\Rightarrow T_o' = 2\pi\sqrt{\frac{I_\Delta}{4k}} = \frac{1}{2}\times2\pi\sqrt{\frac{I_\Delta}{k}}$

$T_o' = \frac{1}{2}T_o$ (A)

20)
$T_o = 2\pi\sqrt{\frac{I_\Delta}{k}}$ $\quad k = k'\frac{(2r)^4}{\ell}$

$k^* = k'\frac{(2r)^4}{\frac{\ell}{4}} = 4k'\frac{(2r)^4}{\ell} = 4k$

$\Rightarrow T_o' = 2\pi\sqrt{\frac{I_\Delta}{4k}} = \frac{1}{2}\times2\pi\sqrt{\frac{I_\Delta}{k}}$

$T_o' = \frac{1}{2}T_o$ (A)

21) B

22)
$T_o = 2\pi\sqrt{\frac{I_\Delta}{k}} \Rightarrow$

$2 = 2\pi\sqrt{\frac{0.02}{k}}$ نربع الطرفين

$4 = 40\frac{0.02}{k} \Rightarrow k = \frac{40\times0.02}{4}$

$k = 0.2\ mN\,rad^{-1}$ (D)

23) نلاحظ أن:

$T_{o_2} = \frac{1}{2}T_{o_1}$

$\cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{k_2}} = \frac{1}{2}\times\cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{k_1}}$

نربع الطرفين:

6/

$$\frac{1}{k_2} = \frac{1}{4} \times \frac{1}{k_1} \Rightarrow k_2 = 4k_1$$

$$\cancel{k'}\frac{(2r)^4}{\ell_2} = 4 \times \cancel{k'}\frac{(2r)^4}{\ell_1} \Rightarrow$$

$$\frac{1}{\ell_2} = \frac{4}{\ell_1} \Rightarrow \ell_2 = \frac{1}{4}\ell_1$$

أي:

(D) $\ell' = \frac{1}{4}\ell$

س 24)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \qquad k = k'\frac{(2r)^4}{\ell}$$

$$k^* = k'\frac{(2r)^4}{\frac{\ell}{4}} = 4k'\frac{(2r)^4}{\ell} = 4k$$

$$\Rightarrow T_0' = 2\pi\sqrt{\frac{I_\Delta}{4k}} = \frac{1}{2} \times 2\pi\sqrt{\frac{I_\Delta}{k}}$$

$$T_0' = \frac{1}{2}T_0 = \frac{1}{2}(2) = 1\ s \qquad (C)$$

س 25)

$$T_{0_1} = 2T_{0_2}$$

$$\cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{k_1}} = 2 \times \cancel{2\pi}\sqrt{\frac{\cancel{I_\Delta}}{k_2}}$$

نربع الطرفين:

$$\frac{1}{k_1} = 4\frac{1}{k_2} \Rightarrow k_1 = \frac{1}{4}k_2$$

$$\cancel{k'}\frac{(2r)^4}{\ell_1} = \frac{1}{4}\cancel{k'}\frac{(2r)^4}{\ell_2} \Rightarrow$$

$$\ell_1 = 4\ell_2 \qquad (A)$$

س 26) عندما ننقص طول السلك بمقدار الثلث يكون الطول الجديد:

$$\ell' = \ell - \frac{1}{3}\ell = \frac{2}{3}\ell \Rightarrow$$

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \qquad k = k'\frac{(2r)^4}{\ell}$$

$$k^* = k'\frac{(2r)^4}{\frac{2\ell}{3}} = \frac{3}{2}k'\frac{(2r)^4}{\ell} = \frac{3}{2}k$$

$$\Rightarrow T_0' = 2\pi\sqrt{\frac{I_\Delta}{\frac{3}{2}k}} \Rightarrow$$

$$T_0' = 2\pi\sqrt{\frac{2}{3}\frac{I_\Delta}{k}} = \sqrt{\frac{2}{3}} \times 2\pi\sqrt{\frac{I_\Delta}{k}}$$

