Gravity and Orbits
Practice Problems
Fall 2013

1. Calculate the weight of a 75 kg person when they are standing at sea level and when they are standing on Cameron Pass (~10,000 feet)

2. Consider a 75 kg person standing at sea level on Earth. Compare the force of the Earth on the person to the force of the Moon on the person and the force of the Sun on the person.

3. Determine how fast two different projectiles, a 75kg man shot out of a cannon and a 0.01 kg bullet would have to be shot to never land – go into orbit. Neglect air resistance and surface features (such as mountains) that might get in the way.

4. Consider a satellite in a geosynchronous orbit around Earth. That means the satellite always remains over the same geographic location on Earth (say Equador).
    a. What is r, the distance from the center of the Earth?
    b. What is its altitude (from the surface)?
    c. What is its speed?

5. Calculate the period of the Moon's orbit around the Earth.

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$ $\quad F_G = \frac{Gm_1m_2}{r^2}$ $\quad 1\ radian = 57.3^o$

$T^2 = \frac{4\pi^2}{GM} r^3$ $\quad v = \frac{2\pi r}{T} = \sqrt{\frac{GM}{r}}$

$w = mg$ $\quad \Sigma\vec{F} = m\vec{a}$ $\quad g = 9.8 m/s^2$

Astronomical Data

Planetary body	Mean distance from sun (m)	Period (years)	Mass (kg)	Mean radius (m)
Sun	—	—	1.99×10^{30}	6.96×10^{8}
Moon	3.84×10^{8}*	27.3 days	7.36×10^{22}	1.74×10^{6}
Mercury	5.79×10^{10}	0.241	3.18×10^{23}	2.43×10^{6}
Venus	1.08×10^{11}	0.615	4.88×10^{24}	6.06×10^{6}
Earth	1.50×10^{11}	1.00	5.98×10^{24}	6.37×10^{6}
Mars	2.28×10^{11}	1.88	6.42×10^{23}	3.37×10^{6}
Jupiter	7.78×10^{11}	11.9	1.90×10^{27}	6.99×10^{7}
Saturn	1.43×10^{12}	29.5	5.68×10^{26}	5.85×10^{7}
Uranus	2.87×10^{12}	84.0	8.68×10^{25}	2.33×10^{7}
Neptune	4.50×10^{12}	165	1.03×10^{26}	2.21×10^{7}

*Distance from earth