Sample Exam III Solutions

1)

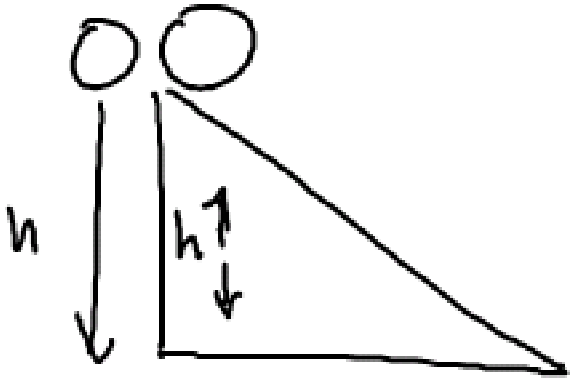
$\vec{a}$ direction is?

$$\vec{a} = \frac{\Delta\vec{v}}{t}$$

$$\vec{a} = \frac{\vec{v}_F - \vec{v}_i}{t}$$

$$\vec{a} = \vec{v}_F + (-\vec{v}_i)$$

2)



$$mgh = \frac{1}{2}mv^2$$

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

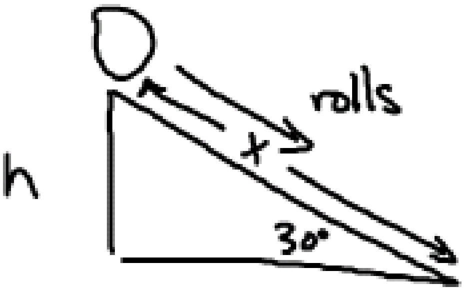
$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\frac{v^2}{r^2}$$

$$mgh = \frac{7}{10}mv^2$$

$$\sqrt{\frac{10}{7}gh} = v_2$$

3) from #2 $V_F = \sqrt{\frac{10}{7}gh}$



(will roll w/ constant a)

$x \sin 30 = h$

$\frac{1}{2}x = h$

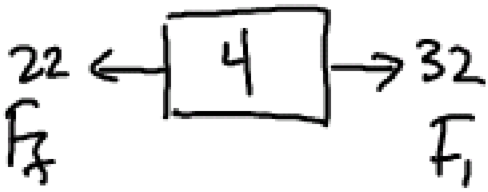
$x = 2h$

$$V_F^2 = \cancel{V_0^2}^{\,0} + 2a\Delta x$$

$$\frac{10}{7}gh = 2a(2h)$$

$$\frac{10}{28}g = a$$

4)



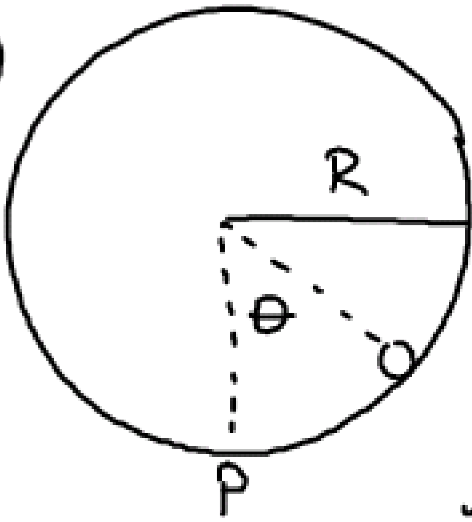
$F_{NET} = 10$ $\qquad a = \frac{10}{4} = 2.5\ \frac{m}{s^2}$

$\Delta x = \cancel{v_0 t}^{\,0} + \frac{1}{2}at^2$ $\qquad \Delta x = \frac{1}{2}(2.5)(10)^2$

