

Exercise walk-through

5.3

Torque

AP Physics 1

Torque

Torque is the rotational version of force
– how strongly a force twists:

Twisting strength

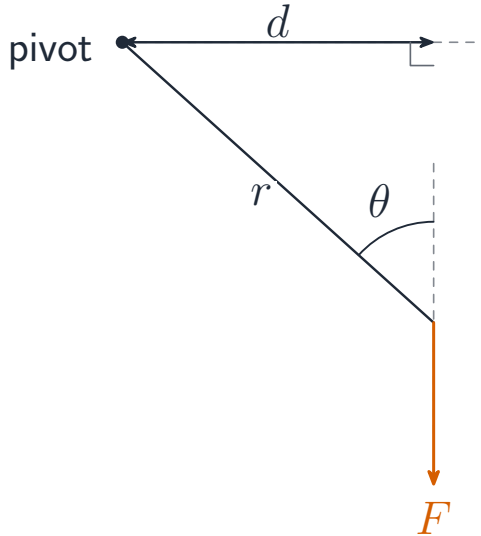
$$\tau = rF \sin \theta$$

The **lever arm** is the perpendicular distance to the force. A bigger lever arm gives **more torque**.



Torque is the rotational analogue of force

The moment of a force depends on



The moment of a force depends on the perpendicular distance from the pivot

Exercises 2.1-2.3

2.1 A 30 N force acts perpendicular to a door, 0.80 m from the hinge. Find the torque.[1]

2.2 State the angle between the force and the lever arm that gives the maximum torque.[1]

2.3 A 40 N force acts at 30° to a 0.60 m arm. Find the torque. [2]

Exercises 2.1-2.3

2.1 A 30 N force acts perpendicular to a door, 0.80 m from the hinge. Find the torque.[1]

2.1

- $\tau = 30 \times 0.80 = 24 \text{ N m}$

2.2 State the angle between the force and the lever arm that gives the maximum torque.[1]

2.2

- 90° (perpendicular)

2.3 A 40 N force acts at 30° to a 0.60 m arm. Find the torque. [2]

2.3

- $\tau = rF \sin \theta = 0.60 \times 40 \times \sin 30^\circ = 12 \text{ N m}$

Exercises 2.4·3.1

2.4 Explain why a longer wrench makes it easier to loosen a tight bolt.

[2]

3.1 Torque is greatest when the force is applied

[1]

☐

A along the arm

B at 45° to the arm

C perpendicular to the arm

D at the axis

Exercises 2.4·3.1

2.4 Explain why a longer wrench makes it easier to loosen a tight bolt. [2]

2.4

- A longer arm is a larger lever arm r , so the same force produces a bigger torque
 $\tau = rF$

3.1 Torque is greatest when the force is applied [1]

☐

A along the arm

B at 45° to the arm

C perpendicular to the arm

D at the axis

3.1 C

- perpendicular to the arm.

Exercise 3.2

3.2 A 10 N force acts at a perpendicular distance of 0.20 m from an axis. The torque is [1]

☐

A 0.02 N m

B 2.0 N m

C 10 N m

D 50 N m

Exercise 3.2

3.2 A 10 N force acts at a perpendicular distance of 0.20 m from an axis. The torque is [1]

☐

A 0.02 N m

B 2.0 N m

C 10 N m

D 50 N m

3.2 B

- $\tau = 10 \times 0.20 = 2.0 \text{ N m}$

Exercise 3.3 (a)

3.3 A seesaw pivots at its centre. A 300 N child sits 1.5 m from the pivot.

(a) Find the torque this child produces.

[2]

Exercise 3.3 (a)

3.3 A seesaw pivots at its centre. A 300 N child sits 1.5 m from the pivot.

(a) Find the torque this child produces.

[2]

(a)

- $\tau = 300 \times 1.5 = 450 \text{ N m}$

Exercise 3.3 (b)

3.3 A seesaw pivots at its centre. A 300 N child sits 1.5 m from the pivot.

(b) Find where a 450 N child must sit to balance the seesaw.

[2]

Exercise 3.3 (b)

3.3 A seesaw pivots at its centre. A 300 N child sits 1.5 m from the pivot.

(b) Find where a 450 N child must sit to balance the seesaw.

[2]

(b)

- balance needs equal torque: $450 \times d = 300 \times 1.5 \Rightarrow d = 1.0$ m from the pivot