Rosary School – Marj Elhamam

9Id Turning Forces

Study sheet 4

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Date: ____/____/ 2025

Grade: 8 ( )

Subject: **Physics**

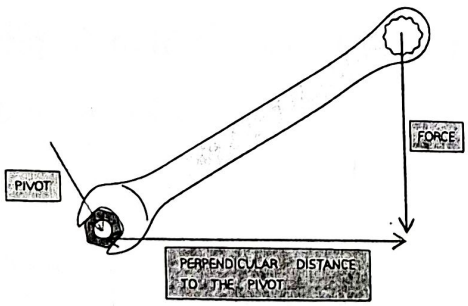
Learning Objectives

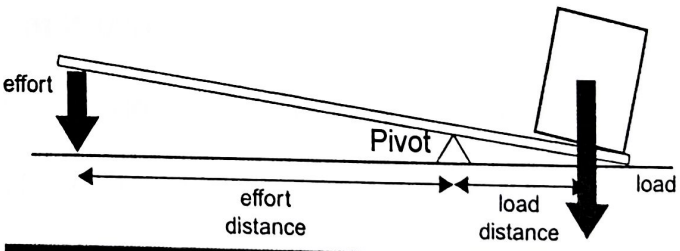
- Identify the pivot, load and effort in Class 1 levers and explain how levers are used in common devices.
- State what is meant by a moment of a force and describe the factors that affect its size.
- Recall that an object will balance if the moments are equal and opposite.
- Use the formula relating moment, force and perpendicular distance.

Moments

- Forces can be used to turn objects around pivots. A **pivot** is also known as a **fulcrum**.
- A turning force is called a **moment**. Moments are measured in **newton metres (N m).**

moment (N m) = force (N) × perpendicular distance from the pivot (m).





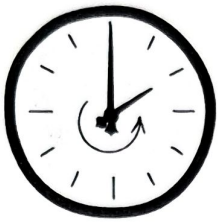
B | The effort is smaller than the force needed to lift the weight of the load directly.

The longer the distance the greater the moment. This is why it is easier to turn a long spanner than a short one.

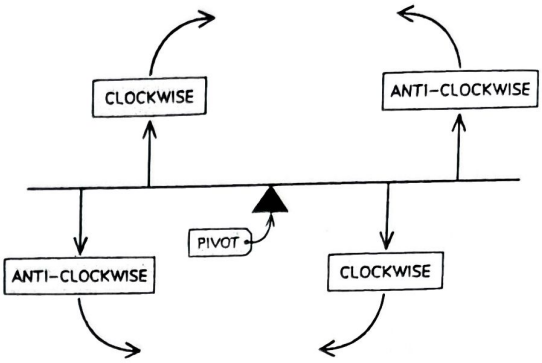
The principle of moments:

If an object is in **Equilibrium** (balanced), the **clockwise** moment about a pivot equals the **anticlockwise** moment about that pivot.

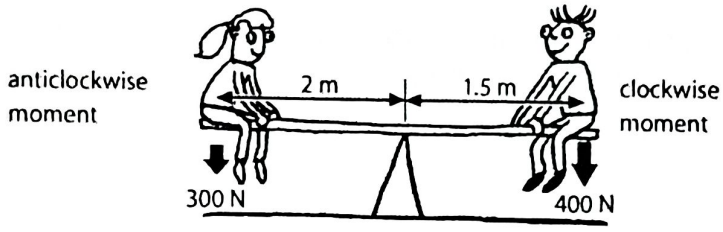
Clockwise rotation



Anticlockwise rotation



Example:



For the seesaw:

the anticlockwise moment = force (in N) × perpendicular distance from the pivot (m)

$= 300 \text{ N} \times 2 \text{ m}$

$= 600$ **N m**

the clockwise moment = force (in N) × perpendicular distance from the pivot (m)

$= 400 \text{ N} \times 1.5 \text{ m}$

$= 600$ **N m**

The clockwise and anticlockwise moments are the same, so the seesaw is balanced, or in **equilibrium**.