$= 125$

$W = Fd = 22(125)$

5)



question should say

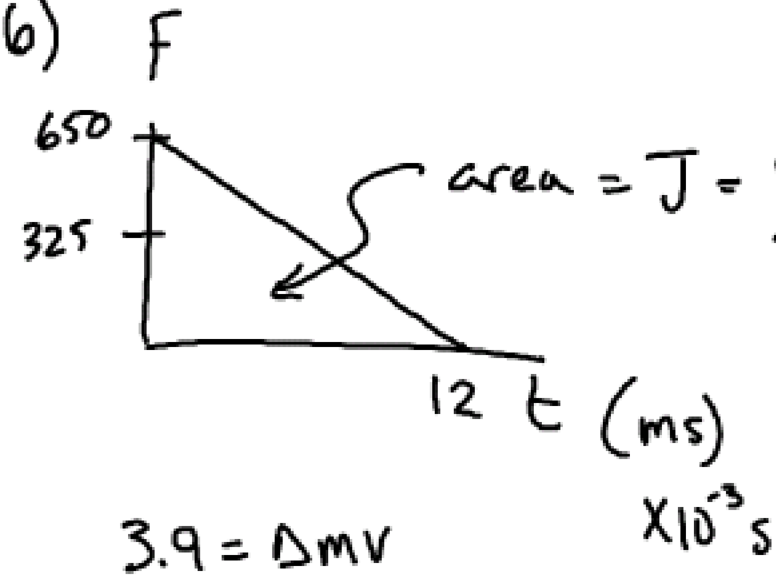
"oscillation speed is ω"

ω for pendulum

$$T = \frac{2\pi}{\omega}$$

$$\omega = \frac{2\pi}{2\pi\sqrt{\frac{l}{g}}} = \sqrt{\frac{g}{l}}$$

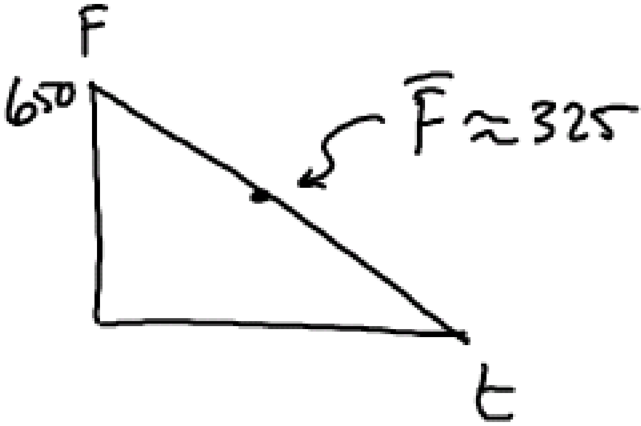
6)



$$3.9 = \Delta mv$$

$$\frac{3.9}{0.025} = \Delta v = V_F - \cancel{V_i}^{0} = 156\,\frac{m}{s}$$

7)

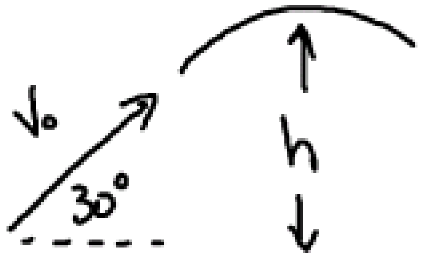


$$W = \Delta K$$

$$F \cdot d = \frac{1}{2} m v_f^2 - 0$$

$$d = \frac{\frac{1}{2}(.025)(156)^2}{325} = 0.936$$

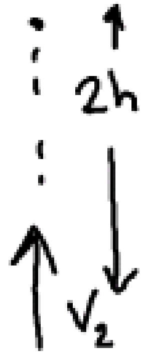
8)



$$\cancel{V_F^2}^{\,0} = V_0^2 + 2a\Delta x$$

$$-\left(\frac{V_0}{2}\right)^2 = 2(-10)h$$

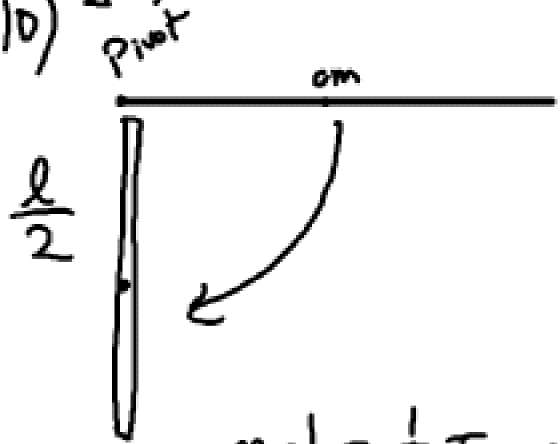
$$V_0^2 = 80h$$



$$-V_2^2 = 2(-10)(2h)$$

$$V_2^2 = 40h$$

10) & 9)



