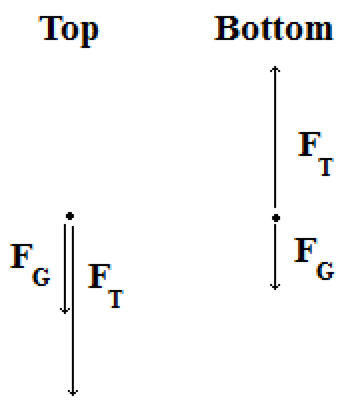
1.

ΣF = -3mg	
m = m	a = -3g
F_G = -mg F_T = -2mg	

a. The net force is 3mg downward.

b. $3g = \frac{v_0^2}{L}$ so $v_0 = \sqrt{3Lg}$

c.



d. Greater. At the top, the tension and gravity add to create the centripetal force, so the tension is less than the centripetal force. At the bottom, the tension must oppose gravity and create the centripetal force, so the tension is greater than the centripetal force.

x
$\Delta s = L\sqrt{12}$
$v = \sqrt{3Lg}$
$\Delta t = \sqrt{\frac{4L}{g}}$

y	
Δs = -2L	v_{avg} =
v_i = 0	a = -g
$v_f = -\sqrt{4gL}$	$\Delta t = \sqrt{\frac{4L}{g}}$

e. $\sqrt{\frac{4L}{g}}$

f. $L\sqrt{12}$

g. Farther. The ball would rise and then fall to the ground. It would be in the air for longer and so it would travel a greater distance.

2.

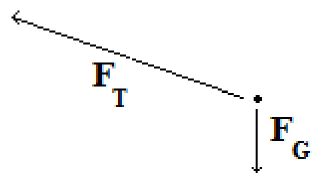
a. Use a stopwatch to record the time of ten revolutions. Divide this time by ten to determine the time of one revolution. Speed is distance divided by this time or the circumference of the circle ($2\pi \cdot 0.500$m) divided by this time.

b. Tension is the centripetal force, so T = $\frac{mv^2}{R} = \frac{(0.200)(3.7)^2}{0.500}$ = 5.476N

c. The average of 5.476 and 5.8 is 5.638. $\frac{5.8-5.476}{5.638}$ x 100% = 5.75%

d.

i.



ii. Because there is always a force of gravity downward, some of the tension must point upwards, meaning the string must always exist at an angle.

iii. If the tension is 5.8N and F_G is 2N, then the angle must be $\sin^{-1}(\frac{2}{5.8})$ = 20.17º.

3.

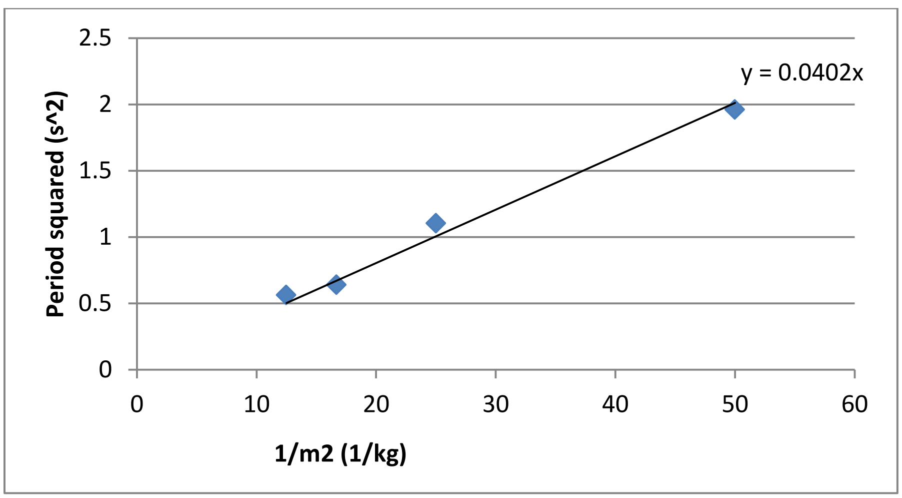
a. Because mass two is stationary, $m_2g = T$. And because T supplies the centripetal force, $T = \frac{m_1 \cdot v^2}{R}$. $v = \frac{2\pi r}{T}$ so $m_2g = \frac{m_1 \cdot v^2}{R} = \frac{m_1}{R} \cdot \frac{4\pi^2 \cdot R^2}{T^2}$