$$T_0' = \sqrt{\frac{2}{3}}\,T_0 \qquad (B)$$

س 27)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \qquad k = k'\frac{(2r)^4}{\ell}$$

$$k^* = k'\frac{(2r)^4}{\frac{\ell}{5}} = 5k'\frac{(2r)^4}{\ell} = 5k$$

$$T_0' = 2\pi\sqrt{\frac{I_\Delta}{5k}} = \frac{1}{\sqrt{5}} \times 2\pi\sqrt{\frac{I_\Delta}{k}}$$

$$T_0' = \frac{T_0}{\sqrt{5}} \qquad (D)$$

س 28)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \qquad k = k'\frac{(2r)^4}{\ell}$$

القطر $2r = d$

قطر السلك الجديد $d' = \frac{d}{2} \Rightarrow k^* = k'\frac{(\frac{d}{2})^4}{\ell}$

$$k^* = k'\frac{(d)^4}{16\ell} = \frac{1}{16}k'\frac{(d)^4}{\ell} = \frac{1}{16}k$$

$$\Rightarrow T_0' = 2\pi\sqrt{\frac{I_\Delta}{\frac{1}{16}k}} = 2\pi\sqrt{\frac{16I_\Delta}{k}}$$

$$T_0' = 4 \times 2\pi\sqrt{\frac{I_\Delta}{k}} = 4T_0 \qquad (C)$$

س 29)

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}} \qquad k = k'\frac{(2r)^4}{\ell} = k'\frac{(d)^4}{\ell}$$

نأخذ القطر الجديد

$$d' = 2d \Rightarrow k^* = k'\frac{(2d)^4}{\ell} = 16k'\frac{(d)^4}{\ell}$$

$$k^* = 16k$$

$$T_0' = 2\pi\sqrt{\frac{I_\Delta}{16k}} = \frac{1}{4} \times 2\pi\sqrt{\frac{I_\Delta}{k}} = \frac{T_0}{4}$$

(A)

س30) نلاحظ من التابع الزمني للسرعة أنه:

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

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

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

$\omega = -0.2 \sin 2\pi = 0 \ rad.s^{-1}$

الجواب (B)

س31) (A)

س32) $T_0 = 2\pi \sqrt{\frac{I_\Delta}{K}}$

$T_0 = 2\pi \sqrt{\frac{2m_1 r_1^2}{K}} \qquad r = \frac{\ell}{2}$

$2 = 2\pi \sqrt{\frac{2 \times 100 \times 10^{-3} \times \frac{1}{16}}{K}}$

نربع الطرفين:

$4 = 40 \ \frac{2 \times 10^{-1} \times 1}{16 K} \Rightarrow$

$K = \frac{40 \times 2 \times 10^{-1}}{4 \times 16} = \frac{1}{8} = 12.5 \times 10^{-2} \ m.N.rad^{-1}$

الجواب (C)

حل الطالب المتفوق

س1) $T_0 = 2\pi \sqrt{\frac{I_\Delta}{K}} = 2\pi \sqrt{\frac{2m_1 r_1^2}{K}}$

البعد بين الكتلتين $2r$ ⇐ البعد بين الكتلة ومحور الدوران r. لكن عندما يصبح البعد بين الكتلتين $4r$ يصبح البعد بين الكتلة ومحور الدوران $2r$

$\Rightarrow T_0' = 2\pi \sqrt{\frac{2m_1 (2r_1)^2}{K}} = 2 \times 2\pi \sqrt{\frac{2m_1 r_1^2}{K}}$

$T_0' = 2 T_0 \qquad (B)$

س2) $T_0 = 2\pi \sqrt{\frac{I_\Delta}{K}}$

$I_\Delta = I_{\Delta/c}(\text{ساق}) + I_{\Delta/c}(\text{قرص}) = \frac{1}{12} m \ell^2 + \frac{1}{2} m' r^2$

