# Review 13

1. A golf club with a mass of 0.4 kg [illegible] around a pivot point 1.5 m long at a speed of 22 m/s. Find the force at [illegible] the ball was hit.

$F_c = m a_c = m \frac{v^2}{r} = (0.4)$ [illegible] $= 1.29 \times 10^2 N$

   a. If the head of the club was in contact with the ball which was 0.3 kg for 0.1 s, at what speed did the ball leave the ground?

$Ft = mv$

$(129)(.1) = (0.3)v$ $\quad v = 43 \frac{m}{s}$

   b. If the ball left the ground at an angle of 45°, how far was the ball hit?

$\sin 45 = \frac{V_y}{43}$ $\quad V_y = 30.4 \frac{m}{s}$

$V_y = V_{y_i} + at$ $\quad 0 = 30.4 + (9.8)t$ $\quad t = 3.10$

$x = V_x t$ $\quad = (30.4)(6.2) = 1.88 \times 10^2 m$

2. Assume that the moon orbits the earth in a circular orbit. From the observed orbital period of 27.3 days, calculate the distance of the moon from the center of the earth. Assume the motion of the moon is determined solely by the earth.

$T = 27.3 d \times \frac{24h}{1d} \times \frac{3600s}{1h} = 2.36 \times 10^6 s$

$r = ?$

$F_g = F_c$ $\quad \frac{m_m 4\pi^2 r}{T^2} = \frac{G m_m m_e}{r^2}$ $\quad r^3 = \frac{G m_E T^2}{4\pi^2}$

$= 3.83 \times 10^8 m$

3. If acceleration due to gravity is 9.782 [illegible] at the Canal Zone and 9.82534 m/s$^2$ in Greenland. How much wider (rad [illegible] the earth at the Canal Zone rather than in Greenland?

$r_{c2} = \sqrt{\frac{6.67 \times 10^{-11} \cdot 5.98 \times 10^{24}}{9.78243}} = 6.39 \times 10^6 m$ $\quad r_c = \sqrt{\frac{6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{9.82554}} = 6.37 \times 10^6 m$

$6.39 \times 10^6 m - 6.37 \times 10^6 m = 2.00 \times 10^4 m$

4. A force of 50 N is required to pull a [illegible] wooden block at a constant velocity across a surface on Earth. What force would be required to pull the same wooden block across the same surface on Mercury?

$F_{fr}$

$\Sigma F_y = N - 20(9.8)$ $\quad F_m = (20)(3.61)$ $\quad g_m = \frac{G m_s}{r^2} = \frac{(6.67 \times 10^{-11})(3.2 \times 10^{23})}{(2.43 \times 10^6)^2}$

$N = 1255$ $\quad = 1.34 \times 10^1 N$ $\quad = 3.61 \frac{m}{s^2}$

5. An experiment is performed in deep [illegible] with two uniform spheres, one with a mass of 50 kg and the other with mass [illegible] kg. The spheres are released from rest with their centers 40 m apart. They accelerate toward each other because of their mutual gravitational attraction. ~~When their centers are 20 meters apart, what is the speed of each sphere?~~

$F_g = \frac{G m_1 m_2}{r^2}$

$(6.67 \times 10^{-11}$ [illegible] $= 2.08 \times 10^{-10}$

$F = m a_{50}$ $\quad 2.08 \times 10^{-10} = 50 a$ $\quad a_{50} = 4.16 \times 10^{-12}$

$F = m a_{100}$ $\quad a_{100} = 2.08 \times 10^{-12}$

$v^2 = v_i^2 + 2ad$ $\quad v^2 = 0 + 2(4.16 \times 10^{-12})$

$v_{50} = 8.32 \times 10^{-11} \frac{m}{s}$

6. Pluto orbits the sun in a nearly circular orbit with radius $5.9 \times 10^{12}$ m and an orbital period of 247.7 years. Use this data to calculate the mass of the sun.

$F_c = F_g$ $\quad m_p \frac{4\pi^2 r}{T^2} = \frac{G m_s}{r^2}$ $\quad m_s = \frac{4\pi^2 r^3}{T^2 G} = \frac{4(3.14)^2 (5.9 \times 10^{12})^3}{6.67 \times 10^{-11} (7.81 \times 10^9)^2}$

$= 1.99 \times 10^{30} kg$

7. How much does a 85 kg person weigh [illegible]?

$W = mg$ $\quad = (85)\, 3.75 \frac{m}{s^2}$ $\quad = 3.19 \times 10^2 N$

$g = \frac{G m_m}{r^2} = \frac{(6.67 \times [illegible])(6.42 \times 10^{23})}{([illegible] \times 10^6)^2} = 3.75 \frac{m}{s^2}$

8. How many days does it take Jupiter to complete one revolution around the sun?

$F_c = F_g$ $\quad m_j \frac{4\pi^2 r}{T^2} = \frac{G m_s m_j}{r^2}$ $\quad T^2 = \frac{4\pi^2 r^3}{G m_s} = \frac{4(3.14)^2 (7.79 \times 10^{11})^3}{(6.67 \times 10^{-11}) 1.99 \times 10^{30}}$ $\quad = 1.19 \times 10^8 s$

$r = 7.78 \times 10^{11} + 6.96 \times 10^8 = 7.79 \times 10^{11}$

$T_j = 247.7 y \times \frac{365}{1y} \times \frac{24h}{1d} \times \frac{3600}{1h} = 7.81 \times 10^9$

$? d = 1.99 \times 10^8 s \times \frac{1 hr}{3600 s} \times \frac{1 d}{24 hr}$

$= 2.30 \times 10^3 d$