assume its in vertical position

$$mgh = \frac{1}{2} I \omega^2$$

$$\cancel{m} g \frac{\cancel{l}}{\cancel{2}} = \frac{1}{\cancel{2}}\left(\frac{1}{3}\cancel{m} l^{\cancel{2}}\right)\omega^2$$

$$\sqrt{\frac{3g}{l}} = \omega \Rightarrow \text{for } v_{cm} = \omega r$$

$$= \sqrt{\frac{3g}{l}}\left(\frac{l}{2}\right)$$

$$= \sqrt{\frac{3gl}{4}} \leftarrow \#9$$

$$L_F = I \omega_F$$

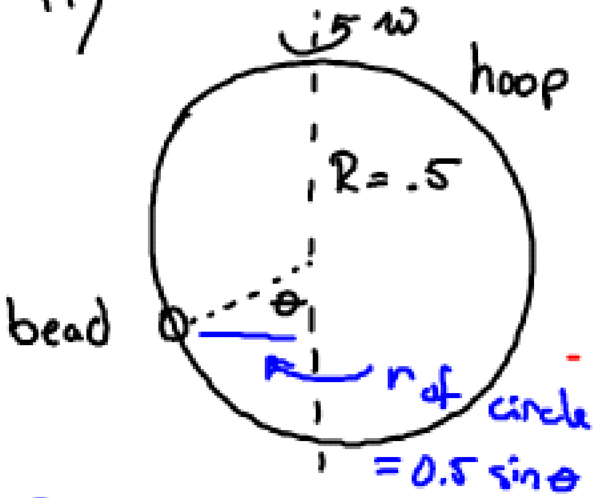
$$= \frac{1}{3} m l^2 \left(\sqrt{\frac{3g}{l}}\right)$$

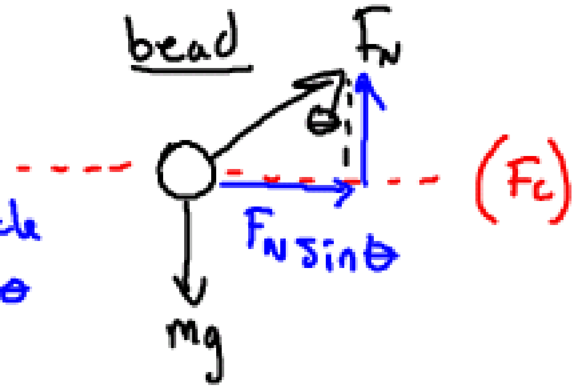
$$= m \sqrt{\frac{3 g l^{\cancel{4}\,3}}{3^{\cancel{2}} \cancel{l}}}$$

$$m l \sqrt{\frac{gl}{3}}$$

11)

$$F_c = \sum F_r = m\frac{v^2}{r}$$





Find F_N

$$\sum F_y = m\cancel{a_y}^{\,0}$$

$$F_N \cos\theta = mg$$

$$F_N = \frac{mg}{\cos\theta}$$

$\therefore$

$$F_N \sin\theta = m\frac{v^2}{r}$$

$$\frac{\cancel{m}g}{\cos\theta}\sin\theta = \cancel{m}\frac{v^2}{r}$$

$$g\tan\theta = \frac{(\omega r)^2}{r}$$

$r = 0.5 \sin\theta$

$$\theta = \tan^{-1}\left(\frac{\omega^2 r}{g}\right)$$

14) from 12

$$\frac{d^2x}{dt^2} = -\omega^2 x$$

$$x = \underset{\substack{\uparrow \\ A}}{0.5} \sin(\underset{\substack{\uparrow \\ \omega}}{14\pi} t)$$

$$a_{max} = A \cdot \omega^2$$

15)

$a = 3\underline{\underline{t}}$ $\qquad W = \int F \, \underline{\underline{dx}}$