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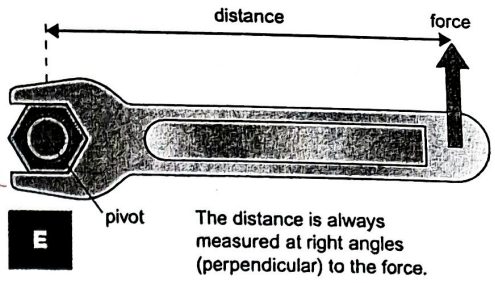
The spanner in fig. E is 20 cm long and the force is 20 N.



a. Calculate the moment of the force.

moment = force x perpendicular distance

$= 20\,N \times \frac{20\,cm}{100}$

$= 4\,Nm$

b. The force is exerted at 10 cm from the pivot, calculate the new moment.

moment = force x perpendicular distance

$= 20N \times \frac{10\,cm}{100}$

$= 2\,Nm$

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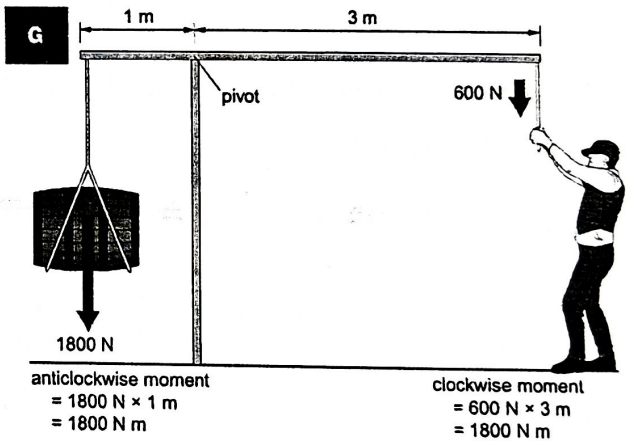

Look at diagram G. Which force is the load, and which is the effort? The barrel (1800N) is the load and the force of the man (600N) is the effort

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Look at diagram G. The rope holding the barrel is moved so that it is only 0.5 m from the pivot.

a. Will the anticlockwise moment be larger or smaller than before? Explain your answer.

it will be smaller because moment = F x d and shorter distance means less moment for the same force.

b. Calculate the new anticlockwise moment. **Show your work.**

moment = Force x perpendicular distance from pivot

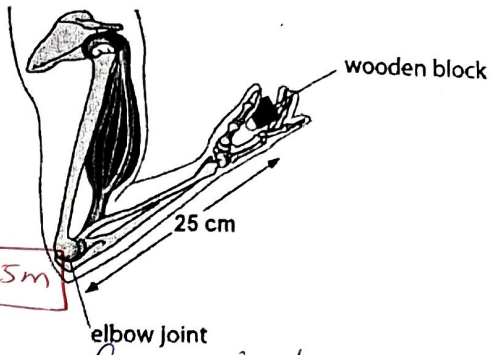
= 1800N x 0.5m

= 900 Nm

Extra Questions:

1. The diagram shows a human arm being used to lift a wooden block. $g = 10\ N/kg$

If the mass of the wooden block is 300g, calculate the moment of its weight. **Show your work.** (N) (kg) (N/kg)



* convert mass to weight: ($W = m \times g$)

$300g \div 1000 = 0.3\ kg$

$W = m \times g = 0.3kg \times 10 = \boxed{3N}$

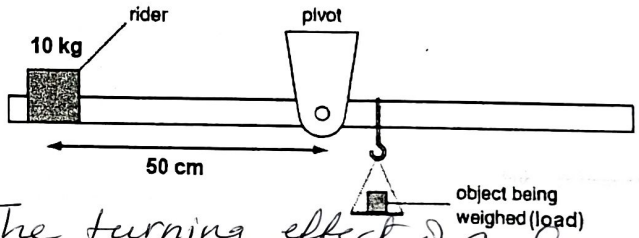
* Convert distance to m: $25cm \div 100 = \boxed{0.25m}$

* moment = Force x perpendicular distance from pivot

$= 3N \times 0.25m$

$= \boxed{0.75\ Nm}$

2. The diagram shows a steelyard. A steelyard is used for weighing objects.



The **rider** has a mass of 10 kg and is 50 cm from the pivot.

→ State the meaning of a "moment" The turning effect of a force

a. Calculate the moment of the rider about the pivot. **Show your work.**

moment = Force x perpendicular distance from pivot

$= (100N) \times 0.5\ m$

$= 50Nm$

b. The steelyard is balanced. **State** the moment of the load about the pivot.

50 Nm

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c. The 10 kg rider was replaced by a new 20 kg rider.

State how far should the new rider be placed from the pivot to keep the steelyard balanced?

closer to the pivot at 25 cm

$d = \frac{\text{moment}}{\text{force}} = \frac{50Nm}{200N} = 0.25\ m$