$= \frac{1}{12}(12 \times 10^{-3})(0.1)^2 + \frac{1}{2}(12 \times 10^{-3}) \times 25 \times 10^{-4}$

$= 1 \times 10^{-5} + 15 \times 10^{-5} = 16 \times 10^{-5} \ Kg.m^2$

$\Rightarrow T_0 = 2\pi \sqrt{\frac{16 \times 10^{-5}}{4 \times 10^{-4}}} = 4 \ s \qquad (A)$

س3) $T_0 = 2\pi \sqrt{\frac{I_\Delta}{K}} = 2\pi \sqrt{\frac{2m_1 r_1^2}{K}}$

حيث $r = \frac{\ell}{2}$ ⇐

$T_0 = 2\pi \sqrt{\frac{2m_1 \ell^2}{4K}} = 2\pi \sqrt{\frac{m_1 \ell^2}{2K}}$

$1 = 2\pi \sqrt{\frac{75 \times 10^{-3} \ell^2}{30 \times 10^{-2}}} \Rightarrow$

$1 = 2\pi \sqrt{\frac{25 \times 10^{-2} \ell^2}{1}}$

نربع الطرفين:

$1 = 40 \times 25 \times 10^{-2} \ell^2 \Rightarrow \ell^2 = \frac{1}{10} = \frac{\pi^2}{100}$

$\Rightarrow \ell = \frac{\pi}{10} = 0.1\pi \ m \qquad (C)$

س4) من الشكل نلاحظ أن:

$3\frac{T_0}{4} = 1 \Rightarrow T_0 = \frac{4}{3} s \Rightarrow \omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{\frac{4}{3}}$

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

ومن الشكل نلاحظ:

$t = 0 \qquad \alpha = 0 \qquad \Rightarrow$

$$T_0' = 0.5\sqrt{1 + \frac{2 \times 80 \times 10^{-3} \times \left(\frac{3}{4}\right)^2}{3 \times 10^{-2}}}$$

$$T_0' = 0.5\sqrt{1 + \frac{\cancel{16 \times 10^{-2}} \times 9}{3 \times \cancel{10^{-2}} \times 16}}$$

$$T_0' = 0.5 \times 2 = 1\ S \qquad (A)$$

س6

$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{K}} = 2\pi\sqrt{\frac{2m_1 r_1^2}{K}}$$

نلاحظ أن البعد الجديد $2r'$ هو خمس البعد القديم

$$\Rightarrow T_0' = 2\pi\sqrt{\frac{2m_1\left(\frac{1}{5}r_1\right)^2}{K}}$$

$$T_0' = 2\pi\sqrt{\frac{2m_1 r_1^2}{25K}} = \frac{1}{5} \times 2\pi\sqrt{\frac{2m_1 r_1^2}{K}}$$

$$T_0' = \frac{1}{5}T_0 = \frac{2}{5} = 0.4\ S \qquad (A)$$

س7 نلاحظ من الشكل: $2T_0 = 8 \Rightarrow T_0 = 4\,S$

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

$$\omega_{max} = \mp\frac{\pi^2}{4}\ rad.s^{-1}$$

حساب $\bar{\varphi}$: من شرط البدء

$$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \omega = -\omega_0\theta_{max}\sin(\omega_0 t + \bar{\varphi})$$

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

لكن: $\omega_0 \neq 0$ ، $\theta_{max} \neq 0 \in$

$$\sin\bar{\varphi} = 0 \Rightarrow \varphi = 0, \pi\ rad$$

نختار الحل الذي يجعل السرعة الزاوية سالبة بعد زمن قدره

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

$$0 = -\omega_0^2\theta_{max}\cos\varphi$$

لكن $\omega_0 \neq 0 \quad \theta_{max} \neq 0$

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

نختار الحل الذي يجعل التسارع الزاوي سالب بعد زمن قدره $t = \frac{T_0}{4} = \frac{\frac{4}{3}}{\frac{4}{1}} = \frac{1}{3}S$

$$\varphi = \frac{\pi}{2}rad \Rightarrow \alpha = -\omega_0^2\theta_{max}\cos\left(\frac{3\pi}{2}\times\frac{1}{3}+\frac{\pi}{2}\right)$$

$$\alpha = -\omega_0^2\theta_{max}\underbrace{\cos\pi}_{-1} = +\omega_0^2\theta_{max} > 0$$