$W = \Delta K$

$J = \int F dt = \Delta mv$

$\int \cancel{m} a \, dt = \Delta \cancel{m} v$

$\int 3t \, dt = \Delta v$

$\frac{3}{2}t^2 + \cancel{c} = \Delta v$

$\frac{3}{2}t^2 = v_f - \cancel{v_i} \; -4$

$\frac{3}{2}t^2 + 4 = v_f$

15) $W = \int F\,dx = \Delta K$

$a = 3t$

$J = \int F\,dt = \Delta mv$

$\dfrac{\int \cancel{m} a\,dt}{\cancel{m}} = \Delta v$

$\int 3t\,dt = \Delta v$

$\frac{3}{2}t^2 + \cancel{C}^{0} = \Delta v$

$\frac{3}{2}t^2 + 4 = v_F$

$\frac{3}{2}(2)^2 + 4 = v_F(2) = 10\,\frac{m}{s}$ $\quad W = \Delta K$

$=$

$\frac{1}{2}m(v_F^2 - v_i^2) = \frac{1}{2}(1)(10^2 - 4^2) = \frac{84}{2} = 42\,J$

16)

$$J = \int F \, dt$$

$$= \int ma \, dt$$

$$\int m 3t \, dt$$

17)

$\Delta x = ?$

$V = \frac{3}{2}t^2 + 4$

$\frac{dx}{dt} = \frac{3}{2}t^2 + 4$

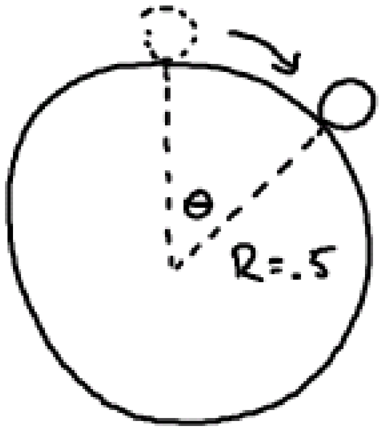
$\int dx = \int \frac{3}{2}t^2 + 4 \; dt$

$x = \frac{1}{2}t^3 + 4t + \cancel{c}^{\,0}$

$= \frac{1}{2}(2)^3 + 4(2)$

$X = 12 \text{ m}$

18)

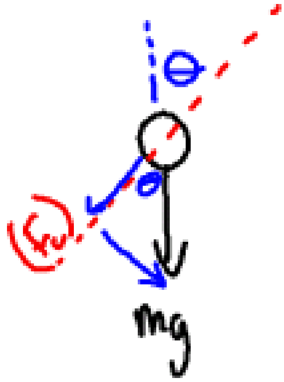


Circular path

$$F_c = \sum F_r = \frac{mv^2}{r}$$

V when loses contact

(code for $F_N = 0$)



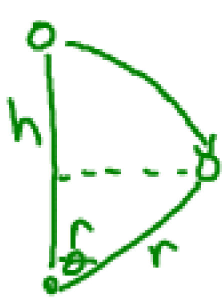
$$F_c = \cancel{m}g\cos\theta = \frac{\cancel{m}v^2}{r}$$

$$\sqrt{rg\cos(48.2)} = V$$

(or)

