Major 2 – 011

Q13 → Q18

(Q13)

$I = 6.0$ ~~x 10~~ $kg \cdot m^2$

$\alpha = 2.0\ rad/s^2$

$\Sigma \tau = I\alpha$

$\Sigma \tau = (6.0)(2) = 12$ ~~kg m~~ $N \cdot m$

$t=0 \rightarrow t = 5$

$W = \int (\Sigma \tau)\, d\theta$

$\Sigma \tau$ is constant

$W = (\Sigma \tau)\Delta\theta$

$W = I\alpha\Delta\theta$

$\Delta\theta = ?$ $\quad_0$ $\quad \alpha$ ✓, $\omega_0 = 0$ (start from rest) & $t = 5.0\ s$

find $\Delta\theta$ ✓ ok

$\Delta\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

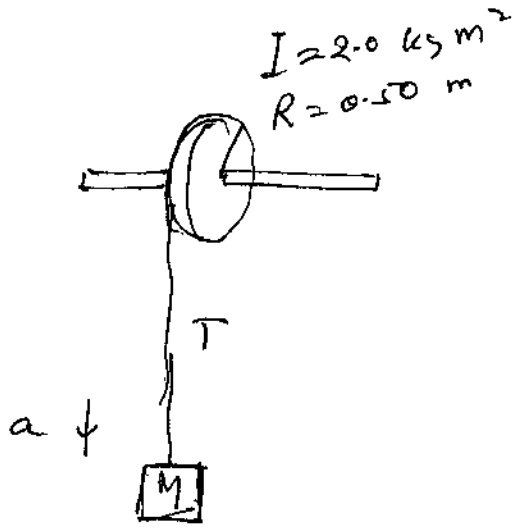
$\Delta\theta = 0 + \frac{1}{2}\alpha t^2$ ✓

$\Rightarrow \quad W = (I\alpha)\left(\frac{1}{2}\alpha t^2\right)$

$= (12)\left(\frac{1}{2}(\alpha)(5)^2\right)$

$\boxed{W = 300\ J}$

(14)



M

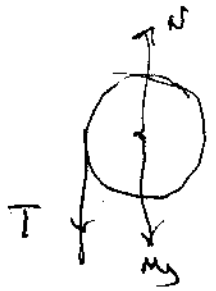
$\sum \vec{F} = m\vec{a}$

$$Mg - T = Ma \quad \text{—(1)}$$

(T: ?, a: ?)

a & T are both unknowns.

~~Pulley~~ flywheel



$\sum \tau = I\alpha$

$TR = I\left(\frac{a}{R}\right)$

m (1)

$T = \left(\frac{I\,a}{R^2}\right)$ —(2)

$$Mg - \frac{Ia}{R^2} = Ma$$

$$Mg = a\left(M + \frac{I}{R^2}\right)$$

$$a = \frac{Mg}{M\left(1 + \frac{I}{MR^2}\right)}$$

$$a = \frac{g}{1 + \frac{I}{MR^2}} = \frac{9.8}{1 + \frac{2}{(10)(0.50)^2}}$$

$$a = 5.4 \ m/s^2$$

(15) $\omega_0 = 0$, $\Delta\theta = 8$ rev, $t = 17$ s

~~α ?~~ ω ?

$$\Delta\theta = \frac{1}{2}(\omega + \omega_0)\, t$$

$$\Delta\theta = 8 \text{ rev} = 8 \text{ rev} \times \left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right)$$
$$= 8(2\pi) \text{ rad}$$

$$16\pi = \frac{1}{2}(\omega + 0)\, 17$$

$$\omega = \frac{(2)(16)\pi}{17} = 5.9 \text{ rad/s}$$

(16) $K = K_T + K_R = \frac{1}{2} m v^2 + \frac{1}{2} I_{com} \omega^2$

$$= \frac{1}{2}(32)(5.0)^2 + \frac{1}{2}\left(\frac{1}{2} M R^2\right)\frac{v^2}{R^2}$$

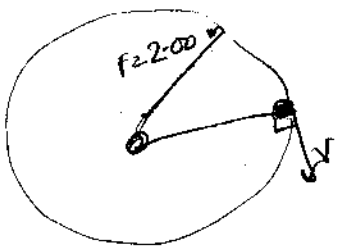
$$= \frac{1}{2} m v^2 + \frac{1}{2}\left(\frac{1}{2} m v^2\right)$$

$$= \frac{3}{4} m v^2$$

$$= \frac{3}{4}(32)(5.0)^2$$

$$W = 600 \text{ J}$$

Q17



$\omega = 10.0$ rad/s

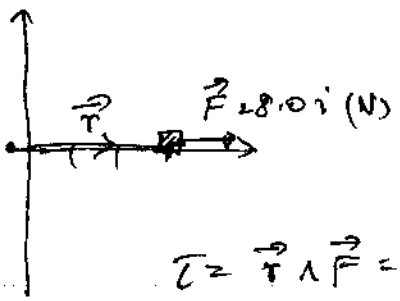
$v = r\omega = (2)(10) = 20$ m/s

$\vec{l} = \vec{r} \times \vec{p} = r m v \sin\theta$

$l = r m v = 2(2)(10)(20)$ $\quad \theta = 90$

$$\boxed{l = 400 \ \frac{kg \cdot m^2}{s}}$$

Q18



$\tau = \vec{r} \times \vec{F} =$ zero