

This is a problem involving uniform circular motion.

A fan rotates at 1000 revolutions per minute.
The tip of the blades have a radius of 0.20 m.

(a) What is the distance traveled by the tip of a blade during one full revolution?

(b) What is the speed of a blade tip?

(c) What is the acceleration of a blade tip?

Solution:

(a) The travel distance is equal to the circumference of a circle with radius 0.20 m.

$$\text{Travel distance} = 2\pi(0.20) = 1.26 \text{ m (answer)}$$

$$(b) \text{ speed} = \frac{\text{Travel distance}}{\Delta t}$$

If we take the travel distance to be 1.26 m from part (a), the Δt is the time it takes for the blade tip to make one full revolution.

$$\text{Then, } \Delta t = \frac{1 \text{ rev}}{1000 \text{ rev/min}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 0.06 \text{ sec}$$

$$\text{So, speed} = \frac{1.26 \text{ m}}{0.06 \text{ s}} = 21 \text{ m/s (answer)}$$

$$(c) a = \frac{v^2}{r} \text{ (centripetal acceleration magnitude)} \quad a = \frac{(21)^2}{0.20} = 2200 \text{ m/s}^2 \text{ (ans.)}$$