Centripetal Net Force Particle Model:
Circular Motion Problem Solving Tips

When we did Newton's 2nd law, we established: sum of forces = net force = ma

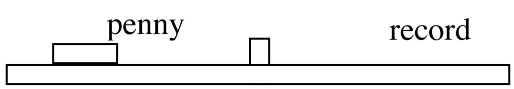
$$\Sigma F = m * a$$

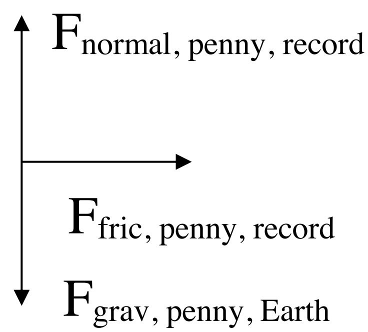
Now, for circular motion: sum of radial forces = centripetal force = $\frac{mv^2}{r}$ $\Sigma F_C = m * a_c$

Note that "Centripetal force" is just a fancy name for the **net force**. It is not a kind of interaction (like gravity or normal forces) and is **NOT** drawn on force diagrams.

EXAMPLES:

1. What frictional force is needed to keep a penny from sliding off a record rotating at $33\,^1/_3$ revolutions per minute when it is placed 10 cm from the center of the record. (mass of penny = 2.5 grams)





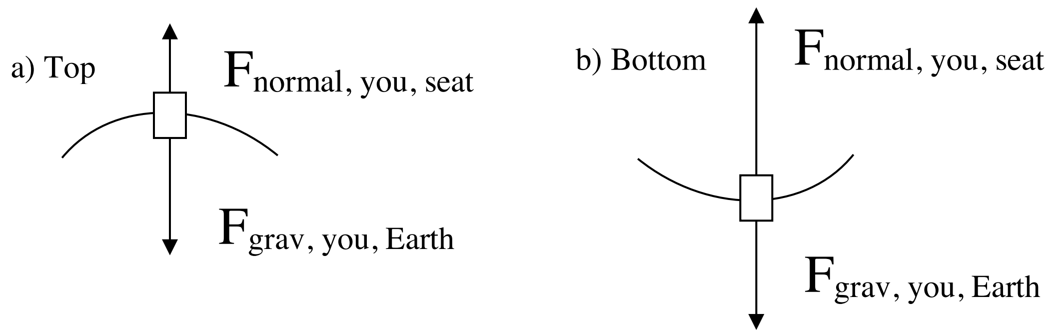
Net radial force = F_{fric}

$$33\frac{1}{3}\frac{rev}{min} * \frac{1\ min}{60\ sec} = 0.555\ \frac{rev}{s} \qquad \left(0.555\frac{rev}{s}\right)^{-1} = 1.8\ s/rev$$

$$\Sigma F_C = F_{fric} = m * a_c \qquad a_c = \frac{v^2}{r} \qquad \text{v} = \frac{2\pi r}{T}$$

$$F_{fric} = m * \frac{\left(\frac{2\pi r}{T}\right)^2}{r} = 0.0025\ kg * \frac{\left(\frac{2\pi\ 0.1m}{1.8\ s}\right)^2}{0.1\ m} =$$

2. A ferris wheel with a 20 m radius and tangential speed of 4 m/s has all 70 kg of you riding it. How big is the normal force exerted on you at **a**) the top **b**) the bottom?



Towards the center is positive

$$\Sigma F_{C\ Top} = m * a_c$$

$$F_g - F_N = m * \frac{v^2}{r}$$

$$F_N = F_g - m * \frac{v^2}{r}$$

$$\Sigma F_{C\ Bottom} = m * a_c$$

$$F_N - F_g = m * \frac{v^2}{r}$$

$$F_N = F_g + m * \frac{v^2}{r}$$