حل الاختبار الشامل للنواسات

السؤال الأول:

1) مطالة

$$T_0 = 2\pi\sqrt{\frac{L}{g}}$$

عندما يصبح $L' = \frac{L}{4}$

$$T_0' = 2\pi\sqrt{\frac{\frac{L}{4}}{g}} = \frac{1}{2}\times 2\pi\sqrt{\frac{L}{g}} = \frac{1}{2}T_0$$

$$T_0' = \frac{1}{2}\times 2 = 1\,s$$

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

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

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

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

$$T_0' = \frac{1}{2}T_0$$

4)

$$\Delta E_K = \sum \vec{W}_F$$

$$E_{K_2} - E_{K_1} = W_{\vec{w}} + W_{\vec{R}}$$

الوضع البدائي: $\theta = \theta_{max}$ بدون سرعة ابتدائية

الوضع النهائي: $\theta = 0$

$$\frac{1}{2}I_\Delta\omega^2 - 0 = mgh + 0$$

نقطة تأثير $\vec{R}$ تنتقل

$$\omega = \sqrt{\frac{2mgh}{I_\Delta}} = \sqrt{\frac{2mgd(1-\cos\theta_{max})}{I_\Delta}}$$

2

$I_{\Delta/0} = I_{\Delta/C} + md^2$ حسب هايغنز

$d = OC = \frac{L}{2}$ حسب

$$= \frac{1}{12}mL^2 + m\frac{L^2}{4}$$

(1) (3)

$$= \frac{4}{12}mL^2 = \frac{1}{3}mL^2$$

$$\Rightarrow \omega = \sqrt{\frac{2\times 4g\frac{L}{2}(1-\cos\theta_{max})}{\frac{1}{3}\times 4L^2}}$$

$$\omega = \sqrt{\frac{3g(1-\cos\theta_{max})}{L}}$$

$$\omega = \sqrt{\frac{3(10)(1-\frac{1}{2})}{1.5}} = \pi\ rad.s^{-1}$$

5)

T_0 بسيط $= T_0$ مركب

$$2\pi\sqrt{\frac{L}{g}} = 2$$ نربع

$$40\frac{L}{10} = 4 \Rightarrow 4L = 4 \Rightarrow$$

$$L = 1m$$

السؤال الثاني: صفحة 16 من الكتاب

السؤال الثالث: صفحة 21 + 22 من الكتاب

حتى (أجرب واستنتج) + صفحة 23 من محاور

نواس الفتل + استنتج صفحة 24

السؤال الرابع: صفحة 30 من الكتاب

+ صفحة 31 حتى نهاية دورات الرموز

السؤال الخامس:

1) صفحة 9 إلى 10 من الكتاب (منتصفها)

2) صفحة 32 من الكتاب (التعريف أول الصفحة)
صفحة 32 آخر النصف (الا ستنتاج).

المسألة الأولى:

(1

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

$$2X_{max} = 10\,cm \Rightarrow X_{max} = 5\times10^{-2}\,m$$

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

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

حساب $\bar{\varphi}$ من شروط البدء:

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

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

$$\Rightarrow \bar{x} = 5\times10^{-2}\cos\left(\frac{\pi}{10}t\right)$$

(2

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

$$= \frac{\pi}{10}\times5\times10^{-2} = 5\pi\times10^{-3}\ m.s^{-1}$$

(3

$$a = -\omega_0^2 X = -\omega_0^2 \times(-X_{max})$$

$$a = +\omega_0^2 X_{max} = +\frac{10}{100}\times5\times10^{-2}$$

$$a = 5\times10^{-3}\ m.s^{-2}$$

(4

$$\omega_0 = \sqrt{\frac{k}{m}} \Rightarrow \omega_0^2 = \frac{k}{m} \Rightarrow$$

$$k = \omega_0^2 m = \frac{10}{100}\times1 = 0.1\ N.m^{-1}$$

(b

$$F = kX = 0.1\times2\times10^{-2}$$

$$= 2\times10^{-3}\ N$$

(c

$$E_p = \frac{1}{2}kx^2 = \frac{1}{2}(0.1)(2\times10^{-2})^2$$

$$= 0.05\times4\times10^{-4} = 2\times10^{-5}\ J$$

$$E = \frac{1}{2}kX_{max}^2 = \frac{1}{2}(0.1)(5\times10^{-2})^2$$

$$= 0.05\times25\times10^{-4} = 12.5\times10^{-5}\ J$$

$$E_k = E - E_p = 12.5\times10^{-5} - 2\times10^{-5}$$

$$= 10.5\times10^{-5}\ J$$

المسألة الثانية:

(1

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

نصف

$$2\times10^{-2} = \frac{1}{2}m(20\times10^{-2})^2$$

$$2\times10^{-2} = m\times2\times10^{-2} \Rightarrow m = 1\,kg$$

(2

$$k = \omega_0^2 I_{\Delta} = \left(\frac{2\pi}{T_0}\right)^2 . I_{\Delta}$$

$$k = \left(\frac{2\pi}{2}\right)^2 \times 2\times10^{-2} = 0.2\ mN.rad^{-1}$$

13

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

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

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

نحسب $\bar{\varphi}$ من شروط البدء:

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

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

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

$\Rightarrow \bar{\theta} = \pi \cos(\pi t)$

14

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

$\omega = -10 \sin \pi t$

لكن لحظة المرور الأول بوضع التوازن

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

$\Rightarrow \omega = -10 \sin\frac{\pi}{2} = -10 rad.s^{-1}$

15

$\alpha = -\omega_0^2 \theta = -10 \times -\frac{\pi}{2} = +5\pi \ rad.s^{-2}$

16

$E = \frac{1}{2} K \theta_{max}^2 = \frac{1}{2}(0.2)(10) = 1 J$

المسألة الثالثة:

(1

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

$I_\Delta = I_{\Delta_{بسيط}} + I_{\Delta/m_2} = \frac{1}{12} m_1 L^2 + m_2 r_2^2$

$= \frac{1}{12} m_1 L^2 + m_1 \left(\frac{L}{2}\right)^2 = \frac{1}{12} m_1 L^2 + m_1 \frac{L^2}{4}$

(1) (1

$= \frac{4}{12} m_1 L^2 = \frac{1}{3} m_1 L^2$

$m = 2m_1$

$d = \frac{m_1 \bar{r}_1 + m_1 \bar{r}_2}{m_1 + m_2} = \frac{0 + m_1 \frac{L}{2}}{2m_1}$

$d = \frac{L}{4} (m) \Rightarrow$

$T_0 = 2\pi\sqrt{\frac{\frac{1}{3} m_1 L^2}{2m_1 g \frac{L}{4}}} = 2\pi\sqrt{\frac{2L}{3g}}$

$T_0 = 2\pi\sqrt{\frac{2(\frac{3}{2})}{3(10)}} = 2 S$

12

$T_{0_{بسيط}} = T_{0_{مركب}}$

$2\pi\sqrt{\frac{L}{g}} = 2 \Rightarrow 40\frac{L}{10} = 4$

$\Rightarrow L = 1 m$

المسألة الرابعة:

$m_1 = m_2 = 100g$

1) $K = \omega_0^2 I_0$ (*)

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

$I_0 = I_{0/m_1} + I_{0/m_2} = 2m_1 r_1^2$ $r = \frac{L}{2}$

$= 2 \times 100 \times 10^{-3} \times (20 \times 10^{-2})^2$

$= 0.2 \times 4 \times 10^{-2} = 8 \times 10^{-3} \ kgm^2$

نعوض في (*):

$K = 10 \times 8 \times 10^{-3} = 8 \times 10^{-2} \ mN \ rad^{-1}$

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

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

$t=0, \ \omega=0 \Rightarrow \bar{\theta} = \theta_{max} = \frac{\pi}{3} \ rad$

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

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

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

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

3) b

$v_{m_2} = \omega . r_{m_2}$

$= \frac{\pi}{2} \times \frac{3}{4} = \frac{3\pi}{8} \ m.s^{-1}$

4) a

$\Delta E_K = \sum \bar{W}_{\bar{F}}$

$E_{K_2} - E_{K_1} = W_{\vec{w}} + W_{\vec{R}}$

الوضع البدائي: $\theta = \theta_{max}$ بدون سرعة ابتدائية

الوضع النهائي: $\theta = 0$

$\frac{1}{2} I_0 \omega^2 - 0 = 2mgh + 0$

نعوض h بـ $\vec{R}$ تنتقل

$\omega = \sqrt{\frac{4mgh}{I_0}} = \sqrt{\frac{4 \times mg\frac{L}{4}(1-\cos\theta_{max})}{\frac{1}{3} \times mL^2}}$

