WS #7

(59) $m = 10.0\,kg$

$I = \frac{mr^2}{2}$

$v_{cm} = 10.0\,m/s$

$K_r = ?\quad K_t = ?\quad K = ?$

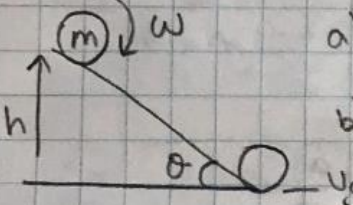
$K_t = \frac{1}{2}mv^2 = \frac{1}{2}(10)(10)^2 = \boxed{500\,J}$

$K_r = \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{mr^2}{2}\right)\left(\frac{v_{cm}^2}{r^2}\right)$

$= \frac{1}{4}(10)(10)^2 = \boxed{250\,J}$

$K = K_r + K_T = \boxed{750\,J}$

(60) $I = \frac{2}{5}mr^2$



a) v_{cm} rolling $t = ?$

b) v_{cm} slipping $t = ?$

a) $E_0 = E_f$

$U_g = K_r + K_t$

$mgh = \frac{1}{2}\left(\frac{2}{5}mr^2\right)\frac{v_{cm}^2}{r^2} + \frac{1}{2}mv_{cm}^2$

$gh = \frac{v_{cm}^2}{5} + \frac{v_{cm}^2}{2} = \frac{7}{10}v_{cm}^2$

$\boxed{v_{cm} = \sqrt{\frac{10}{7}gh}}$

b) sliding only

$E_0 = E_f$

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

$v = \sqrt{2gh}$

c) $x = v_{avg} \cdot t$

$\frac{h}{\sin\theta} = \left(\frac{0+v}{2}\right)t$

$t = \frac{2h}{v\sin\theta}$

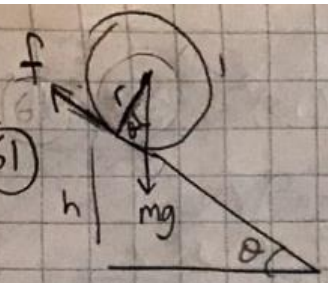
rolling $t = \frac{2h}{\sin\theta}\sqrt{\frac{10}{7}gh}$

sliding $t = \frac{2h}{\sin\theta}\sqrt{\frac{1}{2}gh}$

$\frac{t_{roll}}{t_{slide}} = \sqrt{\frac{0.7}{0.5}} = 1.18$

$\boxed{t_{roll} = 1.18\,t_{slide}}$

(61)



axis is taken as point of contact

$$\Sigma\tau = I\alpha$$

$$(mg)\, r \sin\theta = (I_{cm} + mr^2)\,\alpha$$

$$mg\, r \sin\theta = \left(\frac{mr^2}{2} + mr^2\right)\frac{a}{r}$$

$$\boxed{a = \frac{2g\sin\theta}{3}}$$

a) $a_{disk} = ?$ $I = \frac{mr^2}{2}$

b) $a_{hoop} = ?$ $I = mr^2$

c) $f_{disk} = ?$

b) $\Sigma\tau = I\alpha$

$$mgr\sin\theta = (I_{cm} + mr^2)\alpha = (mr^2 + mr^2)\frac{a}{r}$$

$$mgr\sin\theta = 2mr^2\frac{a}{r}$$

$$\boxed{a = \frac{g\sin\theta}{2}}$$

c) axis is taken as CM

$$\Sigma\tau = I\alpha$$

$$\left(\frac{1}{r}\right) r \cdot f = \frac{mr^2}{2} \cdot \frac{a}{r}\left(\frac{1}{r}\right)$$

$$F_n \cdot \mu = \frac{ma}{2}$$

$$\Sigma F_y = F_n - mg\cos\theta$$

$$F_n = mg\cos\theta$$

$$\mu = \frac{ma}{2F_n} = \frac{m\left(\frac{2g\sin\theta}{3}\right)}{2\,mg\cos\theta} = \boxed{\frac{1}{3}\tan\theta}$$