حل مرفوض

$$\varphi = \frac{3\pi}{2}rad \Rightarrow \alpha = -\omega_0^2\theta_{max}\cos\left(\frac{3\pi}{2}\times\frac{1}{3}+\frac{3\pi}{2}\right)$$

$$\alpha = -\omega_0^2\theta_{max}\underbrace{\cos 2\pi}_{1} = -\omega_0^2\theta_{max} < 0$$

حل مقبول

$$\Rightarrow \alpha = -0.6\cos\left(\frac{3\pi}{2}t + \frac{3\pi}{2}\right)$$

الجواب (A)

س5 بدون وجود كتلتين

$$T_0 = 2\pi\sqrt{\frac{I_{0\,ساق}}{K}}$$

بوجود كتلتين

$$T_0' = 2\pi\sqrt{\frac{I_{0\,ساق} + 2m_1 r_1^2}{K}}$$

$$\frac{T_0'}{T_0} = \frac{\cancel{2\pi}\sqrt{\frac{I_{0\,ساق}+2m_1r_1^2}{\cancel{K}}}}{\cancel{2\pi}\sqrt{\frac{I_{0\,ساق}}{\cancel{K}}}} \Rightarrow$$

$$T_0' = T_0\sqrt{\frac{I_{0\,ساق}+2m_1r_1^2}{I_{0\,ساق}}}$$

$$T_0' = T_0\sqrt{1 + \frac{2m_1r_1^2}{I_{0\,ساق}}}$$

$\bar{\varphi}=0\ rad \Rightarrow \omega=-\omega_0\,\theta_{max}\sin\left(\frac{\pi}{2}\times 1+0\right)$

$\omega=-\omega_0\,\theta_{max}\underbrace{\sin\frac{\pi}{2}}_{1}=-\omega_0\,\theta_{max}<0$

حل مقبول

$\bar{\varphi}=\pi\ rad \Rightarrow \omega=-\omega_0\,\theta_{max}\sin\left(\frac{\pi}{2}\times 1+\pi\right)$

$\omega=-\omega_0\theta_{max}\underbrace{\sin\frac{3\pi}{2}}_{-1}=+\omega_0\theta_{max}>0$

حل مرفوض

$\Rightarrow \omega=-\frac{\pi^2}{4}\sin\left(\frac{\pi}{2}t\right)$ (c)

8)

$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta=\theta_{max}=\frac{\pi}{2}\ rad$

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

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

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

$\omega=-\omega_0\theta_{max}\sin(\omega_0 t+\bar{\varphi})$

$=-2\pi\times\frac{\pi}{2}\sin(2\pi t)$

$\omega=-10\sin 2\pi t$ (B)

9)

$T_0=2\pi\sqrt{\frac{I_\Delta}{k}} \Rightarrow 1=2\pi\sqrt{\frac{2\times10^{-3}}{k}}$

نربع الطرفين:

$1=40\,\frac{2\times10^{-3}}{k} \Rightarrow k=8\times10^{-2}\ m.N.rad^{-1}$

باعتبار أن:

$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta=\theta_{max}=\frac{\pi}{2}\ rad.s^{-1}$

في وضع التوازن: $\theta=0 \Rightarrow E_p=0$

$\Rightarrow E_k=E=\frac{1}{2}k\,\theta_{max}^2$

$=\frac{1}{2}\times 8\times10^{-2}\times\frac{10}{4}=0.1\ J$

الجواب (c)

