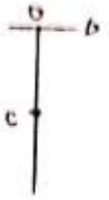
حل اختبار النواس الثقلي

الحالة الأولى:



$T_0 = 2\pi\sqrt{\frac{I_\Delta}{mgd}}$ (ن 1)

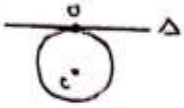
$d = OC = \frac{L}{2}$

$I_{\Delta 10} = I_{\Delta 1C} + md^2$ هايغنز

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

(1) (1)

$T_0 = 2\pi\sqrt{\frac{\frac{1}{3}mL^2}{mg\frac{L}{2}}} = 2\pi\sqrt{\frac{2L}{3g}}$



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

$d = OC = R$

$I_{\Delta 10} = I_{\Delta 1C} + md^2$

$= mR^2 + mR^2 = 2mR^2$

$T_0 = 2\pi\sqrt{\frac{2mR^2}{mgR}} = 2\pi\sqrt{\frac{2R}{g}}$

$T_0' \simeq T_0\left[1 + \frac{\theta_{max}^2}{16}\right]$ (ن 3)

$\simeq 2\pi\sqrt{\frac{\ell}{g}}\left[1 + \frac{\theta_{max}^2}{16}\right]$

$\simeq 2\pi\sqrt{\frac{40\times10^{-2}}{10}}\left[1 + \frac{(\frac{\pi}{3})^2}{16}\right]$

1

$T_0 \simeq 0.4\pi\left[1 + \frac{10}{144}\right]$

$\simeq 1.25\left[\frac{154}{144}\right] \simeq 1.335$

$\Gamma_{\vec{w}10} = -mgd\sin\theta$ (ن 4)

$T_0 = 2\pi\sqrt{\frac{I_\Delta}{mgd}}$ (ن 5)

I_Δ هايغنز $= I_{\Delta 1 m_1} + I_{\Delta 1 m_2}$

$= m_1 r_1^2 + m_2 r_2^2$

$= (0.4)(0.2)^2 + (0.6)(0.8)^2$

$= 0.016 + 0.384 = 0.4\ kg\,m^2$

m هايغنز $= m_1 + m_2 = 0.4 + 0.6 = 1kg$

$d = \frac{m_1\bar{r}_1 + m_2\bar{r}_2}{m_1+m_2} = \frac{(0.4)(-0.2)+(0.6)(0.8)}{1}$

$d = 0.4\ m$

$\Rightarrow T_0 = 2\pi\sqrt{\frac{0.4}{1\times10\times0.4}} = 2S$

السؤال الثاني: الحل صفحة 30 + 31 من الكتاب

السؤال الثالث: الحل صفحة 32 حتى نهاية الملاحظة + صفحة 34 حتى نهاية الملاحظة

السؤال الرابع: المقرر في صفحة 32 من الكتاب + من بداية الملاحظة صـ32

السؤال الخامس:

1) صفحة 35 من الكتاب حتى بداية (2)

2) صفحة 35 من الكتاب من بداية (2) وحتى نهاية الصفحة

السؤال السادس:

المسألة الأولى:

1)

$$\Delta E_K = \sum W_F$$

$$E_{K_2} - E_{K_1} = W_{\vec{W}} + W_{\vec{T}}$$

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

الوضع النهائي: $\theta = 0$

$$\frac{1}{2}mv^2 - 0 = mgh + W_{\vec{T}}$$

$W_{\vec{T}} = 0$ حامل $\vec{T}$ عمودا على الانتقال في كل لحظة

$$v^2 = 2gh \Rightarrow v = \sqrt{2gh}$$

$$v = \sqrt{2gl(1-\cos\theta_{max})}$$

$$v = \sqrt{2(10)(1)\left(1-\frac{1}{2}\right)} = \pi \ m.s^{-1}$$

2)

$$\sum \vec{F} = m\vec{a}$$

$$\vec{W} + \vec{T} = m\vec{a}$$

بالإسقاط على المحور الناظم الذي له نفس حامل وجهة $\vec{T}$

$$-W + T = ma_c$$

$$T = mg + m\frac{v^2}{r}$$

$$T = mg + m\frac{2gl(1-\cos\theta_{max})}{l}$$

$$T = mg + 2mg(1-\cos\theta_{max})$$

$$= mg + 2mg - 2mg\cos\theta_{max}$$

$$T = 3mg - 2mg\cos\theta_{max}$$

$$T = mg(3 - 2\cos\theta_{max})$$

$$T = 0.1 \times 10\left(3 - 2\left(\frac{1}{2}\right)\right) = 2N$$

3)

$$T_0' \simeq T_0\left[1 + \frac{\theta_{max}^2}{16}\right]$$

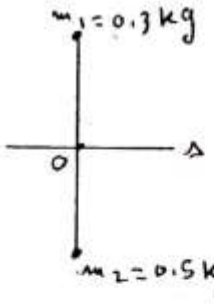
$$\simeq 2\pi\sqrt{\frac{l}{g}}\left[1 + \frac{\theta_{max}^2}{16}\right]$$

