

Solutions

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

2.1

- Toward the centre of the circle

2.2

- centripetal force:

$$F_c = \frac{mv^2}{r} = \frac{(3 \text{ kg})(4 \text{ m s}^{-1})^2}{2 \text{ m}}$$

- $F_c = \mathbf{24 \text{ N}}$ towards the centre

2.3

- Friction (between the tyres and the road)

2.4

- centripetal acceleration:

$$a_c = \frac{v^2}{r} = \frac{(6 \text{ m s}^{-1})^2}{3 \text{ m}}$$

- $a_c = \mathbf{12 \text{ m s}^{-2}}$ towards the centre

3.1 B

- the centripetal force points toward the centre

3.2 B

- $F_c = \frac{mv^2}{r}$, so $F_c \propto v^2$ at fixed m and r :

$$\frac{F'_c}{F_c} = \left(\frac{2v}{v}\right)^2 = 4$$

3.3

(a)

- centripetal force:

$$F_c = \frac{mv^2}{r} = \frac{(0.5 \text{ kg})(3 \text{ m s}^{-1})^2}{1 \text{ m}}$$

- $F_c = \mathbf{4.5 \text{ N}}$

(b)

- The tension in the string

3.4

(a)

- centripetal acceleration:

$$a_c = \frac{v^2}{r} = \frac{(10 \text{ m s}^{-1})^2}{50 \text{ m}}$$

- $a_c = \mathbf{2 \text{ m s}^{-2}}$ towards the centre of the curve

(b)

- friction is the only horizontal force, so it supplies the centripetal force:

$$F_f = ma_c = (1000 \text{ kg})(2 \text{ m s}^{-2}) = \mathbf{2000 \text{ N}}$$