10) وجدنا في السؤال رقم (5) أنه:

$T_0'=T_0\sqrt{1+\frac{2m_1 r_1^2}{K}}$

$T_0'=1\sqrt{1+\frac{2\times36\times10^{-3}\times\frac{1}{4}}{2\times10^{-3}}}$

$T_0'=\sqrt{10}=\pi\ s$ (B)

11) وجدنا في السؤال رقم (5) وبعد الاستنتاج أنه الجواب (c)

12) $\theta=\theta_{max}\cos(\omega_0 t+\bar{\varphi})$

نبحث عن الثوابت:

$\omega_0=\sqrt{\frac{K}{I_\Delta}}=\sqrt{\frac{8\times10^{-2}}{2\times10^{-3}}}=2\pi\ rad.s^{-1}$

$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta=\theta_{max}=\frac{\pi}{2}\ rad$

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

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

$\theta=\frac{\pi}{2}\cos 2\pi t$ (A)

10

$T_0' = 6.25 - 1.25 = 5\ s$

$T_0' = 2\pi\sqrt{\frac{I_{\Delta_{قرص}} + I_{\Delta/m_1,m_2}}{K}}$

$T_0' = 2\pi\sqrt{\frac{I_\Delta + 2m_1 r_1'^2}{K}}$

$5 = 2\pi\sqrt{\frac{2\times10^{-2} + 2\times750\times10^{-3}\, r_1'^2}{8\times10^{-2}}}$

نربع الطرفين:

$25 = 40\ \frac{2\times10^{-2} + 1.5 r_1'^2}{8\times10^{-2}} \Rightarrow$

$\frac{25\times8\times10^{-2}}{40} = 2\times10^{-2} + 1.5 r_1'^2$

$5\times10^{-2} - 2\times10^{-2} = 1.5 r_1'^2 \Rightarrow$

$r_1'^2 = \frac{3\times10^{-2}}{1.5} = 2\times10^{-2}$

$r_1' = \sqrt{2}\times10^{-1}$ $\qquad \sqrt{2} = 1.4$

$r_1' = 0.14\ m \Rightarrow 2r_1' = 0.28\ m$

البعد بين الكتلتين

الجواب (D)

16

$\theta = \theta_{max}\cos(\omega_0 t + \varphi)$

نبحث عن الثوابت: نحسب ω_0 ...:

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

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

$\theta_{max} = 0.8\ rad$

$\left.\begin{array}{l} t=0 \\ \theta=\theta_{max}\end{array}\right\} \Rightarrow$ $\theta = \theta_{max}\cos(\omega_0 t + \varphi)$, $\theta_{max} = \theta_{max}\cos\varphi$

13

$\left.\begin{array}{l} t=0 \\ \omega=0\end{array}\right\} \Rightarrow \theta = \theta_{max} = \frac{\pi}{2}\ rad$

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

$= \frac{1}{2}\times8\times10^{-2}\left(\frac{10}{4} - \frac{10}{16}\right)$

$= 4\times10^{-2}\times\frac{30}{16} = 7.5\times10^{-2}\ J$ (D)

14

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}}$

$I_{\Delta_{جملة}} = I_{\Delta_{قرص}} + I_{\Delta_{كتلتين}} = \frac{1}{2}mr^2 + 2m_1 r_1^2$

$= \frac{1}{2}(0.5)(10^{-1})^2 + 2\times400\times10^{-3}\times(10^{-1})^2$

$= 25\times10^{-4} + 8\times10^{-3} = 2.5\times10^{-3} + 8\times10^{-3}$

$= 10.5\times10^{-3}\ kg\,m^2$

$T_0 = 2\pi\sqrt{\frac{10.5\times10^{-3}}{4.2\times10^{-2}}} = 2\pi\sqrt{25\times10^{-2}}$

$T_0 = 2\pi\times5\times10^{-1} = \pi\ s$ (B)

