Answer on Question #59386-Physics – Mechanics | Relativity

The 100 gram puck moves at constant speed on a frictionless air table. It is tied to a central post, which causes it to move in a perfect circle. A student with a stopwatch determines that the puck takes 2.5 seconds to complete 5 revolutions.

A. What is the puck's period, T?

B. If the string is 15 cm long, how fast is the puck moving?

C. Determine the acceleration of the puck. In what direction is it accelerating?

D. Determine the net force on the puck.

E. Assume the string can only withstand 5 N of force. If the puck was moving twice the speed would the string break? Justify your answer.

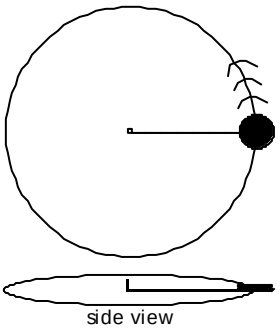
Solution

A.

$$\omega = \frac{5\,rev}{2.5\text{ s}} = 2\frac{rev}{s} = 2\pi(2)\frac{rad}{s}.$$

$$f = \frac{\omega}{2\pi} = \frac{2\pi(2)}{2\pi} = 2\ Hz.$$

$$T = \frac{1}{f} = \frac{1}{2} = 0.5\ s.$$



B.

$$v = \omega R = 2\pi(2)\frac{rad}{s}\cdot 0.15m = 0.6\pi\frac{m}{s} \approx 1.9\frac{m}{s}.$$

C.

$$a = \omega^2 R = \left(2\pi(2)\frac{rad}{s}\right)^2 \cdot 0.15m \approx 24\frac{m}{s^2}$$

The direction of acceleration is towards to the center of circle.

D.

$$F_{net} = ma = 0.1\ kg \cdot 24\frac{m}{s^2} = 2.4\ N.$$

E.

$$F_{net} = \frac{mv^2}{R} \sim v^2.$$

$$F'_{net} = F_{net}\left(\frac{v'}{v}\right)^2 = 2.4\ N\ (2)^2 = 9.6\ N.$$

Thus, the net force exceeds 5N and the string would break.