$\omega = \sqrt{\frac{3g(1-\cos\theta_{max})}{4L}}$

$\omega = \sqrt{\frac{3(10)(1-\frac{1}{2})}{4(\frac{3}{2})}} = \frac{\pi}{2} \ rad.s^{-1}$

$$\omega = -\omega_0 \theta_{max} \sin(\omega_0 t + \bar{\varphi}) \quad ;3$$

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

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

لحظة إمرار الأول بموضع التوازن

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

$$\Rightarrow \omega = -\frac{10}{3} \underbrace{\sin \frac{\pi}{2}}_{1} = -\frac{10}{3}\ rad\,s^{-1}$$

(4

$$T_0 = 2\pi \sqrt{\frac{I_0}{k}} \qquad k = k' \frac{(2r)^4}{L}$$

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

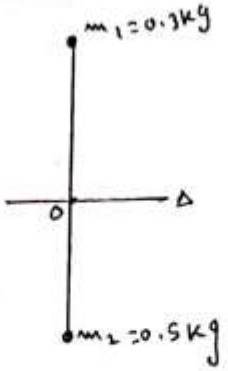
$$k^* = 2k \Rightarrow$$

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

$$T_0' = \frac{1}{\sqrt{2}} \times 2\pi \sqrt{\frac{I_0}{k}} = \frac{T_0}{\sqrt{2}}$$

$$T_0' = \frac{2}{\sqrt{2}}\ s$$

9/



المسألة الثانية:

(1

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

$$I_0 = m_1 r_1^2 + m_2 r_2^2 \qquad r = \frac{L}{2}$$

علماً أن

$$= 0.3\left(\frac{1}{4}\right)^2 + (0.5)\left(\frac{1}{4}\right)^2$$

$$= \frac{0.8}{16} = 0.05\,kg\,m^2$$

$$m_{\text{علماً أن}} = m_1 + m_2 = 0.3 + 0.5 = 0.8\,kg$$

$$d = OC = \frac{m_1 \bar{r}_1 + m_2 \bar{r}_2}{m_1 + m_2}$$

$$d = \frac{(0.3)\left(-\frac{1}{4}\right) + (0.5)\left(\frac{1}{4}\right)}{0.8}$$

$$d = \frac{\frac{1}{4}(0.2)}{0.8} = \frac{1}{16}\,m \Rightarrow$$

$$T_0 = 2\pi \sqrt{\frac{0.05}{0.8 \times 10 \times \frac{1}{16}}} = 2\,S$$

12

$$T_{0\,\text{بسيط}} = T_{0\,\text{ركب}}$$

$$2\pi\sqrt{\frac{L}{g}} = 2 \Rightarrow$$

$$\pi^2 \frac{L}{10} = 4 \Rightarrow 4L = 40 \Rightarrow$$

$$L = 1m$$

13

$$\Delta E_K = \sum \vec{W}_{\vec{F}}$$

$$E_{K_2} - E_{K_1} = W_{\vec{w}} + W_{\vec{R}}^{0}$$

الوضع البدائي: $\theta = \theta_{max}$

بدون سرعة ابتدائية

الوضع النهائي: $\theta = 0$

$$\frac{1}{2} I_\Delta \omega^2 - 0 = mgh + 0$$

نقطة تأثير $\vec{R}$ تنعدم

$$\omega = \sqrt{\frac{2mgh}{I_\Delta}} = \sqrt{\frac{2mgd(1-\cos\theta_{max})}{I_\Delta}}$$

$$\omega = \sqrt{\frac{2 \times 0.8 \times 10 \times \frac{1}{16}(1-\frac{1}{2})}{0.05}} = \pi \ rad.s^{-1}$$

(4

$$v_{m_2} = \omega r_{m_2} = \pi \times \frac{1}{4}$$

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