(63) a) solid disk reaches down first b/c it has lower I

b) $I_{disk} = \frac{mr^2}{2}$

$I_{hoop} = mr^2$

$E_0 = E_f$

$U_g = K_r + K_t$

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

$mgh = \frac{1}{2}v^2\left(m + \frac{I}{r^2}\right)$

$$v^2 = \frac{2mgh}{m + \frac{I}{r^2}}$$

$$v^2_{disk} = \frac{2mgh}{\underbrace{m + \frac{mr^2}{2r^2}}_{3m/2}}$$

$$v_{disk} = \sqrt{\frac{4gh}{3}}$$

$$v_{hoop} = \sqrt{\frac{2mgh}{m + \frac{mr^2}{r^2}}} = \sqrt{gh}$$

since $v_{disk} > v_{hoop}$, the disk reaches the bottom first!

(69) $\omega_0 = 65.0 \text{ rad/s}$ @ $t = 0$

a) $\alpha = -10.0 - 5.00t = \frac{d\omega}{dt}$

$$\int_{\omega_0}^{\omega} d\omega = \int_0^3 -10.0 - 5.00t \, dt$$

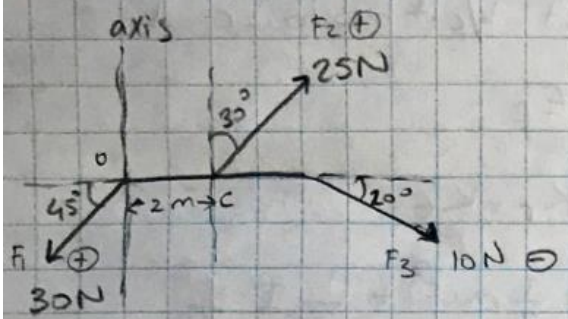
$$\omega = \omega_0 - 10t - \frac{5t^2}{2}\Big|_0^3 = 65 - 30 - \frac{45}{2} = 12.5$$

$\boxed{\omega = 12.5 \text{ rad/s}}$

b) $\omega = \frac{d\theta}{dt} \Rightarrow \theta = \int \omega \, dt = \omega_0 t - 5t^2 - \frac{5t^3}{6}\Big|_0^3$

$$\theta = (65.3) - (5.9) - \left(\frac{5.27}{6}\right) = \boxed{128 \text{ rad}}$$

CH11 Pr #5



torque about $r_1 = 0$ point O

a) $\Sigma\tau = 0 + F_2 \cdot r_2 \sin 60 - F_3 r_3 \sin 20$

$\Sigma\tau = (25)(2)(\sin 60) - (10)(4)(\sin 20)$

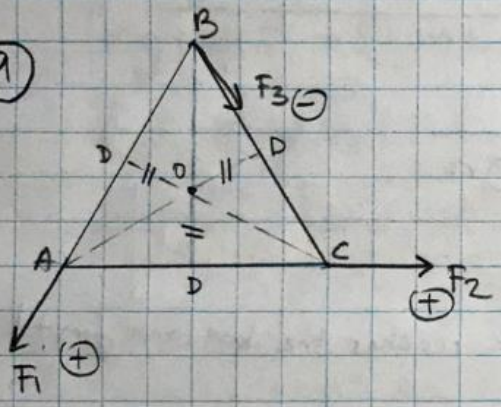
$\boxed{\Sigma\tau = +30\ N\,m \text{ or } 30\ N\,m\ CCW}$

b) torque about point C

$\Sigma\tau = F_1 r_1 \sin 45 - F_3 r_3 \sin 20$

$= (30)(2)\sin 45 - (10)(2)\sin 20 = \boxed{+36\ N\,m}$

(9)



a) $\tau = F \cdot d$

the lever arm "d" is the same for all three forces (OD)

$\Sigma\tau = F_1 d + F_2 d - F_3 d = 0$

$Fd + Fd - F_3 d = 0$

$\boxed{F_3 = 2F}$

b) any point between B & C has the same lever arm (OD) so nothing would change.