Solving Circular Motion Problems in the Horizontal Plane

1. David winds up with a 150 g pebble in his slingshot. The slingshot thongs are 43 cm long and are revolving 5 times per second. What is the tension in the thongs?

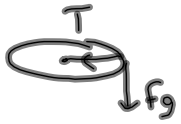
$m = 0.150\,kg$
$r = 0.43\,m$
$f = 5\,Hz$

$T = F_{Net} = F_c$
need $\vec{V}$.

$V = 2\pi r f$
$V = 2\pi(0.43m)(5Hz)$
$V = 13.5\,m/s$

$T = F_{Net}$
$T = F_c$
$T = \frac{mV^2}{r}$
$T = \frac{(0.15kg)(13.5m/s)^2}{(0.43m)}$
$T = 64N$

2. David knows from past experience that if he swings the sling shot too fast the tension becomes too great and the thongs snap. If the thongs can withstand a maximum tension of 120 N, what is the maximum rpm's allowed?



$m = 0.15\,kg$
$r = 0.43m$
$T = 120N = F_c$
$rpm = ?$
$f = ?$ $(V = 2\pi r f)$

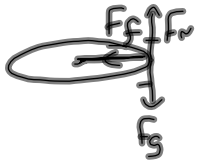
$T = F_{Net} = F_c$
$T = \frac{mV^2}{r}$
$V = \sqrt{\frac{Tr}{m}}$
$V = \sqrt{\frac{(120N)(0.43m)}{0.15\,kg}}$
$V = 18.5\,m/s$

$V = 2\pi r f$
$f = \frac{V}{2\pi r} = \frac{18.5m/s}{2\pi(0.43)} = 6.85\,Hz$

$rpm's = 6.85\frac{rev}{s} \times \frac{60s}{1min} = 411\,rpms$

3. A 210 g potato is sitting 21 cm from the center of a microwave oven tray slides off the rotating tray if its linear speed exceeds 11 cm/s. Determine the coefficient of static friction between the potato and the tray.

DOF



$m = 0.21\ kg$
$V = 0.11\ m/s$
$\mu = ?$
$r = 0.21\ m$

$F_{net} = f_f$

$F_c = F_f$

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

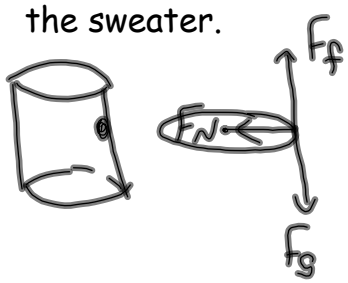
$\frac{V^2}{r} = \mu g$

$\frac{V^2}{rg} = \mu$

$\frac{(0.11\ m/s)^2}{(0.21\ m)(9.8\ m/s^2)} = \mu$

$0.0059 = \mu$

4. Suppose that the drum in your washer spins with a frequency of 6.2 Hz. The diameter of the drum is 58.0 cm and your wet woolen sweater has a mass of 3.2 kg early in the spin. Determine the linear speed of you sweater and the centripetal force exerted by the wall of the drum on the sweater.

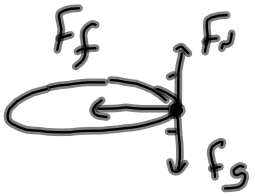


$f = 6.2\ Hz$
$m = 3.2\ kg$
$r = 0.29\ m$
$V = ?$
$F_c = ?$

$V = 2\pi rf$
$= 2\pi(0.29\ m)(6.2\ Hz)$
$= 11.3\ m/s$

$F_c = \frac{mV^2}{r}$
$= \frac{(3.2\ kg)(11.3\ m/s)^2}{0.29\ m}$
$= 1400\ N$

5. What is the maximum speed at which a 1200 kg car can round a curve on a flat road if the radius of curvature is 75 m and the coefficient of static friction is 0.20?



$F_c = f_f$

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

$v = \sqrt{\mu g r}$

$m = 1200\,kg$
$r = 75\,m$
$\mu = 0.20$
$v = ?$

$v = \sqrt{(0.2)(9.8\,m/s^2)(75\,m)}$

$v = 12\,m/s$

6. What is the purpose of the spin cycle on an automatic washer? How does it work?

Purpose- to remove water from clothes
-The water has inertia and because the holes can exert no force on the water, it escapes through the holes.
-The sides of the drum however, prevent the clothes from flying off. The sides of the drum exert a normal force on the clothes, but not on the water where the holes are. You could say that the clothes are forced away from the water.