$\boxed{9.6}$ $\theta(t) = 250t - 20t^2 - 1.5t^3$

a) $\omega(t) = 0 \Rightarrow t_0 = ?$

$\rightarrow \omega = \frac{d\theta}{dt} = 250 - 40t - 4.5t^2 = 0$

$\therefore t_0 = 4.23\ s$

b) $\alpha(t) = ?$ at $t = t_0$

$\alpha = \frac{d^2\theta}{dt^2} = -40 - 9t = -78\ rad/s^2$

c) $\theta(t_0) = ?$

$\theta = 250 \cdot 4.23 - 20(4.23)^2 - 1.5(4.23)^2 = 586\ rad \xrightarrow[\frac{1}{2\pi}]{} 93.3\ rev$

d) $w(t=0) = ?$ $250\ rad/s$

e) $w_{av}(t=0 \rightarrow t = t_0) \rightarrow \frac{\Delta\theta}{\Delta t} = \frac{586}{4.23}\frac{rad}{s} = 139\ rad/s$

$\boxed{9.7} \rightarrow$ similar

$\boxed{9.26}$ $r = \frac{0.75m}{2}$ $w_0 = 0.25\ \frac{rev}{s}$ $\alpha = 0.9\ \frac{rev}{s^2}$

a) $w(t=0.2) = ?$ $w = w_0 + \alpha t = 0.25 + 0.9 \times 0.2 = 0.43\ rev/s$

b) $\Delta\theta = ?$ $w_0 t + \frac{1}{2}\alpha t^2 = 0.25 \times 0.2 + \frac{1}{2} \times 0.9 \times (0.2)^2$

$= 0.05 + 0.018 = 0.068\ rev$

c) $v_t = ?$ at $t = 0.2$ $v = w \cdot r = 0.43 \times 0.375\ \frac{m \cdot rev}{s}$

$1\ rev = 2\pi\ rad \Rightarrow v = 0.43 \times 0.375 \times 2\pi \simeq 1\ m/s$

d) $a = \sqrt{a_t^2 + a_r^2} = \sqrt{\left(\frac{v^2}{r}\right)^2 + (\alpha \cdot r)^2} = \sqrt{\left(\frac{1}{0.375}\right)^2 + (0.9 \times 2\pi \times 0.375)^2} \simeq 3.5\ \frac{m}{s^2}$

$\boxed{9.67}$ $r = 25\text{ cm}$, $a(t) = At$ $\quad v_0 = 0$ $\quad a(3) = 1.8\ \text{m/s}^2$

a) $A = ?$ $\Rightarrow$ $\frac{a}{t} = A = \frac{1.8}{3} = 0.6\ \text{m/s}^3$

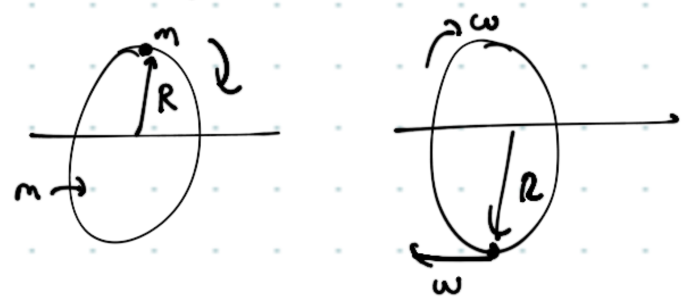
b) $\alpha = ?$ $\quad \alpha = \frac{a}{r} = \frac{0.6t}{0.25} = 2.4t$

c) $\omega(t) = 15\ \text{rad/s}$ $\Rightarrow t = ?$

$$\omega(t) = \int_0^t \alpha(t')\,dt' = \int_0^t (2.4t')\,dt' = 15 \Rightarrow 2.4\frac{t^2}{2} = 15 \Rightarrow t = \sqrt{\frac{30}{2.4}} \cong 3.5\text{s.}$$

d) $\theta(3.5) = ?$ $\quad \theta = \int_0^t \omega(t')\,dt' = \frac{1.2t^3}{3} = 0.4t^3 = 0.4(3.5)^3 \sim 18\text{ rad}$

