Circular Motion and Gravity EOC

6. $\frac{3600 rev}{1 min} \times \frac{1 min}{60 sec} \times \frac{2\pi rad}{1 rev} = 376.9911184 rad/s$

$\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$

$0 = 376.9911184^2 + 2\alpha(50 rev \times \frac{2\pi rad}{1 rev})$

$= 376.9911184^2 + 200\pi\alpha$

$-376.9911184^2 = 200\pi\alpha$

$\alpha = \frac{376.9911184^2}{200\pi}$

$\alpha = 226.1946711 rad/s^2$

19. a) $F = ma$

$F = m\frac{v^2}{R_d^2}$

$F = 55 \times \frac{28}{0.8}$

$F = 1100N$

b) her weight $= mg$

$= 55 \times 9.8$

$= 539N$

$1100 \div 539 = 2.040816327$

29. $F_g = \frac{Gm_1m_2}{r^2} = \frac{6.67\times10^{-11} \times 5.98\times10^{24} \times 3\times10^4}{384000\times1000\div2}$

$= 324.5979818N$

13. $\theta = \bar{\omega}t$

$\theta = \frac{\omega_0+\omega}{2}t$

$37 rev \times \frac{2\pi rad}{1 rev} = 74\pi rad$

$74\pi = \frac{\omega_0+98}{2}(3)$ $\quad \frac{74\pi\times2}{3} - 98 = \omega_0$

$\omega_0 = 56.98523758 rad/s$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$\theta - \theta_0 - \omega_0 t = \frac{1}{2}\alpha t^2$

$\frac{(\theta - \theta_0 - \omega_0 t)\times2}{t^2} = \alpha$

$\alpha = \frac{(74\pi - 0 - 56.98523758\times3)\times2}{3^2}$

$\alpha = 13.67158747 rad/s^2$

26.

$F = ma$

$T - F_g = m\frac{v^2}{R}$

$T = m\frac{v^2}{R} + mg$

$T = 85\times\frac{8^2}{10} + 85\times 9.8$

$\boxed{T = 1377\,N}$

If the rope breaks at 1000N, but Tarzan exerts 1377N it will break and he will not make it across

39. $v^2 = \frac{Gm_e}{r}$ $\quad v = \sqrt{\frac{Gm_e}{r}}$

b) $v = \sqrt{\frac{6.67\times10^{-11}\times 5.98\times10^{24}}{200\times1000 + 6.38\times10^6}}$

$\boxed{v = 7785.751931\,m/s}$

a) $2\pi r = 2\pi\times(200\times1000 + 6.38\times10^6)$

$= 41\,343\,359.32\,m$

$\frac{41\,343\,359.32}{7785.751931} = 5\,310.130568\,s$

$5\,310.130568\,s \times \frac{1h}{3600s} = \boxed{1.475\,h}$

46.

OR

a)

$F \geq ma$

$F_f + mg\sin(\theta) \geq m\frac{v^2}{R}$

$F_n\mu + mg\sin(\theta) \geq m\frac{v^2}{R}$

$mg\cos(\theta)\mu + mg\sin(\theta) \geq m\frac{v^2}{R}$

$g(\cos(\theta)\mu + \sin(\theta)) \geq \frac{v^2}{R}$

$v \leq \sqrt{Rg(\cos(\theta)\mu + \sin(\theta))}$

$F \leq ma$

$-F_f + mg\sin(\theta) \leq m\frac{v^2}{R}$

$-F_n\mu + mg\sin(\theta) \leq m\frac{v^2}{R}$

$-mg\cos(\theta)\mu + mg\sin(\theta) \leq m\frac{v^2}{R}$

$g(-\cos(\theta)\mu + \sin(\theta)) \leq \frac{v^2}{R}$

$v \geq \sqrt{Rg(\cos(\theta)\mu + \sin(\theta))}$

b) $v \leq \sqrt{100\times9.8\times(\cos(10)\times0.1 + \sin(10))}$

$\boxed{v \leq 16.33\,m/s}$

$v \geq \sqrt{100\times9.8\times(-\cos(10)\times0.1 + \sin(10))}$

$\boxed{v \geq 8.58\,m/s}$

35. $v^2 = \frac{Gm_c}{r}$ $r = \frac{Gm_c}{v^2}$ $r = \frac{6.67\times10^{-11} \times 5,98\times10^{24}}{5000^2}$

$r = 15\,954\,640$

$15\,954\,640 - 6.38\times10^6 = \boxed{9\,574\,640\,m}$

$2\pi r = 2\pi \times 15\,954\,640$

$\frac{2\pi \times 15\,954\,640}{5000} = 20\,049.19193\,s$

$20\,049.19193\,s \times \frac{1h}{3600s} = \boxed{5.569\,h}$