Key Part 2 pd:«Period»

Circular Motion

AT Circular Motion 2 (16)

Directions: Solve the following problems. Show all work and circle your answers. This test is worth 50 points.

Mass of Earth 5.98×10^{24}kg

Mass of Moon 7.35×10^{22}kg

Mass of Mars 6.39×10^{23}kg

Radius of Earth 6.38×10^{6}m

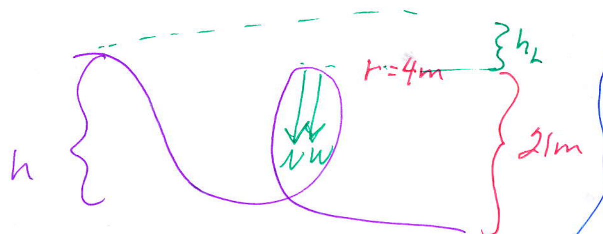
Radius of Moon 1.74×10^{6}m

Radius of Mars 3.34×10^{6}m

Universal Constant of Gravitations 6.67×10^{-11}Nm^2/kg^2

A roller coaster drops down from its initial hill, through a loop, and around a turn. The radius of curvature of the bottom of the loop is 12m, the radius at the top of the loop is 4m. The height of the top of the loop is 21 m. After the loop, the train returns to the ground in which the track makes a banked turn to the left with a radius of curvature of 28m. Assume no energy is lost on the roller coaster.

1) How high is the initial hill? Riders feel weightless at the top of the loop



$\Sigma F_y = -N - W = -ma_c$

$N = \text{Zero}$

$-W = -ma_c$

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

$mg = \frac{mv^2}{r}$

$g = \frac{v^2}{r}$

PE = KE

$mgh_L = \frac{1}{2}mv^2$

$gh_L = \frac{1}{2}v^2$

$2gh_L = v^2$

$g = \frac{2gh_L}{r}$

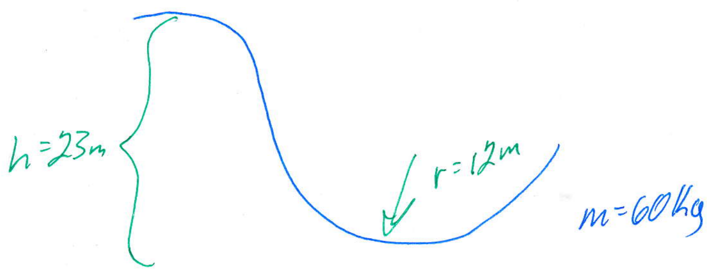
$r = 2h_L$

$\frac{r}{2} = h_L$

$2m = h_L$

$h = 21m + h_L = 23m$

2) Assuming the riders have a mass of 60kg, how heavy will they feel at the bottom of the hill?



$\Sigma F_y = N - w = ma_c$

$N - w = \frac{mv^2}{r}$

$N = \frac{mv^2}{r} + w$

$N = \frac{mv^2}{r} + mg$

$PE = KE$

$mgh = \frac{1}{2}mv^2$

$2gh = v^2$

$N = \frac{m2gh}{r} + mg$

$N = mg\left(\frac{2h}{r} + 1\right)$

$N = (60kg)(9.8 m/s^2)\left(\frac{2(23m)}{12m} + 1\right)$

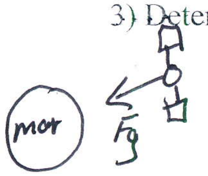
$N = 4.8g$ = 2842N

~~3.8g~~ ~~3g~~ = ~~2254N~~

3.56

A satellite orbits around Mars.

3) Determine the height above the surface of the Mars if the satellite is traveling at 4,530 m/s



$$\Sigma F_c = F_g = m a_c$$

$$\frac{G m m}{r^2} = \frac{m v^2}{r}$$

$$\frac{G m_m}{r} = v^2$$

$$\frac{G m_m}{v^2} = r = \frac{(6.67\times10^{-11}\,\frac{Nm^2}{kg^2})(6.39\times10^{23}\,kg)}{(4530\,m/s)^2} = 2.1\times10^{6}\,m$$

$(2.077\times10^{6}\,m)$

$$\sqrt{\frac{(6.67\times10^{-11}\,\frac{Nm^2}{kg^2})(6.39\times10^{23}\,kg)}{(3.34\times10^{6}\,m)}} = v = 3.6\times10^{3}\,m/s$$

Orbits Inside the planet...

4) How long does it take for the satellite to go around Mars once?

It Can't... ~~Going~~ Speed To Great To Orbit... Need To Go Slower ... If Orbit At Surface; 3,600 m/s ... period of

$$v = \frac{2\pi r}{T}$$

$$T = \frac{2\pi r}{v} = 5.83\times10^{3}\,s$$

97 min

«First_Name» «Last_Name» Pd «Period»