$\boxed{9.80}$



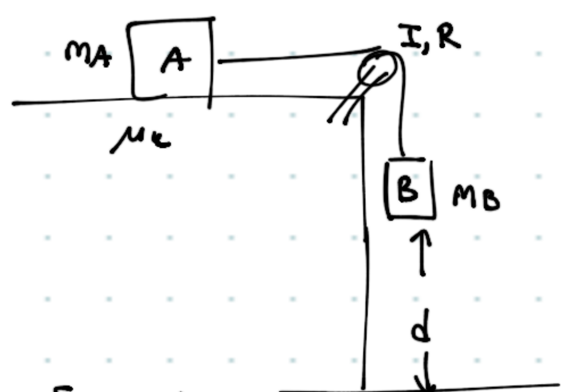
$I_1 = I_{disc} = \frac{1}{2}mR^2$

$I_2 = I_{obj} = mR^2$

$$E_i = E_f \Rightarrow \cancel{m}g2\cancel{R} = \frac{1}{2}I_1\omega^2 + \frac{1}{2}I_2\omega^2 = \frac{3}{4}\cancel{m}R^{\cancel{2}}\omega^2$$

$\therefore$ $\boxed{\omega^2 = \frac{8g}{3R}}$

$\boxed{9.85}$



$v = ?$

$E_i = E_f \Rightarrow$

$$m_B g d - \mu_k(m_A g)\cdot d = \frac{1}{2}(m_A + m_B)v^2 + \frac{1}{2}I\frac{v^2}{R^2}$$

$$\therefore\ gd\left[m_B - \mu_k m_A\right] = \frac{v^2}{2}\left[m_A + m_B + \frac{I}{R^2}\right] \Rightarrow v = \sqrt{\frac{2gd(m_B - \mu_k m_A)}{m_A + m_B + \frac{I}{R^2}}}$$

$\boxed{10.8}$ $M = 8.4$ kg $r = 25$ cm 4 small $m = 2$kg masses

$\tau_{Friction} = ?$ $w_i = 75$ rpm $w_f = 50$ rpm $\Delta t = 30$s

$\underset{\uparrow const}{\tau} = I \underset{\uparrow const}{\alpha}$ Calculate $I, \alpha \rightarrow$ get τ ! $\quad 0.6 \quad \cancel{1.2} \quad \cancel{4.8}$

$I = I_{sphere} + I_{balls} = \frac{2}{3}MR^2 + 2mR^2 = 2R^2\left[\frac{M}{3} + m\right] = \cancel{2}(0.25)^2\left[\frac{8.4}{3} + 2\right]$

$\frac{\Delta w}{\Delta t} = \alpha = \frac{50-75}{30} \frac{rev}{min} \cdot \frac{1}{s} \Rightarrow -\frac{25}{30} \cdot \frac{2\pi}{60} \frac{rad}{s^2} \cong -0,09$

$\rightarrow \tau = 0.6 \times -0.09 \sim -0.54$ N.m

$\boxed{10.29}$ $m = 1.5$ kg , $r = 0.1$m ,

a) $\tau = ?$ $w_0 = 0$ $w_f = 1200 \frac{rev}{min}$ $\Delta t = 2.5$s

$\tau \rightarrow$ const , $\alpha \rightarrow$ const

$\therefore w_f = \cancel{w_0}^{\,0} + \alpha \Delta t \Rightarrow$ $\alpha = \frac{\frac{\cancel{1200} \cdot 2\pi}{\cancel{60}}}{\cancel{2.5}} \cong 50$ rad/s^2 $\quad$ (8, $\cancel{20}$)

