Solutions

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

2.1

- the force is perpendicular, so $\sin\theta = 1$:

$$\tau = rF = (0.3\text{ m})(20\text{ N})$$

- $\tau = \mathbf{6}$ N m

2.2

- Zero (the lever arm is zero)

2.3

- The perpendicular distance from the axis to the line of the force

2.4

- only the perpendicular component turns the arm:

$$\tau = rF\sin\theta = (0.4\text{ m})(50\text{ N})\sin 30^\circ$$

- $\tau = \mathbf{10}$ N m

3.1 B

- perpendicular gives the maximum torque

3.2 A

- perpendicular force:

$$\tau = rF = (0.25\text{ m})(8\text{ N}) = 2\text{ N m}$$

3.3

(a)

- the weight acts perpendicular to the level seesaw:

$$\tau = rF = (1.5\text{ m})(300\text{ N})$$

- $\tau = \mathbf{450}$ N m

(b)

- balance: clockwise torque = anticlockwise torque:

$$(450\text{ N})\,d = 450\text{ N m} \quad \Rightarrow \quad d = \frac{450\text{ N m}}{450\text{ N}}$$

- $d = \mathbf{1.0}$ m from the pivot

3.4

(a)

- only the component perpendicular to the door turns it:

$$\tau = rF\sin\theta = (0.8\text{ m})(40\text{ N})\sin 60^\circ$$

- $\tau = \mathbf{27.7}$ N m

(b)

- Apply it perpendicular to the door (or farther from the hinge)