Turning Effects of Forces

Question Paper

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Level	O Level
Subject	Physics
Exam Board	Cambridge International Examinations
Unit	Newtonian Mechanics
Topic	Turning Effect of Forces
Booklet	Question Paper

Time Allowed: **49 minutes**

Score: **/41**

Percentage: **/100**

Grade Boundaries:

1   A uniform horizontal beam, pivoted at its right-hand end, is in equilibrium. A force of 60 N acts vertically upwards on the beam as shown.
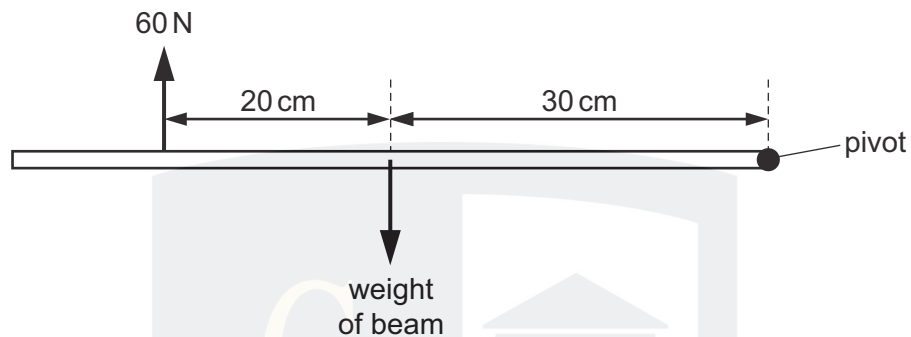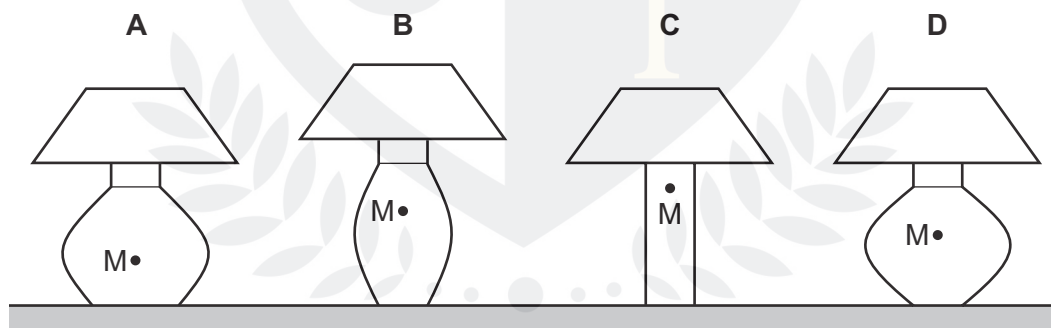

What is the weight of the beam?

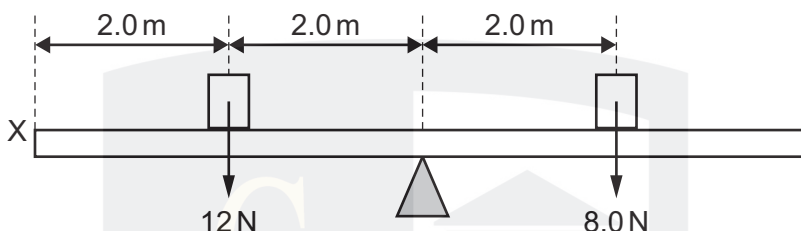**A**   36 N   **B**   40 N   **C**   90 N   **D**   100 N

2   Four table lamps are shown along with the position M of the centre of mass in each case.

Which lamp is the most stable?

3   A uniform plank is pivoted at its mid-point. Two weights are added to the plank, one weight on each side of the pivot in the positions shown.
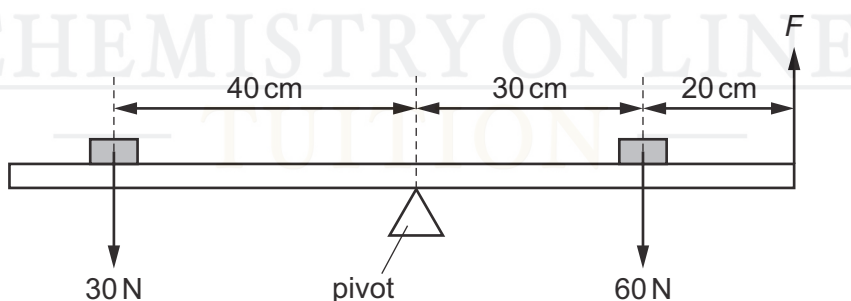

A vertical force is applied at point X to balance the plank.