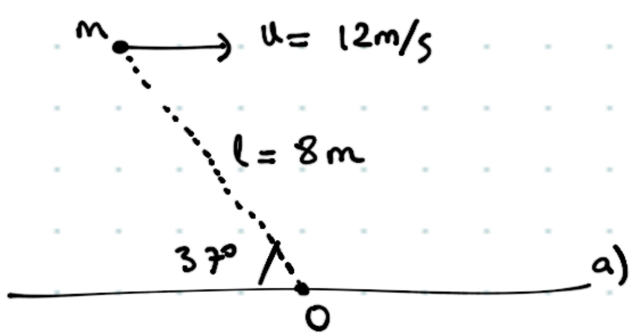
$\tau = I\alpha = \frac{1}{2} \cdot 1.5 \cdot (0.1)^2 \cdot 50 \sim \frac{1.5}{4} \sim 0.375$ N.m

b) $\Delta\theta = ?$ $\theta = \cancel{w_0 t}^{\,0} + \frac{1}{2}\alpha t^2 = \frac{1}{2} \cdot 50 \cdot (2.5)^2 = \frac{\cancel{50}^{\,25} \cdot 25}{\cancel{8}4} = \frac{625}{4} \cong 156$ rad

c) $W = \vec{F} \cdot \Delta\vec{x} \Rightarrow \tau \cdot \Delta\theta = 0.375 \times 156 \simeq 59$ Joule $\leftarrow$ same

d) $K = \frac{1}{2} I w^2 = \frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} \times 1.5 \times \cancel{(0.1)^2} \times \left(\frac{\cancel{1200}^{\,20} \cdot 2\pi}{\cancel{60}}\right)^2 = 1.5 \times 4\pi^2 \sim 60$ Joul

$\boxed{10.35}$



$m = 2$kg ; $\vec{L}_0 = ?$

$\vec{r} \times \vec{P} = 8 \times 2 \times 12 \times \frac{3}{5}$

a) $L = \frac{48 \times 12}{5} \simeq \boxed{115}$ $\otimes$ into the page

b) $\frac{d\vec{L}}{dt} = \vec{\tau}$ along $m \rightarrow o$

$mg \cdot l\cos\theta = \cancel{20}^{\,4} \cdot 8 \cdot \frac{4}{\cancel{5}} \simeq \boxed{128}$

$\boxed{10.38}$ $m = 12\,kg$ $r = 24\,cm$ $\theta(t) = At^2 + Bt^4$ $A = 1.5$, $B = 1.1$

a) units of A, B b) $L(3) = ?$, $\tau(3) = ?$

$L = I\omega$ for rotation : $\frac{dL}{dt} = \tau = I\alpha$

$\therefore \omega(t) = \frac{d}{dt}\{At^2 + Bt^4\} = 2At + 4Bt^3$

$\therefore L = I\{2At + 4Bt^3\}$. $\tau = \frac{d}{dt}L = I\{2A + 12Bt^2\}$

* $\boxed{10.40}$ $m = 0.025\,kg$, $r_0 = 0.3\,m$, $\omega_0 = 1.75$ rad/s

$\rightarrow r_f = 0.15\,m$

a) $\vec{\tau} = \vec{r} \times \vec{T} = 0$

$\therefore \frac{d\vec{L}}{dt} = 0$

b) $L_i = L_f$

$\rightarrow \cancel{m} v_i r_i = \cancel{m} v_f r_f$

$\Rightarrow 1.75 \times \underset{4}{\cancel{0.3}} \times \cancel{0.3} = \omega_f \cdot \cancel{(0.15)^2}$

$\therefore \omega_f = 7$ rad/s

c) $\Delta KE = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 = \frac{1}{2} m \{[7 \times (0.15)]^2 - [1.75 \times 0.3]^2\}$

$= \frac{1}{2} \times 0.025 \times (1.75 \times 0.3)^2 [4 - 1] = \frac{1}{2} \times \frac{25}{10} \times 10^{-3} \times \underbrace{\underbrace{(1.75)^2}_{\sim 3} \cdot 3 \underbrace{(0.3)^2}_{0.1}}_{1} \sim 0.01$

d) $W = \Delta KE$