

Physics with Synno – Motion-2 – Lesson 17

M.6 Torque

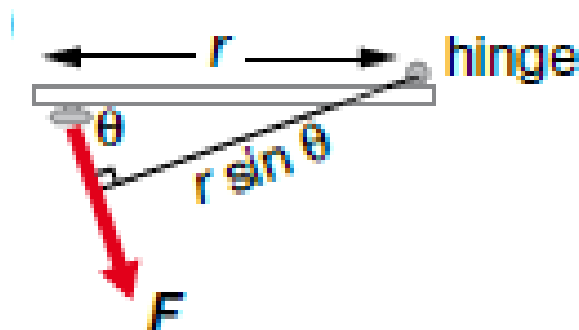
A torque is a force that causes a body to **rotate**, it is sometimes referred to as turning moment. Torque is a **vector** quantity, its direction corresponds to the direction of **rotation**. Clockwise rotation being defined as **negative**. Torque is given by:

$$\tau = r F \sin \theta$$

where F is the applied force

r is distance between the axis of rotation and the force

θ is the angle between the force and the radius



The unit of torque is metre Newton (m N) and should not be confused with the unit of work and energy which is very similar.

Example

A woman whose car has a flat tyre has two wheel-nut spanners in the boot of her car. One wheel spanner is 15 cm long and the other is 75 cm long.

- In order to undo the wheel nuts with a minimum amount of effort, which wheel spanner should the woman select?
- If the maximum force that the woman can apply is 45 N, determine the maximum torque that can be delivered to a wheel nut.

Solution

a The longer one would provide more torque.

b Maximum torque when $\theta = 90^\circ$

$$\tau = 0.75 \times 45 \sin 90^\circ$$

$$\tau = 33.75 \text{ m N}$$

$$\tau = 34 \text{ m N}$$

Example.

A mechanic uses a 17 cm long spanner to tighten a nut. He applies a force of 104 N at an angle of 75° to the spanner. Calculate the amount of torque that the mechanic applies to the nut.

$$R = 0.17 \text{ m} \quad F = 104 \text{ N} \quad \theta = 75^\circ$$

$$\tau = 0.17 \times 104 \sin 75^\circ$$

$$\tau = 17.1 \text{ m N}$$

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