What is the size and direction of this force?

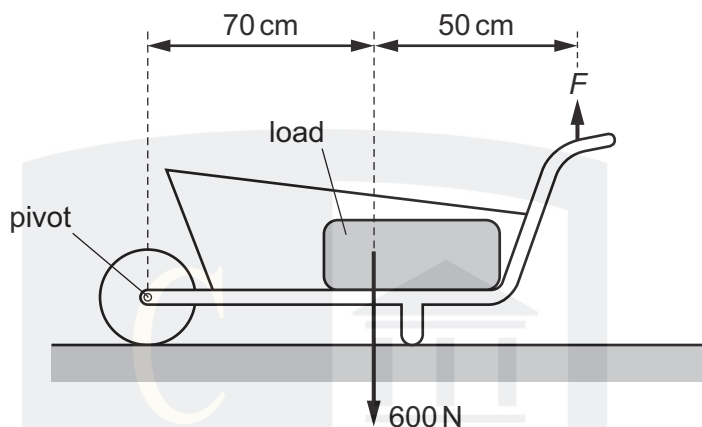|	size/N	direction
A	2.0	downwards
B	2.0	upwards
C	4.0	downwards
D	4.0	upwards

4   A uniform beam is pivoted at its centre. Two weights are placed on the beam in the positions shown and the beam is balanced by an upward force F.

What is the size of F?

A   6 N   **B**   12 N   **C**   30 N   **D**   60 N

5   The total weight of the load and the wheelbarrow shown is 600 N.
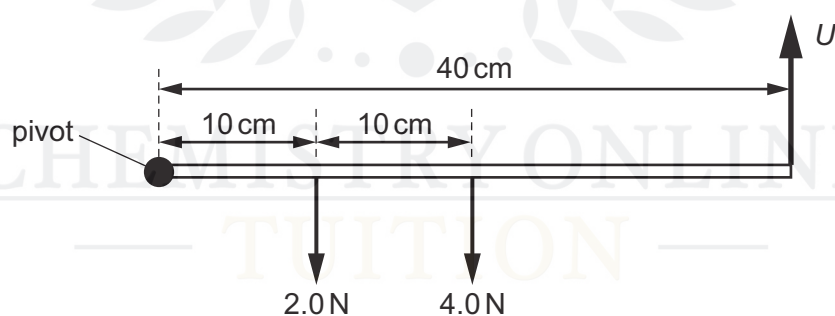

What is the size of force *F* needed just to lift the loaded wheelbarrow?

A   350 N   **B**   430 N   **C**   600 N   **D**   840 N

6   A beam of length 40 cm is pivoted at one end.

The weight of the beam is 4.0 N and acts at a point 20 cm from the pivot. A 2.0 N weight hangs 10 cm from the pivot.

An upward force *U* is needed to keep the beam horizontal.

What is the size of *U*?

A   0.5 N   **B**   1.5 N   **C**   2.5 N   **D**   6.0 N

7   A car is designed to be stable.

    To achieve good stability, where is the centre of mass of the car?

    A   above the front wheels

    B   above the rear wheels

    C   as high in the car as possible

    D   as low in the car as possible

8   A man uses clay to make a pot. He wants the pot to be as stable as possible when placed on a flat surface.

    Which two features of the pot must the man consider?

    A   the area of the base and the height of the centre of gravity

    B   the density of the clay and the area of the base

    C   the density of the clay and the height of the centre of gravity

    D   the weight and the height of the centre of gravity
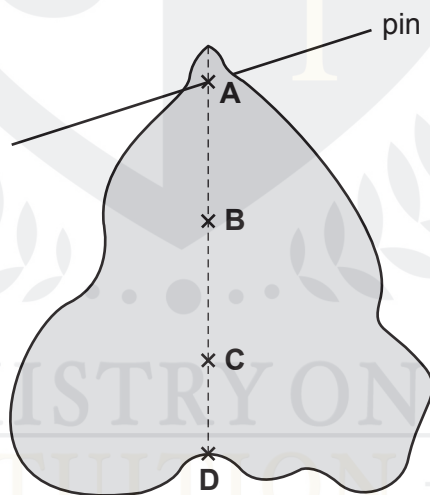
9   What affects the stability of an object?

