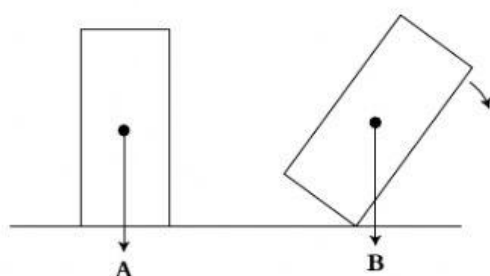
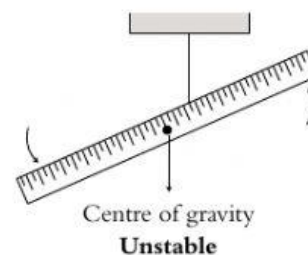
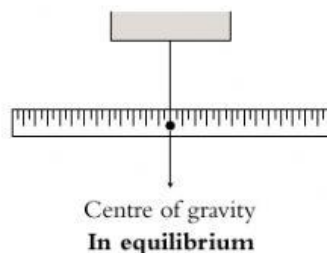


Equilibrium and Turning Forces

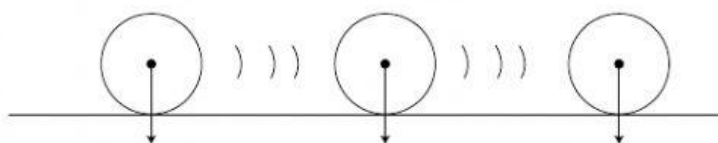
The **centre of gravity** of an object is the point through which the whole weight of the object seems to act.

A metre stick supported above its centre of gravity will be level – in equilibrium; but if it is held somewhere else it will be unstable and tip over.



The object A will keep upright – be in stable equilibrium when its centre of gravity acts downwards through its base. But if it is tipped over too far, the centre of gravity acts outside its base (B) and it topples over; it was tipped into a position of **unstable equilibrium**.

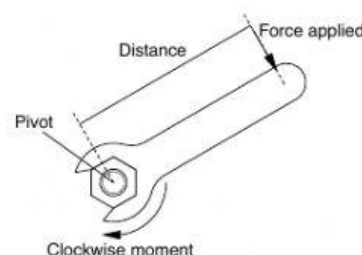
A ball resting on a horizontal surface is always in **neutral equilibrium**, because its centre of gravity always acts through its base, the point at which it touches the surface.



The **turning effect** of a force is called a **MOMENT**. If we open a door, steer a car or use a spanner we are employing the turning effect of a force.

The **MOMENT** of a force = **FORCE** × **DISTANCE**
(Nm) (N) (m)

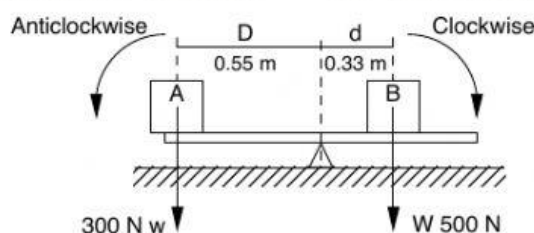
The **distance** is measured from the point where the **force** is acting to the **pivot**.



Principle of Moments

The Principle of Moments says that: In equilibrium (or 'balance')

The total anticlockwise moment = The total clockwise moment.

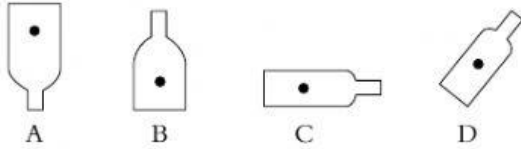


Weight (w) (N)	Distance (D) (m)	Moment (Nm)	Weight (W) (N)	Distance (d) (m)	Moment (Nm)
300	0.55	165	500	0.33	165

Questions

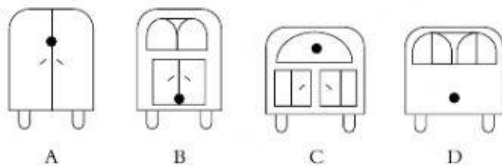
Tick the box next to the correct answer.

- 1 The mark ● shows the centre of gravity of a bottle. Which bottle is in a position of unstable equilibrium?



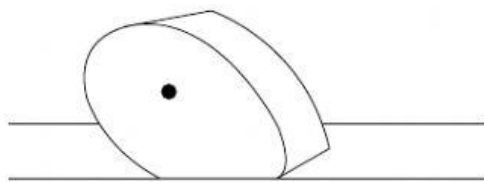
- A ☐
 B ☐
 C ☐
 D ☐

- 2 Four lorries have their centres of gravity marked with ●. Which design of lorry is the most stable?