$$\simeq 2\pi\sqrt{\frac{1}{10}}\left[1 + \frac{\left(\frac{\pi}{3}\right)^2}{16}\right]$$

$$\simeq 2\left[1 + \frac{10}{144}\right] \simeq 2\left[\frac{154}{144}\right]$$

$$\simeq 2.135$$

المسألة الثانية:



$$T_0 = 2\pi\sqrt{\frac{I_\Delta}{mgd}} \qquad (1)$$

I_Δ طبيعة $= I_{\Delta/m_1} + I_{\Delta/m_2}$

$$= m_1 r_1^2 + m_2 r_2^2 = (0.3)\left(\frac{1}{4}\right)^2 + (0.5)\left(\frac{1}{4}\right)^2$$

$$= 0.05\ kg\,m^2$$

m طبيعة $= m_1 + m_2 = 0.3 + 0.5 = 0.8\ kg$

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

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

$$d = \frac{1}{16}\ m$$

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

(2)

$$\Delta E_k = \sum \bar{W}_{\vec{F}}$$

$$E_{k_2} - E_{k_1} = W_{\vec{w}} + W_{\vec{R}}$$

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

الوضع النهائي: $\theta = 0$

3/

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

↓

نقطة تأثير $\vec{R}$ تنعدم

$$\omega = \sqrt{\frac{2mgh}{I_\Delta}}$$

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

$$\omega = \sqrt{\frac{2(0.8)(10)\left(\frac{1}{16}\right)\left(1-\frac{1}{2}\right)}{0.05}}$$

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

$$v_c = \omega r_c = \omega d = \frac{\pi}{16}\ m.s^{-1}$$

(3)

$T_0 = T_0$ بسيط مركب

$$2\pi\sqrt{\frac{\ell}{g}} = 2 \quad \text{بسيط}$$

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

$$\ell = 1\ m$$

المسألة الثالثة:

(1

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

$$I_\Delta = I_{\Delta 1} + I_{\Delta m_2}$$

حيث: نظم

$$= \frac{1}{2}m_1 r_1^2 + m_2 r_2^2 = \frac{3}{2}m_1 r^2$$

حيث: $m = m_1 + m_2 = 2m_1$

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

$$d = \frac{r}{2} \Rightarrow$$

$$T_0 = 2\pi\sqrt{\frac{\frac{3}{2}m_1 r^2}{m_1 g \frac{r}{2}}}$$

$$T_0 = 2\pi\sqrt{\frac{3r}{2g}} = 2\pi\sqrt{\frac{3(\frac{1}{6})}{2(10)}}$$

$$T_0 = 1S$$

(2

$$v_c = \frac{\pi}{6}\ m.s^{-1}$$

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

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

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

وبدون سرعة ابتدائية

الوضع النهائي: $\theta = 0$

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

$$\frac{1}{2}\cdot\frac{3}{2}mr^2\left(\frac{v}{r}\right)^2 = mg\frac{r}{2}(1-\cos\theta_{max})$$

$$\frac{3}{4}r^2\frac{v^2}{r^2} = gr(1-\cos\theta_{max})$$

$$3v^2 = gr(1-\cos\theta_{max})$$

$$3\left(\frac{\pi}{6}\right)^2 = 10\left(\frac{1}{6}\right)(1-\cos\theta_{max})$$

$$\frac{1}{2} = 1-\cos\theta_{max} \Rightarrow$$

$$\cos\theta_{max} = \frac{1}{2} \Rightarrow \theta_{max} = \frac{\pi}{3}\ rad$$

المسألة الرابعة:

(1

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

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

$$\left.\begin{matrix} t=0 \\ \omega=0 \end{matrix}\right\} \Rightarrow \theta = \theta_{max} = \frac{1}{24\pi}\ rad$$

نحسب $\bar{\varphi}$ من شروط البدء:

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

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

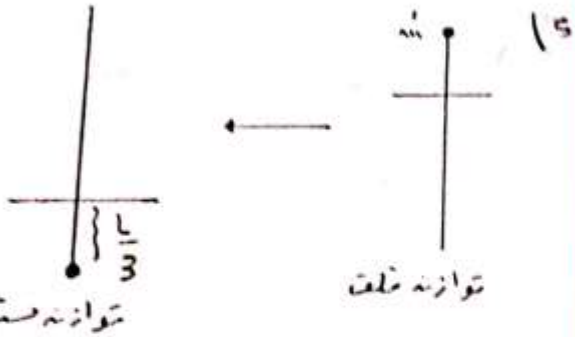
$$\cos\bar{\varphi} = 1 \Rightarrow \bar{\varphi} = 0\ rad$$