    A   only its base area and the location of its centre of mass

    B   only its weight and its base area

    C   only the location of its centre of mass

    D   only its weight

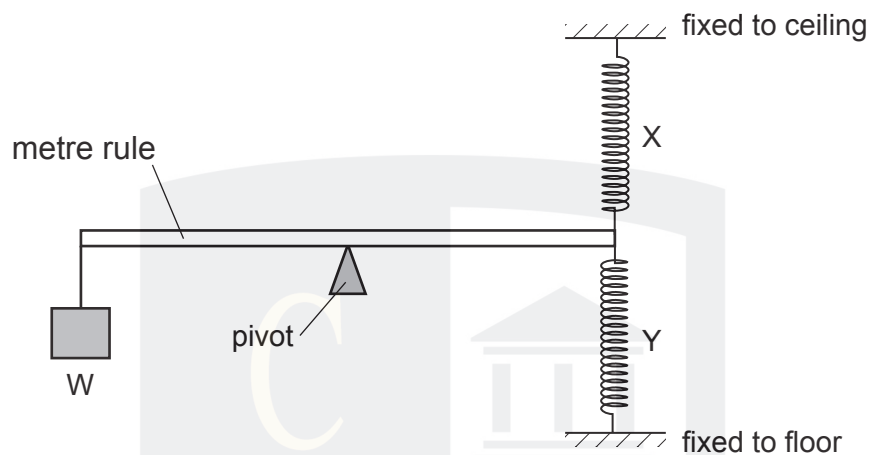10 Which chair is the **least** stable if the child moves?
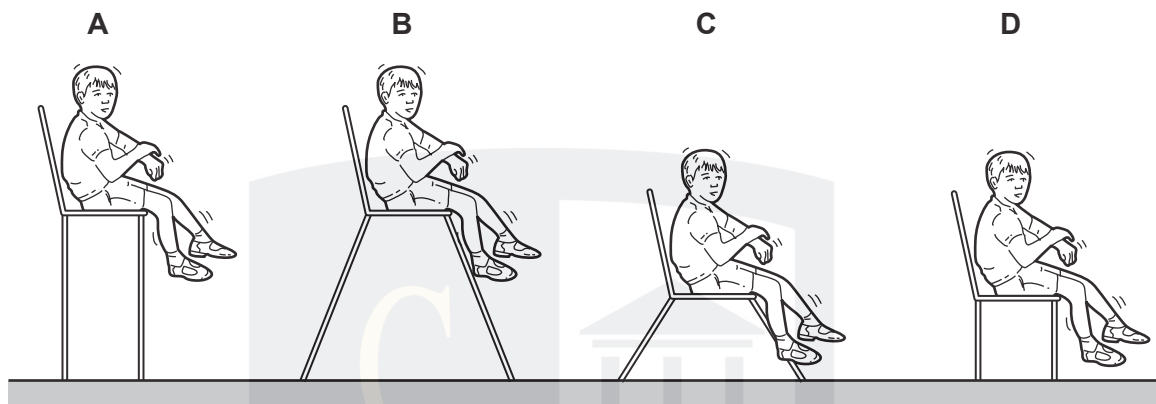
11 A piece of uniform card is suspended freely from a horizontal pin.

Which point is its centre of mass?

12   Two stretched springs X and Y are attached to one end of a metre rule as shown. A weight W is hung from the other end. A pivot is at the centre of the rule.
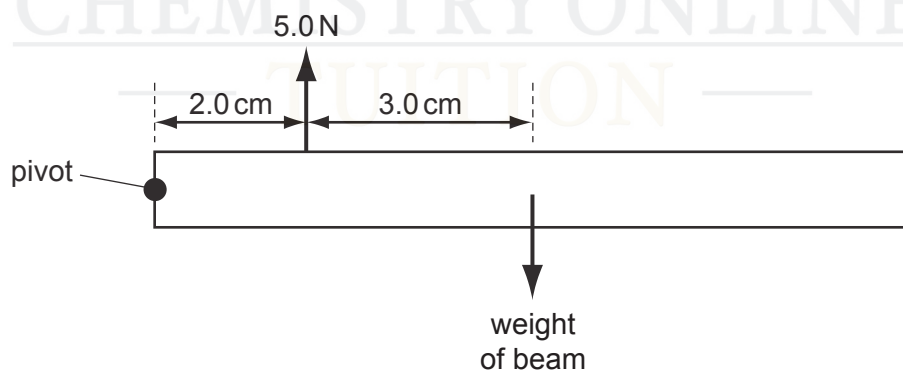

The weight W is moved towards the pivot.