15

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}}$

$I_{\Delta_{جملة}} = I_{\Delta_{قرص}} + I_{\Delta/m_1,m_2} = \frac{1}{2}mr^2 + 2m_1 r_1^2$

$= \frac{1}{2}(1)(20\times10^{-2})^2 + 2\times750\times10^{-3}\times(20\times10^{-2})^2$

$= 2\times10^{-2} + 6\times10^{-2} = 8\times10^{-2}\ kg\,m^2$

$T_0 = 2\pi\sqrt{\frac{8\times10^{-2}}{8\times10^{-2}}} = 2\pi\ s = 6.25\ s$

$T_0' = \pi - 1.14 = 3.14 - 1.14 = 2s$

$T_0' = 2\pi\sqrt{\dfrac{I_{\Delta/\text{ساق}} + 2m_1 r_1'^2}{K}}$

$2 = 2\pi\sqrt{\dfrac{25\times10^{-6} + 2\times20\times10^{-3}\, r_1'^2}{5\times10^{-4}}}$

نربع الطرفين:

$4 = 40\,\dfrac{25\times10^{-6} + 4\times10^{-2}\, r_1'^2}{5\times10^{-4}}$

$\dfrac{4\times5\times10^{-4}}{40} = 25\times10^{-6} + 4\times10^{-2}\, r_1'^2$

$5\times10^{-5} - 2.5\times10^{-5} = 4\times10^{-2}\, r_1'^2$

$2.5\times10^{-5} = 4\times10^{-2}\, r_1'^2$

$r_1'^2 = \dfrac{2.5\times10^{-5}}{4\times10^{-2}} = 625\times10^{-6}$

$r' = 25\times10^{-3} \Rightarrow 2r' = 50\times10^{-3}$

$2r' = 0.05\ m$

س20

$T_0 = 2\pi\sqrt{\dfrac{I_\Delta}{K}} = 2\pi\sqrt{\dfrac{2m_1 r_1^2}{K}}$

لكن $\Leftarrow r = \dfrac{\ell}{2}$

$T_0 = 2\pi\sqrt{\dfrac{2m_1\ell^2}{4K}} = 2\pi\sqrt{\dfrac{m_1\ell^2}{2K}}$

نربع الطرفين:

$T_0^2 = 40\,\dfrac{m_1\ell^2}{2K} \Rightarrow \ell^2 = \dfrac{T_0^2\times2K}{40m_1}$

$\ell^2 = \dfrac{T_0^2 K}{20m_1} \Rightarrow \ell = T_0\sqrt{\dfrac{K}{20m_1}}$ (A)

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

$\Rightarrow \theta = 0.8\cos\frac{\pi}{2}t$ (D)

س17

$E_K = E_t - E_p$

$E_K = \frac{1}{2}K(\theta_{max}^2 - \theta^2)$

$= \frac{1}{2}\times9.2\times10^{-2}\left(\frac{10}{4} - \frac{10}{36}\right)$
(9) (1)

$= \frac{1}{2}\times9.2\times10^{-2}\times\frac{80}{36} = 0.08\ J$

الجواب (D)

س18

$\theta = \theta_{max}\cos(\omega_0 t + \bar{\varphi})$

نبحث عن الثوابت:

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

$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta = \theta_{max} = \dfrac{\pi}{3}\ rad$

$\left.\begin{matrix} t=0 \\ \theta=\theta_{max} \end{matrix}\right\} \Rightarrow \theta_{max} = \theta_{max}\cos\bar{\varphi}$

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

$\Rightarrow \theta = \frac{\pi}{3}\cos\pi t$ (D)

س19

$T_0 = 2\pi\sqrt{\dfrac{I_\Delta}{K}}$

$I_\Delta = I_{\Delta/c\,\text{ساق}} + I_{\Delta/m_1,m_2\,\text{حلقة}}$

$= \frac{1}{12}mr^2 + 2m_1 r_1^2$

$= \frac{1}{12}\times0.02\times(5\times10^{-2})^2 + 2\times20\times10^{-3}\times(5\times10^{-2})^2$

