PH202 Recitation Midterm 1 Review Solutions

Discussion Question 1:

small mass on turntable rotating at 45 rpm

the linear acceleration of the mass is

A) Directed ⊥ to line joining mass and center of rotation

Fake linear $a = \langle a_\theta, a_r \rangle = \langle \alpha r, \omega^2 r \rangle = \langle 0, \omega^2 r \rangle$

so only radial acceleration

B) Fake, $\omega^2 r \Rightarrow$ r dependent

C) $r \downarrow \Rightarrow a \downarrow$ so Fake

D) $r \uparrow \Rightarrow a \uparrow$ so true

E) $\omega^2 r \neq 0$ Fake

Discussion Question 2: hoop, sphere, spherical shell, cylinder

rolling down hill $\Rightarrow I \downarrow$ $t \downarrow$

sphere $= \frac{2}{5}MR^2$, cylinder $= \frac{1}{2}MR^2$, spherical shell $= \frac{2}{3}MR^2$, hoop $= MR^2$

Discussion Question 3: merry go round rotating, girl walks in from outside

$\Rightarrow I \downarrow$ so $\omega \uparrow$ due to conservation of L

$\Sigma L_i = \Sigma L_f$

$I_i \omega_i = I_f \omega_f$

$\omega \uparrow$ as $I \downarrow$

A) Fake, not constant

B) true, $\omega \uparrow$

C) Fake & conservation

D) Fake, conservation

E) $KE_{rot} = \frac{1}{2} I \omega^2 = \frac{1}{2} L \omega$

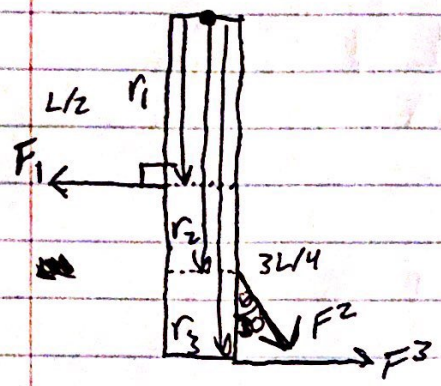
L constant but $\omega \uparrow$ so $KE_{rot} \uparrow$ true

F) Fake $KE \uparrow$

POTD: $M_{rod} = 10kg$ $L = 1m$ $F_1 = 25N$ $F_2 = 10N$ $F_3 = 15N$

$\theta_2 = 30°$

$I = \frac{1}{3}ML^2$ from end of rod



$\sum \tau = I\alpha$

$\sum \tau = \pm\tau_1 \pm\tau_2 \pm\tau_3 = I\alpha$

$-r_1F_1\sin\theta_1 + r_2F_2\sin\theta_2 + r_3F_3\sin\theta_3 = I\alpha$

$-\frac{L}{2}\cdot F_1 + \frac{3L}{4}\cdot F_2\sin 30° + L\cdot F_3 = I\alpha$

$(-\frac{1}{2}\cdot 25)Nm + (\frac{3}{4}\cdot 10\cdot\frac{1}{2})Nm + (1\cdot 15)Nm = I\alpha$

$6.25\,Nm = I\alpha$

$I = \frac{1}{3}ML^2 = \frac{1}{3}(10kg)(1^2) = \frac{10}{3}\,kgm^2$

$\alpha = \frac{6.25Nm}{I}$

$\alpha = \frac{6.25}{\frac{10}{3}} = 1.875\,\frac{rad}{s^2}$

Now could do any kinematics question knowing α.