Linear vs. angular speed

Starter

1. **(Review of previous material)**
Convert the following to radians: (a) $35°$ (b) $162.8°$

Working: (a) $35° \equiv 35 \times \frac{\pi}{180} = \frac{7\pi}{36}$

Notice that since we have a fraction, we leave the angle in terms of π.

(b) $162.8° \equiv 162.8 \times \frac{\pi}{180} = \frac{407\pi}{450} \approx 2.84^{c}$

2. Convert the following to degrees: (a) $\frac{5\pi}{6}$ (b) 2.39^{c}

Working: (a) $\frac{5\pi}{6} \equiv \frac{5\pi}{6} \times \frac{180}{\pi} = 150°$

(b) $2.39^{c} \equiv 2.39^{c} \times \frac{180}{\pi} \approx 137°$

3. A particle, P, takes 30 seconds to make one revolution of a circle of radius 3 m.
(a) What angle (in radians) does the particle move through in 1 second?
(b) What arc length is traversed in 1 second?

Working: (a) Angle in one second $= \frac{2\pi}{30} = \frac{\pi}{15}$

(b) Arc length in one second $= \frac{6\pi}{30} = \frac{\pi}{5}$ m

E.g. 1 A particle moves in a circle of radius 2 m with tangential speed 3 m/s. Calculate its angular speed.

Working: $v = 3, r = 2$

$v = r\omega \quad \Rightarrow \quad \omega = \frac{v}{r} = \frac{3}{2} = 1.5$ rad/s

E.g. 2 The tangential speed of an object moving around a circle is given as 8 m/s and the angular velocity is 4 rad/s. Calculate the radius of its path.

Working: $v = 8, \omega = 4$

$v = r\omega \quad \Rightarrow \quad r = \frac{v}{\omega} = \frac{8}{4} = 2$ m

E.g. 3 An old gramophone record of diameter 30 cm rotates at 78 revolutions per minute. Calculate its angular speed and the linear speed of the rim in m/s.

Working: 78 revolutions per minute $\equiv \frac{78}{60} = 1.3$ revolutions per second

Angular speed $= 2\pi \times 1.3 = 2.6\pi = 8.17$ rad/s (3 s.f.)

Linear speed of the rim, $v = r\omega = 0.15 \times 2.6\pi = \frac{39\pi}{100} \approx 1.23$ m/s.

Video: Angular speed and accelaration

Video: Angular velocity and speed

Solutions to Starter and E.g.s

Exercise

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