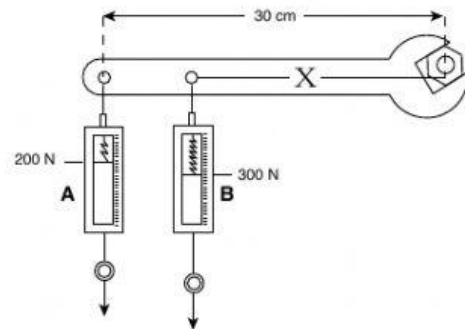
- A ☐
 B ☐
 C ☐
 D ☐

- 3 A block of wood with the centre of gravity marked ● is placed on a table. The block:



- A will topple over to the left ☐
 B will topple over to the right ☐
 C will remain upright ☐
 D is said to be in unstable equilibrium ☐

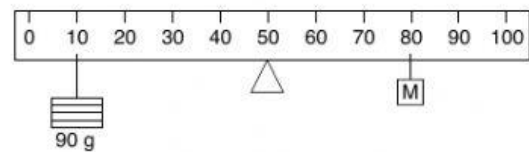
- 4 When the forcemeter A was used on its own on the spanner to loosen a nut it read 200 N. Forcemeter B was then used on its own to loosen the nut and it read 300 N.



What was the distance X in the diagram?

- A 10 cm ☐
 B 15 cm ☐
 C 20 cm ☐
 D 25 cm ☐

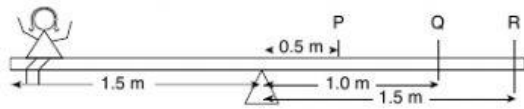
- 5 The diagram shows a metre stick pivoted at its centre.



The metre stick will balance when the mass M is:

- A 100 g ☐
 B 120 g ☐
 C 150 g ☐
 D 180 g ☐

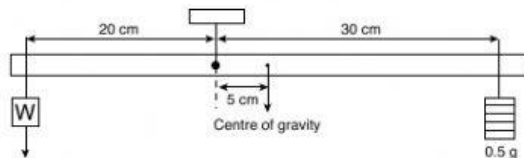
- 6 A girl weighing 200 N sits on a seesaw and is balanced by a boy weighing 300 N.



Where should the boy sit to make the seesaw balance?

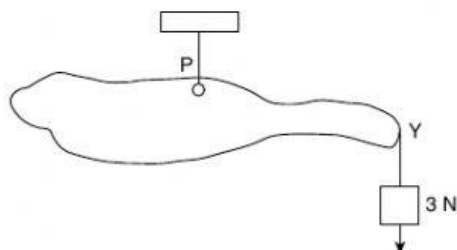
- A at position P ☐
- B at position Q ☐
- C at position R ☐
- D at some other position ☐

- 7 If the weight of the uniform horizontal rod is 1.0 N, what must be the weight of W for the rod to be level?



- A 0.10 N ☐
- B 1.0 N ☐
- C 4.0 N ☐
- D 8.0 N ☐

- 8 A thin uniform sheet of metal is cut into an irregular shape. It is 400 mm long, weighs 5 N and is hung at point P, halfway along it. The 3 N weight hung at Y makes it balance as shown.



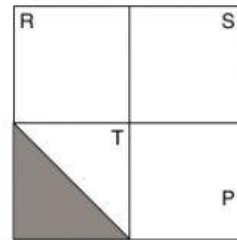
What is the distance of the centre of mass of the metal sheet from point P?

- A 50 mm ☐
- B 100 mm ☐
- C 120 mm ☐
- D 150 mm ☐

- 9 Which of these sportsmen most needs to have a low centre of gravity?

- A a high jumper ☐
- B a snooker player ☐
- C a weightlifter ☐
- D a hurdler ☐

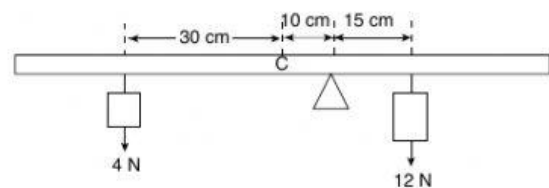
- 10 A square metal sheet has the corner (shaded) cut off.



Which point will be nearest to the centre of gravity of the new sheet?

- A R ☐
- B S ☐
- C T ☐
- D P ☐

- 11 A uniform metre stick with its centre of gravity at C is supported on a pivot with weights attached on either side as shown in the diagram.



What is the mass of the metre stick?

- A 0.2 kg ☐
- B 2 N ☐
- C 60 N ☐
- D 60 kg ☐