Solving $m_2g = \frac{m_1}{R} \cdot \frac{4\pi^2 \cdot R^2}{T^2}$ for T produces $T = 2\pi\sqrt{\frac{m_1 r}{m_2 g}}$

b. By the equation $T = 2\pi\sqrt{\frac{m_1 r}{m_2 g}}$, a linear graph could be drawn with T^2 and $\frac{1}{m_2}$.

c.

$\frac{1}{m_2}$ $(\frac{1}{kg})$	50	25	16.7	12.5
m_2 (kg)	0.020	0.040	0.060	0.080
T (s)	1.40	1.05	0.80	0.75
T^2 (s^2)	1.96	1.1025	0.64	0.5625



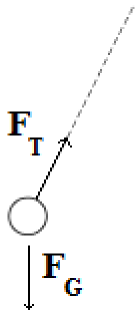
d. If $T^2 = 4\pi^2 \cdot \frac{m_1 r}{m_2 g}$ then $\frac{T^2}{\frac{1}{m_2}} = 4\pi^2 \cdot \frac{m_1 r}{g}$ = this slope

$0.0402 = 4\pi^2 \cdot \frac{m_1 r}{g} = 4\pi^2 \cdot \frac{(0.012)(0.80)}{g}$

$g = 9.43 m/s^2$

4.

a.



b. $\cos\theta = \frac{mg}{T}$ so $m = \frac{T}{g}\cos\theta$

c. $R = L\sin\theta$ and $\sin\theta = \frac{\frac{mv^2}{R}}{T}$ so $\sin\theta = \frac{\frac{mv^2}{L\sin\theta}}{T}$

$v = \sqrt{\frac{LT\sin^2\theta}{m}}$

d. Use P for period to distinguish from T, tension.

$v = \frac{2\pi R}{P} = \sqrt{\frac{LT\sin^2\theta}{m}}$ so $P = \frac{2\pi R}{\sqrt{\frac{LT\sin^2\theta}{m}}}$

Frequency is the reciprocal of period. If something rotates twice per second, it only takes half a second to rotate once. $f = \frac{1}{T} = \frac{\sqrt{\frac{LT\sin^2\theta}{m}}}{2\pi R}$

e. The ball would leave the circle tangent to its path and fall to the ground as a projectile.

5.

a. $F_G = \frac{Gm_E m_m}{R^2} = \frac{(6.67E-11)(6.0E24)(7.4E22)}{3.8E8^2} = 2.05 \times 10^{20}N$

b. $F_G = \frac{Gm_E m_s}{R^2} = \frac{-(6.67E-11)(6.0E24)(2.0E30)}{1.5E11^2} = -3.56 \times 10^{22}N$

c. $\Sigma F = 2.05 \times 10^{20}N + (-3.56 \times 10^{22}N) = -3.5395 \times 10^{22}N$

6.

a. $F_G = \frac{GM_E m}{a^2}$

b. $a = \frac{F_G}{m} = \frac{GM_E}{a^2}$

c. The acceleration is less than g because the satellite is farther from the center of the Earth. Thus, the acceleration due to gravity is weaker.

d. $a = \frac{v^2}{R}$ so $\frac{GM_E}{a^2} = \frac{v^2}{a}$

$v = \sqrt{\frac{GM_E}{a}}$

e. $v = \frac{2\pi R}{T} = \frac{2\pi a}{T} = \sqrt{\frac{GM_E}{a}}$

$T = \sqrt{\frac{4\pi^2 a^3}{GM_E}}$