$= 25\times10^{-6} + 100\times10^{-6} = 125\times10^{-6}\ kg\,m^2$

$\Rightarrow T_0 = 2\pi\sqrt{\dfrac{125\times10^{-6}}{5\times10^{-4}}} = 2\pi\times5\times10^{-1} = \pi\ s$

س21)

$$\omega = -\omega_0 \theta_{max} \sin(\omega_0 t + \bar{\varphi})$$

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

$$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta = \theta_{max} = \frac{\pi}{3}\ rad$$

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

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

$$\Rightarrow \omega = -\frac{\pi}{2} \times \frac{\pi}{3} \sin\left(\frac{\pi}{2} t\right)$$

$$\omega = -\frac{10}{6} \sin\frac{\pi}{2} t = -\frac{5}{3} \sin\frac{\pi}{2} t$$

لحظة المرور الثاني بوضع التوازن

$$t = \frac{3T_0}{4} = \frac{3\times4}{4} = 3\ s \Rightarrow$$

$$\omega = -\frac{5}{3} \sin\frac{3\pi}{2} = +\frac{5}{3}\ rad.s^{-1}$$

الجواب (D)

س22)

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

$$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta = \theta_{max} = \frac{\pi}{2}\ rad$$

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

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

$$\omega = -\omega_0 \theta_{max} \sin(\omega_0 t + \bar{\varphi})$$

$$\omega = -\pi \times \frac{\pi}{2} \sin(\pi t)$$

$$\omega = -5 \sin \pi t$$

لحظة المرور الأول بوضع التوازن

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

$$\omega = -5 \underbrace{\sin\frac{\pi}{2}}_{1} = -5\ rad.s^{-1}$$

س23) نبحث عن الثوابت:

$$T_0 = 2\pi\sqrt{\frac{I_0}{k}}$$

$$I_0 = \frac{1}{2} m r^2 = \frac{1}{2} \times 2 \times (4\times10^{-2})^2$$

$$= 16\times10^{-4}\ kg\,m^2$$

$$T_0 = 2\pi\sqrt{\frac{16\times10^{-4}}{16\times10^{-3}}} = 2\ S \Rightarrow$$

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

$$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta = \theta_{max} = \frac{\pi}{4}\ rad$$

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

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

$$\Rightarrow \bar{\theta} = \frac{\pi}{4} \cos \pi t \qquad (D)$$

13

24

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{k}}$

$I_\Delta = I_{\Delta\,قرص} + I_{\Delta\,ساق} + I_{\Delta / m_1, m_2}$
كلي

$= \frac{1}{2}mr^2 + \frac{1}{12}ML^2 + 2m_1r_1^2$

$= \frac{1}{2}(0.12)(5\times10^{-2})^2 + \frac{1}{12}(0.012)(0.1)^2$

$+ 2(0.05)(0.02)^2$

$I_\Delta = 15\times10^{-5} + 1\times10^{-5} + 4\times10^{-5}$
كلي

$= 20\times10^{-5} = 2\times10^{-4}\ kg\,m^2$

$T_0 = 2\pi\sqrt{\frac{2\times10^{-4}}{8\times10^{-4}}} = \pi\ s$

$T_0' = 3.14 + 0.86 = 4\ s$

$T_0' = 2\pi\sqrt{\frac{I_{\Delta\,قرص} + I_{\Delta\,ساق} + 2m_1r_1'^2}{K}}$

$4 = 2\pi\sqrt{\frac{16\times10^{-5} + 2\times0.05\,r_1'^2}{8\times10^{-4}}}$

نربع الطرفين:

$16 = 40\,\frac{16\times10^{-5} + 0.1\,r_1'^2}{8\times10^{-4}}$

$\frac{16\times8\times10^{-4}}{40} = 16\times10^{-5} + 0.1\,r_1'^2$

$32\times10^{-5} - 16\times10^{-5} = 0.1\,r_1'^2$

$0.1\,r_1'^2 = 16\times10^{-5} \Rightarrow r_1'^2 = 16\times10^{-4}$

$r_1' = 4\times10^{-2}\,m \Rightarrow 2r_1' = 0.08\,m$ (D)

25

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{K}} = 2\pi\sqrt{\frac{2m_1r_1^2}{k}}$

$T_0 = 2\pi\sqrt{\frac{2\times0.2(0.1)^2}{0.1}} = 0.4\pi\ S$

$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{0.4\pi} = 5\ rad.s^{-1}$

$\theta_{max} = 1\ rad$

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

$\theta_{max} = \theta_{max}\cos\bar\varphi \Rightarrow$

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

$\theta = 1\cos 5t$ (C)

26

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

$\left.\begin{array}{l} t=0 \\ \omega=0 \end{array}\right\} \Rightarrow \theta = \theta_{max} = \frac{\pi}{3}\,rad$

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

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

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

$\omega = -\omega_0\theta_{max}\sin(\omega_0 t + \bar\varphi)$

$\omega = -2\pi\times\frac{\pi}{3}\sin(2\pi t)$

$\omega = -\frac{20}{3}\sin 2\pi t$

لحظة لمرور الأول بوضع التوازن

$t = \frac{T_0}{4} = \frac{1}{4}s \Rightarrow \omega = -\frac{20}{3}\sin 2\pi\times\frac{1}{4}$

$\Rightarrow \omega = -\frac{20}{3}\ rad.s^{-1}$ (A)

27) نعلم من الشكل:

$2T_0 = 8 \Rightarrow T_0 = 4\,s$

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

$\omega_{max} = +\frac{\pi^2}{8}\ rad.s^{-1}$

$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \omega = -\omega_0 \theta_{max} \sin(\omega_0 t + \varphi)$

$0 = -\omega_0 \theta_{max} \sin \varphi$

لكن $\theta_{max} \neq 0$ ، $\omega_0 \neq 0$

$\Rightarrow \sin\varphi = 0 \Rightarrow \varphi = \left\{\begin{matrix} 0 \\ \pi \end{matrix}\right. rad$

نختار الحل الذي يجعل السرعة الزاوية سالبة

من أجل زمن $t = \frac{T_0}{4} = \frac{4}{4} = 1\,s$

$\varphi = 0\ rad \Rightarrow \omega = -\omega_0 \theta_{max} \sin(\frac{\pi}{2} \times 1 + 0)$

$\omega = -\omega_0 \theta_{max} < 0$ حل مقبول

$\varphi = \pi\ rad \Rightarrow \omega = -\omega_0 \theta_{max} \sin(\frac{\pi}{2} \times 1 + \pi)$

$\omega = -\omega_0 \theta_{max} \underbrace{\sin\frac{3\pi}{2}}_{-1} = +\omega_0 \theta_{max} > 0$

حل مرفوض

$\omega = -\frac{\pi^2}{8} \sin(\frac{\pi}{2} t)$ (D)

28) $T_0 = 2\pi \sqrt{\frac{I_\Delta}{k}} = 2\pi \sqrt{\frac{2m_1 r_1^2}{k}}$

$r = \frac{l}{2}$

$T_0 = 2\pi \sqrt{\frac{2m_1 l^2}{4k}}$

$\Rightarrow T_0^2 = 40 \frac{2m_1 l^2}{4K} \Rightarrow$

$l^2 = \frac{T_0^2 \times 4K}{40 \times 2m_1}$

$l^2 = \frac{T_0^2 K}{20 m_1} \Rightarrow l = T_0 \sqrt{\frac{K}{20 m_1}}$

$l = 2.5 \sqrt{\frac{16 \times 10^{-3}}{20 \times 125 \times 10^{-3}}}$

$l = 2.5 \times 8 \times 10^{-2} = 0.2\,m$ (A)