key Level II Physics Pd 2

CIRCULAR MOTION

FT CIRCULAR MOTION (2.1)

Directions: Solve the following problems. Each is worth 5 points. Your work will be graded, not just the answer!

1) A 40g stopper is whirled around in a circle at the end of a 60cm long string such that it goes around 25 times in 16 seconds. Determine period.

$\frac{16s}{25 Rev} = .64s$

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2) A 40g stopper is whirled around in a circle at the end of a 60cm long string such that it goes around 25 times in 16 seconds. Determine linear speed.

$v = 2\pi rf = 2\pi(.6m)\left(\frac{25 Rev}{16 Sec}\right) = 5.89\ m/s$

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3) A 40g stopper is whirled around in a circle at the end of a 60cm long string such that it goes around 25 times in 16 seconds. Determine the centripetal acceleration.

$$a_c = \frac{v^2}{r} = \frac{(2\pi r f)^2}{r} = 4\pi^2 f^2 r = 4\pi^2 \left(\frac{25 \text{ rev}}{16 \text{ s}}\right)^2 (.6 \text{ m})$$

$$57.8 \text{ m/s}^2$$

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4) A 40g stopper is whirled around in a circle at the end of a 60cm long string such that it goes around 25 times in 16 seconds. Determine centripetal force.

$$F_c = \frac{mv^2}{r} = m 4\pi^2 f^2 r = (.04kg)(4)(\pi^2)\left(\frac{25 Rev}{16s}\right)^2(.6m)$$

2.3 N

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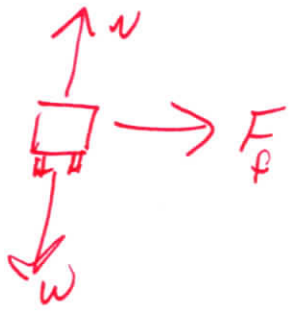
5) A 1500kg car is traveling at a constant speed of 40 mi/hr (18 m/s) when it encounters a turn of radius 25m. Determine the coefficient of friction between the tires and the road needed to negotiate the turn.



$\Sigma F_y = N - w = 0$

$N = w$

$N = mg$

$\Sigma F_x = F_f = ma_c$

$\mu N = ma_c$

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

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

$\mu = \frac{v^2}{gr} = \frac{(18 m/s)^2}{(9.8 \frac{m}{s^2})(25m)}$

$\mu = 1.3$

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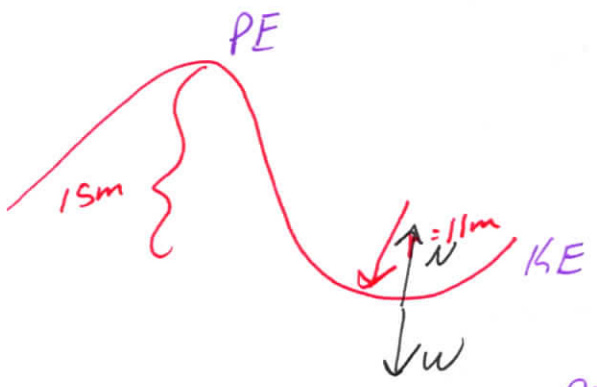
6) A roller coaster is 15 m tall. The train goes down the first hill to the ground and curves upward on a curve with a radius 11m. Determine how heavy a 60Kg person will feel at the bottom of the "curve."



$PE = KE$

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

$2gh = v^2$

$\Sigma F_y = N - w = ma_c$

$N = ma_c + w$

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

$N = m\left(\frac{v^2}{r} + g\right)$

$N = m\left(\frac{2gh}{r} + g\right)$

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

$N = (60kg)(9.8m/s^2)\left[\frac{(2)(15m)}{r} + 1\right]$

~~$N = 18228N$~~

$2192N$

3.7 Times Heavier...

3.7g

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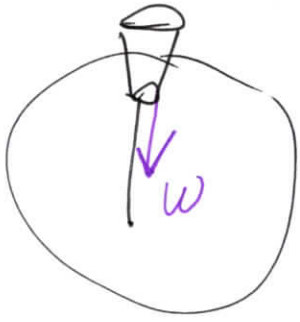
7) A 20g stopper is whirled around in a vertical circle at the end of a 1.25m long string. Determine the slowest frequency the stopper can have and still stay in the circle (not fall at the top).



$\Sigma F_y = -w = -ma_c$

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

$gr = v^2$

$\sqrt{gr} = v = \sqrt{(9.8\frac{m}{s^2})(1.25m)}$

$v = 3.5\ m/s$

Oops..

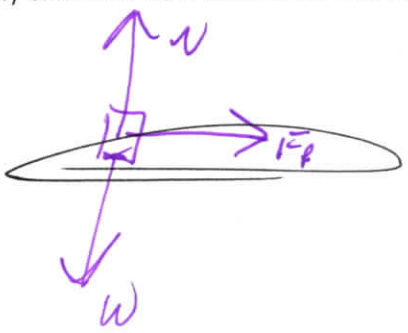
Frequency Requested

$v = 2\pi rf$

$\frac{v}{2\pi r} = \frac{3.5\frac{m}{s}}{2\pi(1.25m)}$ .45Hz

key Level II Physics Pd 2

8) A penny is going to "ride around" on a turntable. The coefficient of friction between the penny and turntable is 0.45. The turntable will rotate at 45 rev/min. What is the greatest distance the penny can have from the center and not slide off the turntable?



$$\Sigma F_y = N - W = 0$$
$$N = W$$
$$N = mg$$

$$\Sigma F_x = F_f = ma$$
$$\mu N = \frac{mv^2}{r}$$
$$\mu N = \frac{m(2\pi r f)^2}{r}$$
$$\mu N = \frac{m 4\pi^2 r^2 f^2}{r}$$
$$\mu N = 4\pi^2 r m f^2$$
$$\mu mg = 4\pi^2 r m f^2$$
$$\mu g = 4\pi^2 r f^2$$
$$\frac{\mu g}{4\pi^2 f^2} = r$$

$$\left(45\frac{\text{Rev}}{\text{min}}\right)\left(\frac{1\text{min}}{60\text{s}}\right) = .75\,\text{Rev/s}$$

$$\frac{(.45)(9.8\,\text{m/s}^2)}{4\pi^2(.75\,\text{Rev/s})^2} = .198\,\text{m}$$