$$\Rightarrow \bar{\theta} = \frac{1}{24\pi}\cos(\pi t)$$

$$\omega_{max} = |\omega_0 \theta_{max}| \quad (4$$

$$= \left|\pi \times \frac{1}{24\pi}\right| = \frac{1}{24}\ rad.s^{-1}$$

(5



توازن مستقر — توازن مختل

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

$$I_{\Delta/m'} = m'r^2 = m'\left(\frac{L}{3}\right)^2$$

$$= \frac{1}{9}m'L^2$$

$$d = OC = \frac{L}{3}$$

$$\Rightarrow T_0 = 2\pi\sqrt{\frac{\frac{1}{9}m'L^2}{m'g\frac{L}{3}}}$$

$$T_0 = 2\pi\sqrt{\frac{L}{3g}}$$

$$T_0 = 2\pi\sqrt{\frac{0.6}{3\times 10}}$$

$$T_0 = 2\sqrt{0.2} \simeq 0.9\ s$$

(2

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

$$I_\Delta = I_{\Delta/m'_1} + I_{\Delta/m'_2} = m'_1r^2 + m'_2r'^2$$

$$= m'\left(\frac{L}{3}\right)^2 + m'\left(\frac{2}{3}L\right)^2$$

$$= \frac{1}{9}m'L^2 + \frac{4}{9}m'L^2 = \frac{5}{9}m'L^2$$

$$m = m' + m' = 2m'$$

$$d = OC = \frac{m'_1\bar{r}_1 + m'_1\bar{r}_2}{m'_1 + m'_2} = \frac{m'\left(-\frac{L}{3}\right) + m'\left(\frac{2L}{3}\right)}{2m'}$$

$$d = \frac{\frac{L}{3}m'}{2m'} = \frac{L}{6}$$

$$\Rightarrow T_0 = 2\pi\sqrt{\frac{\frac{5}{9}m'L^2}{2m'g\frac{L}{6}}}$$

$$T_0 = 2\pi\sqrt{\frac{5L}{3g}}$$ نربع

$$T_0^2 = 4\pi^2\frac{5L}{3\times 10} \Rightarrow L = \frac{3\times T_0^2}{20}$$

$$L = \frac{3\times 4}{20} = \frac{3}{5} \simeq 0.6\ m$$

(3

$I_\Delta = \frac{5}{9} m' L^2$:نجد

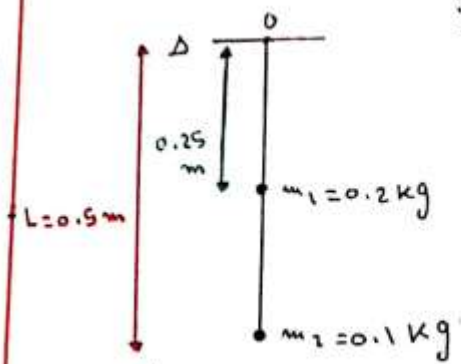
$0.1 = \frac{5}{9} m' (0.6)^2$

$0.1 = m' \frac{5 \times 0.36}{9} \Rightarrow m' = \frac{0.1 \times 9}{5 \times 0.36}$

$m' = 0.5 \ kg$

المسألة الثانية:

(1



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

$J_\Delta = m_1 r_1^2 + m_2 r_2^2 = (0.2)\left(\frac{1}{4}\right)^2 + (0.1)\left(\frac{1}{2}\right)^2$:نجد

$= \frac{0.2}{16} + \frac{0.1}{4} = \frac{0.6}{16} = \frac{3}{80} \ kg\,m^2$

(1) (4)

m :نجد $= m_1 + m_2 = 0.2 + 0.1 = 0.3 \ kg$

$d = \frac{m_1 \bar{r_1} + m_2 \bar{r_2}}{m_1 + m_2} = \frac{(0.2)(\frac{1}{4}) + (0.1)(\frac{1}{2})}{0.3}$

$d = \frac{\frac{2}{20}}{\frac{3}{10}} = \frac{1}{3} \ m$

$T_0 = 2\pi \sqrt{\frac{\frac{3}{80}}{0.3 \times 10 \times \frac{1}{3}}} = \sqrt{\frac{3}{2}} \ s$

(2 (a

$v_c = \omega r_c$

$\frac{2\pi}{5}\sqrt{\frac{2}{3}} = \omega \frac{1}{3} \Rightarrow$

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

$\Rightarrow \quad v_{m_2} = \omega . r_{m_2} = 2\pi\sqrt{\frac{2}{3}} \times 0.1$

$= 0.2\pi\sqrt{\frac{2}{3}} \ m.s^{-1}$

(b

$\Delta E_K = \sum \vec{W_F}$

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

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

الوضع النهائي: $\theta = 0$

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

نقطة تأثير $\vec{R}$ تنعدم

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

$\frac{I_\Delta \omega^2}{2mgd} = 1 - \cos\theta_{max}$

$\cos\theta_{max} = 1 - \frac{I_\Delta \omega^2}{2mgd}$

$= 1 - \frac{\frac{3}{80} \times \frac{80}{3}}{2 \times 0.3 \times 10 \times \frac{1}{3}}$

$\cos\theta_{max} = 1 - \frac{1}{2} = \frac{1}{2} \Rightarrow$

$\theta_{max} = \frac{\pi}{3} \ rad$