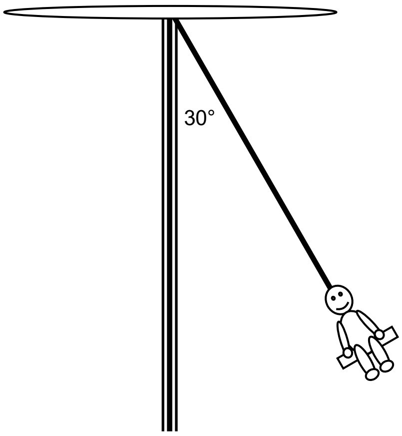
Examples of circular motion

1. Swing carousel

Tony (m = 26.5 kg) is riding on a swing carousel. He moves in a circular path of radius 3.6 m. The time required for one revolution is 5.0 s.



1. Determine T, f and ω.

   T = f = ω =

2. Calculate the centripetal force acting on Tony required for him to move in a circular path:

   F_C =

3. The net force (centripetal force) is the resultant of two forces:
   - Tony's weight (pointing vertically down)
   - The force of the rope (pointing obliquely to the top left)

   Draw a double-lined arrow to represent the centripetal force graphically (100 N corresponds to 1.0 cm).

4. Calculate Tony's weight and draw an arrow to represent F_G graphically (first component of force).

   F_G =

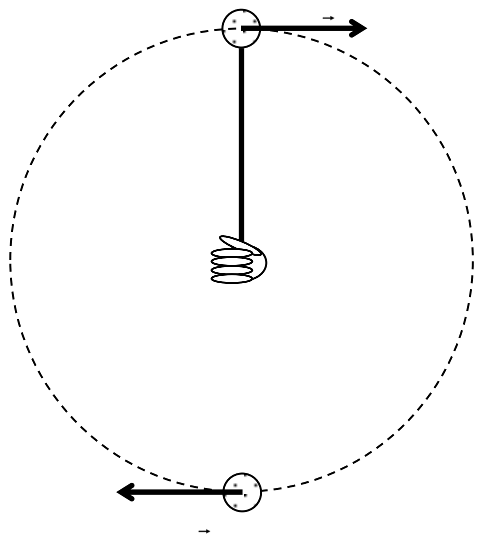
5. Construct the second component of force along the rope. Determine its magnitude by measuring the arrow's length as well by calculation.

   F_{rope} (measured) =

   F_{rope} (calculated) =

2. Whirling a ball in a vertical circle

A ball (m = 102 g) on a string (ℓ = 1.5 m) is whirled along a vertical circular path with $v = 4.7\ \frac{\text{m}}{\text{s}}$.



1. In order to keep the ball on a circular path, a net centripetal force is required. Calculate its magnitude.

   F_C =

2. The net force (centripetal force) is the resultant of two forces:
   - The ball's weight (pointing vertically down)
   - The force of the string (pointing towards the hand, i.e. towards the center of the circle)

   Draw a double-lined arrow to represent the centripetal force graphically acting on the ball at the upmost point of the motion (1.0 N corresponds to 1.0 cm)

3. Calculate the ball's weight and draw an arrow to represent F_G graphically.

   F_G =

4. In the upmost point, the force of the string and the ball's weight are both directed downwards. They sum up to yield the centripetal force. Determine F_{string} and represent it graphically as an arrow.

   F_{string} =

5. In the lowest point of the motion, the weight of the ball is directed downwards while the pull of the string is directed upwards. They sum up to yield an upward centripetal force (acting towards the center of the circle). Determine F_{string} and represent it graphically as an arrow.

   F_{string} =

> In the upmost point, the ball will contiunue in a circular path (and not fall down) as long as the string exerts a downward pull on the ball, i.e. if $F_Z \geq F_G$.
>
> This is the case if $\frac{m \cdot v^2}{r} \geq m \cdot g \quad \Rightarrow \quad \frac{v^2}{r} \geq g$