Homework Discussion, Week 8

Physics 1301 Dr. Andersen

Chapter 11

61.) The total angular momentum must be conserved. The initial angular momentum will have contributions from both the person and the merry-go-round

$$L_i = mvr + \frac{1}{2}Mr^2\omega_i$$

where m is the mass of the person, M is the mass of the merry-go-round, and r is its radius. Afterward, the total moment of inertia will be the sum of the merry-go-round plus a point mass for the person on the rim

$$L_f = (mr^2 + \frac{1}{2}Mr^2)\omega_f.$$

To find ω_f, equate the two angular momenta, and solve.

65.) Again, conservation of angular momentum. The initial will be

$$L_i = (m_{mouse}r^2 + \frac{1}{2}Mr^2)\omega_i.$$

When the mouse reaches the center, it won't be contributing anything to the moment of inertia, so

$$L_f = \frac{1}{2}Mr^2\omega_f.$$

a) Because the moment of inertia has decrease, the angular speed must increase, in order for L to remain constant. b) Equate the angular momenta and solve.

Chapter 12

18.) a) Weight is force of gravity acting on the object, so

$$W = \frac{GmM_e}{r^2}$$

Solving for r gives $r = 2.8 \times 10^7\ m$. b) Using $F = ma$, $a = W/m = 0.50\ m/s^2$. c-d) Because both the force and acceleration of gravity depend on r^2, doubling the distance will decrease both by a factor of $2^2 = 4$.

19.) The acceleration of gravity on the surface of the earth is

$$g = \frac{GM_e}{r_e^2},$$

and for the moon is

$$\frac{1}{6}g = \frac{GM_m}{r_m^2}.$$

Solving for the mass in each gives

$$M_e = \frac{gr_e^2}{G}$$

and

$$M_m = \frac{gr_m^2}{6G}.$$

Substituting $r_m = \frac{1}{4}r_e$ gives

$$M_m = (\frac{1}{6})(\frac{1}{16})(\frac{gr_e^2}{G}).$$

Note that the thing in the third parenthesis is the mass of the earth, so the moon has a mass of approximately 1/96 that of the earth.