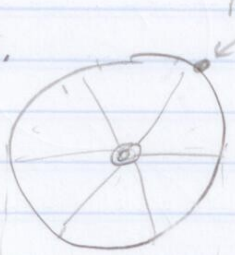
Ch 6 HW

15, 53, 64, 70

15. 

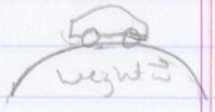
Your roommate is working on his bicycle and has the bike upside down. He spins the 60-cm-diameter wheel, and you notice that a pebble stuck in the tread goes by three times every second. What are the pebble's speed and acceleration?

$f = 3\ rev/s = 3\,s^{-1}$

$v = \omega r = 2\pi f \cdot r = 2\pi 3\,s^{-1} \cdot 0.30\,m$
$= \boxed{5.65\ m/s}$

$a = v^2/r = (5.65\ m/s)^2 / 0.30\,m = \boxed{107\ m/s^2}$

53. A car drives over the top of a hill that has a radius of 50m. What maximum speed can the car have w/out flying off the road at the top of the hill?



$\vec{a}$ is towards the middle of the circle.

When the car leaves the hill because it wants to continue w/ a constant velocity, its normal force becomes zero. So the central speed when this happens is $n = 0$.

$\Sigma F = n - w = -ma$ $\quad n = 0$ so $\quad w = mg = ma = mv^2/r$

$v = \sqrt{gr} = \sqrt{9.8\,50m} = \boxed{22\ m/s}$

64. How long will it take a rock dropped from 2.0m above the surface of Mars to reach the ground?

need g for Mars. $mg = \frac{GMm}{r^2}$

$$g = \frac{GM}{r^2} = \frac{6.67\times10^{-11}\,\frac{Nm^2}{kg^2}\ 6.42\times10^{23}\,kg}{(3.37\times10^{6}\,m)^2}$$

$$= 3.77\,m/s^2$$

$$y = \tfrac{1}{2}at^2$$

$$\sqrt{\frac{2y}{a}} = t = \sqrt{\frac{2\cdot2.0m}{3.77\,m/s^2}} = 1.025 = \boxed{1.0s}$$

70. You are given the equation used to solve a problem.
a. Write a realistic problem for which this is a correct equation. Be sure that the answer your problem requests is consistent w/ the equation.
b. Finish the solution.

$$60N = (0.30kg)\,w^2\,(0.50m)$$

I'll put in the variables to see what I have.

$$F = mw^2r$$

Your Professor swings a 0.30kg tuning fork attached to a 0.50m long string over her head to demonstrate the Doppler Effect. Determine the angular speed of the tuning fork when the tension in the string is 60N. $w = \sqrt{\frac{60}{.3kg\cdot.5m}} = \boxed{20\,rad/s}$