

Solutions

Each answer shows the steps, then the **result**.

2.1

- the angle subtended at the centre of a circle by an arc whose **length equals the radius**

2.2

- a full circle is 2π rad = 360°

$$\theta = 90^\circ \times \frac{2\pi \text{ rad}}{360^\circ} = \frac{\pi}{2} \text{ rad} \approx 1.57 \text{ rad}$$

2.3

- $f = 2.0 \text{ rev s}^{-1}$; $\omega = 2\pi f$

$$\omega = 2\pi f = 2\pi \times 2.0 \text{ s}^{-1} = 4\pi \text{ rad s}^{-1} = \mathbf{12.6 \text{ rad s}^{-1}}$$

2.4

- their **rim speeds** ($v = r\omega$) are equal (the belt does not slip)

3.1 B

- a full circle is 2π radians
- A** is a half-turn; **C** is degrees; **D** is one radian, not a full turn

3.2

- $v = 20 \frac{\text{m}}{\text{s}}$, $r = 50 \text{ m}$; $\omega = v/r$

$$\omega = \frac{v}{r} = \frac{20 \frac{\text{m}}{\text{s}}}{50 \text{ m}} = \mathbf{0.40 \text{ rad s}^{-1}}$$

3.3

(a) 1500 revolutions per minute = 25 revolutions per second, and one revolution is 2π rad

$$\omega = 2\pi f = 2\pi \times 25 \text{ s}^{-1} = \mathbf{157 \text{ rad s}^{-1}}$$

(b) the belt gives both pulleys the same **rim speed** $v = r\omega$

- motor radius 25 mm = 0.025 m

$$v = r\omega = (0.025 \text{ m})(157 \text{ rad s}^{-1}) = 3.93 \frac{\text{m}}{\text{s}}$$

$$\omega_{\text{fan}} = \frac{v}{r} = \frac{3.93 \frac{\text{m}}{\text{s}}}{0.075 \text{ m}} = \mathbf{52 \text{ rad s}^{-1}}$$

- a third of the motor's, because its radius is three times larger

3.4

$$\theta = 1.5 \text{ rad} \times \frac{180^\circ}{\pi} = \mathbf{86^\circ}$$