$$U_i + \cancel{K_i}^0 = \cancel{U_F}^0 + K_F$$

$$\cancel{m}gh = \frac{1}{2}\cancel{m}v_F^2$$

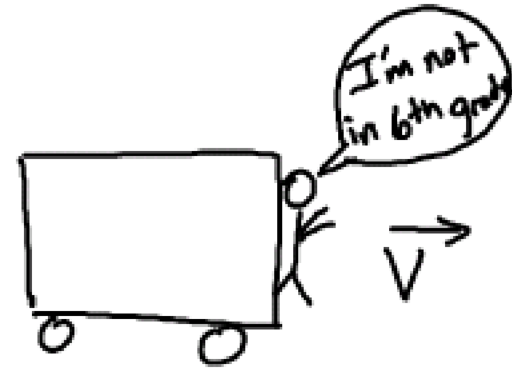


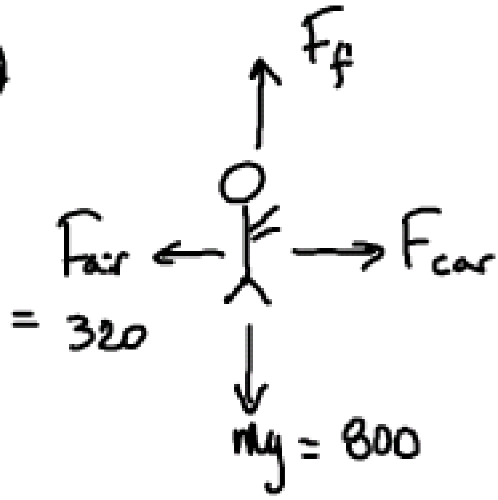
$$h = l - l\cos\theta$$

$$g(l - l\cos\theta) = \frac{1}{2}v^2$$

$$\sqrt{2g(R - R\cos\theta} = V$$

19)





$\mu = 0.8$

$$\Sigma F_x = ma_x$$

$$F_{car} - F_{air} = ma_x \qquad F_{car} = 80(a) + 320$$

$$F_f = \mu F_{car}$$

↑ b/c that's F_N

$$F_f = mg \quad \text{b/c} \quad \Sigma F_y = 0$$

$$mg = \mu F_{car}$$

$$800 = (.8)(80a + 320)$$

22)

$p_i = p_F$ but b/c it rotates after

we use $L_i = L_F$

$$m v r_\perp = I\omega$$

$$m v a = (3ma^2)\omega$$

$$m v_1 a = 3ma^2\left(\frac{v_2}{a}\right)$$

$$v_2 = \frac{v_1}{3}$$

$$\frac{E_2 = \frac{1}{2}(3m)\left(\frac{v_1}{3}\right)^2}{E_1 = \frac{1}{2}m v_1^2}$$

$$\frac{E_F}{E_i} = \frac{1}{3}$$

23)

$F = ma$

$= kg \cdot \frac{m}{s^2}$

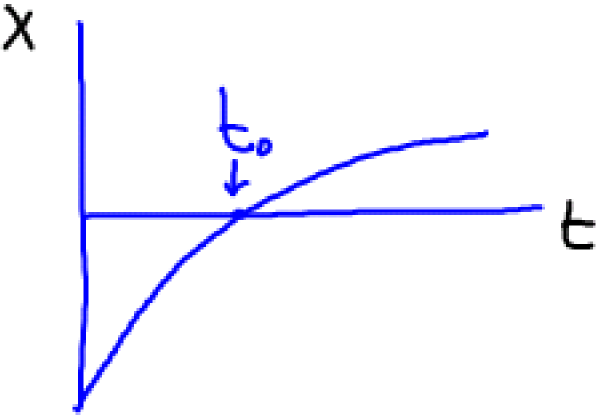
$\tau = rF\sin\theta$

$m \cdot N \rightarrow$ looks $N \cdot m = J \rightarrow$ Energy

$m \cdot \frac{kg \cdot m}{s^2} = \frac{kg\, m^2}{s^2}$

$\Delta K_R = \int \tau \, d\theta$

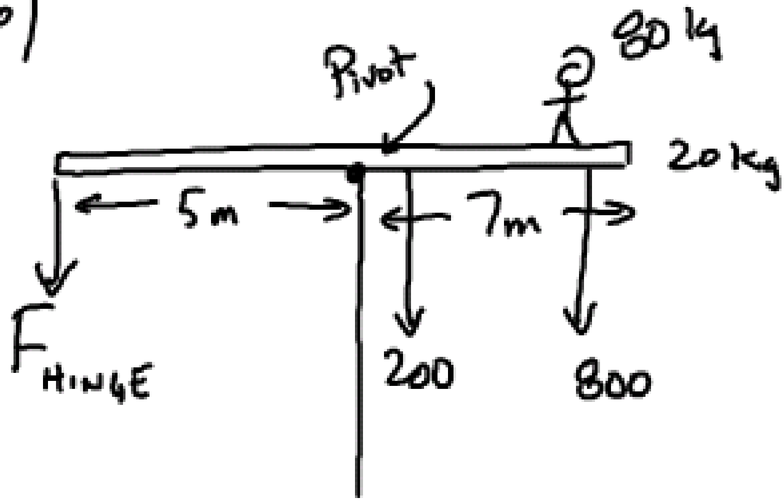
25)



