Rotation worksheet:

1) a) $\theta = \omega_i t + \frac{1}{2}\alpha t^2 = 21\ rad$

b) $\omega_f = \omega_i + \alpha t = 10\ \frac{rad}{s}$

2) a) $5\ rad$ b) $14t + 9t^2 \Rightarrow 14 \cdot 0 + 9 \cdot 0^2 = 0\ \frac{rad}{s}$

c) $14 \cdot 4 + 9 \cdot 4^2 = 200\ \frac{rad}{s}$ d) $14 + 18t \Rightarrow 14 + 18 \cdot 2 = 50\ \frac{rad}{s^2}$

3) a) $\frac{45\ deg}{1\ min} \cdot \frac{2\pi\ rad}{1\ rev} \cdot \frac{1\ min}{60\ s} = 4.71\ \frac{rad}{s} = \omega$

b) $v = r\omega = 4.71\ \frac{rad}{s} \cdot \frac{4\ in}{1} \cdot \frac{2.54\ cm}{1\ in} \cdot \frac{1\ m}{100\ cm} = 0.478\ \frac{m}{s}$

c) $v = r\omega = 0.18\ m/s$

4) $\frac{1}{3}\frac{1}{2}M(5L)^2 + 3m(5L)^2 = \frac{25}{6}mL^2 + 75mL^2$

$\Rightarrow \frac{475}{6}mL^2$

5) $a_r = \frac{v^2}{r} = \omega^2 r = (10\ \frac{rad}{s})^2\ 0.8\ m = 80\ m/s^2$

$a_T = r\alpha = 50\ \frac{rad}{s^2} \cdot 0.8\ m = 40\ m/s^2$

6) a) $m_B r_{cb}^2 + m_C r_{cc}^2 = 0.1 \cdot 0.5^2 + 0.2 \cdot 0.4^2 = 0.057\ kg\ m^2$

b) $m_A r_{AC}^2 = 0.3 \cdot 0.4^2 = 0.048\ kg\ m^2$

c) $K_r = \frac{1}{2} I \omega^2 = \frac{1}{2}\ 0.057\ kg\ m^2 (4\ \frac{rad}{s})^2 = 0.456\ J$

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7) $M = 50kg \quad r = 0.06m \quad F = 9N \quad \Delta x = 2m$

$W = F \cdot \Delta x = Nm = J = 18J$

$K_r = \frac{1}{2} I \omega = F\Delta x = \frac{1}{2} \cdot \frac{1}{2} m r^2 \omega^2$

$F\Delta x = \frac{1}{4} m v^2 \Rightarrow v = \sqrt{\frac{4F\Delta x}{m}} = \boxed{1.2 m/s}$

8) $F \cdot r = I\alpha \Rightarrow Fr = \frac{1}{2} m r^2 \alpha \Rightarrow F = \frac{1}{2} ma$

$\Rightarrow \frac{2F}{m} = a = \frac{2 \cdot 20}{50} = 0.8 \frac{m}{s^2} \qquad \alpha = \frac{a}{r} = \boxed{8 \frac{rad}{s^2}}$

9) a) $\Sigma f_1 = m_1 a = T_1$ ①

$\Sigma f_2 = m_2 a = F_{g2} - T_2 \Rightarrow T_2 = F_{g2} - m_2 a$ ②

$\Sigma \tau = \tau_2 - \tau_1 = T_2 r - T_1 r \Rightarrow I\alpha = r(T_2 - T_1)$ ③

1 & 2 in 3

$I\alpha = r(F_{g2} - m_2 a) - r(m_1 a)$

$\Rightarrow m_p a = F_{g2} - m_2 a - m_1 a \Rightarrow m_p a + m_2 a + m_1 a = F_{g2}$

$\Rightarrow a(m_p + m_2 + m_1) = F_{g2} \Rightarrow a = \frac{F_{g2}}{m_p + m_2 + m_1} = \boxed{3.39 \frac{m}{s^2}}$

b) $\alpha = \frac{a}{r} = \boxed{13.56 \frac{rad}{s^2}}$

c) $T_1 = 12kg \cdot 3.39 m/s^2 = 40.68 N$

$T_2 = 9kg \cdot 9.8 \frac{m}{s^2} - 9kg \cdot 3.39 m/s^2 = 57.7 N$

Rotation ω S

10) a) $300N \cdot 2.3 - 600N \cdot 0.9m = \boxed{150 Nm}$ yes

b) see sheet

c) $\Sigma \tau = I\alpha \Rightarrow \alpha = \frac{\Sigma \tau}{I}$

$$\alpha = \frac{150 Nm}{\frac{1}{2} 28kg \cdot 2.3m^2} = \boxed{2.025 \frac{rad}{s^2}}$$