$V \rightarrow$ slope $+$

$a \rightarrow \Delta$slope $(-)$

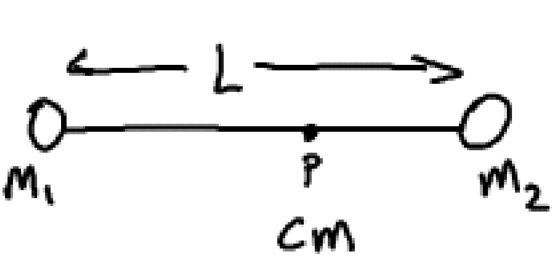
26)



$$F(5) = 200(1) + 800(7)$$

$$F = \frac{5800}{5}$$

29)



28)

$$X_{cm} = \frac{0(m_1) + Lm_2}{m_1+m_2} = \frac{Lm_2}{m_1+m_2}$$ #28)

$$I_{m_1} = m_1\left(\frac{Lm_2}{m_1+m_2}\right)^2 \quad \text{or} \quad \left(\frac{m_1 L}{m_1+m_2}\right)$$

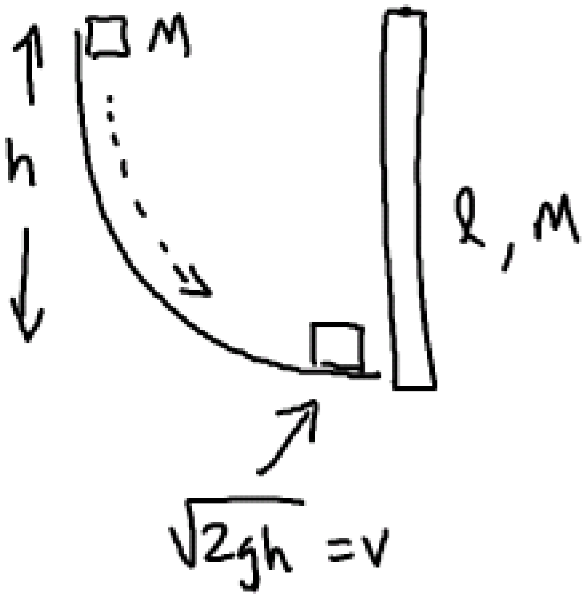
$$I_{m_2} = m_2\left(L - \frac{Lm_2}{m+m_2}\right)^2$$

use this instead of this

$$\frac{m_1 L^2 m_2^2}{(m_1+m_2)^2} + \frac{m_2 m_1^2 L^2}{(m_1+m_2)^2}$$

$$\frac{\cancel{(m_1+m_2)}(m_1 m_2 L^2)}{(m_1+m_2)^{\cancel{2}}}$$

33)



$$L_i = L_F$$

$$mvr_\perp = I\omega_F$$

$$m\left(\sqrt{2gh}\right)l = \frac{4}{3}ml^2\omega_F$$

$$\frac{3\sqrt{2gh}}{4l} = \omega_F$$

$$I_F = \underbrace{\frac{1}{3}ml^2}_{\text{rod}} + \underbrace{ml^2}_{\text{block}}$$

34

Nothing

$$F_c = F_g$$

$$\frac{\cancel{m_1} v^2}{\cancel{r}} = G\frac{\cancel{m_1} m_2}{r^{\cancel{2}}}$$

$$V_{orb.} = \sqrt{\frac{Gm}{r}}$$

$$E_{Tot} = U + K$$

$$= -G\frac{mm}{r} + \frac{1}{2}m\left(\sqrt{\frac{Gm}{r}}\right)^2$$

$$= -G\frac{mm}{r} + \frac{1}{2}\frac{mGm}{r}$$

$$E_{Tot} = -\frac{1}{2}\frac{Gm_1m_2}{r}$$