How does the extension of each spring change?

	spring X	spring Y
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

13   A beam pivoted at one end has a force of 5.0 N acting vertically upwards on it as shown. The beam is in equilibrium.
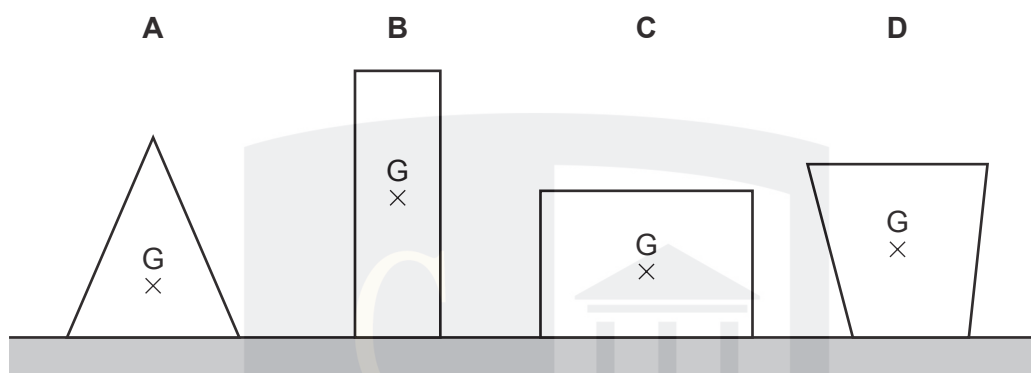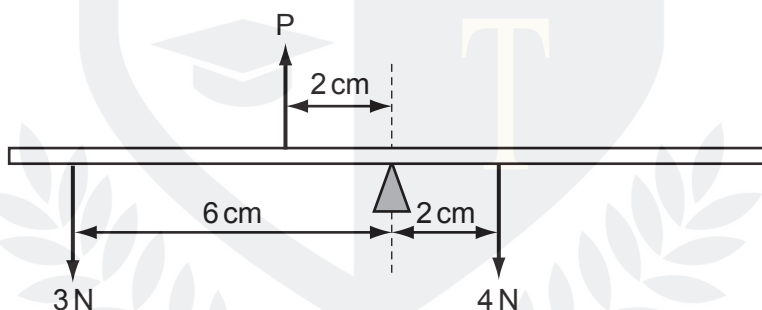

What is the weight of the beam?

A   2.0 N   B   3.0 N   C   3.3 N   D   5.0 N

14 Four objects of equal mass rest on a table. The centre of mass of each object is labelled G.

Which object is the least stable?

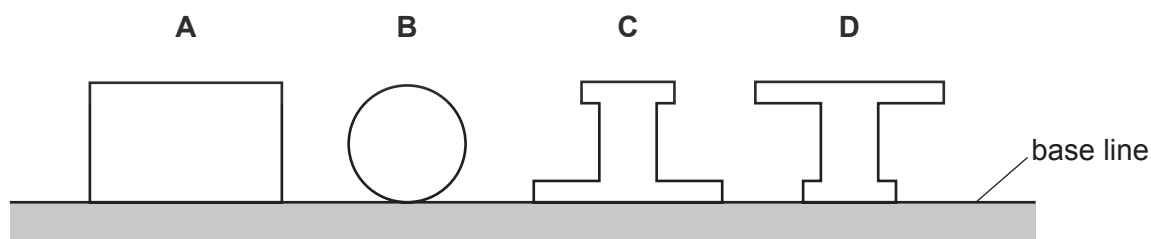15 The diagram shows a uniform balanced beam, pivoted about its centre.
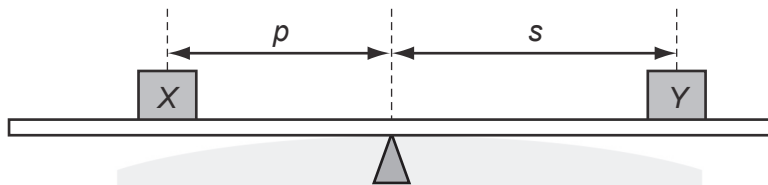

What is the value of force P?

A 5 N   **B** 7 N   **C** 10 N   **D** 13 N

16 The diagram shows four shapes, cut from the same piece of card.

Which shape has its centre of mass nearest to the base line?

17 Masses *X* and *Y* are placed on opposite sides of the centre of a uniform metre rule, which is pivoted at its centre.
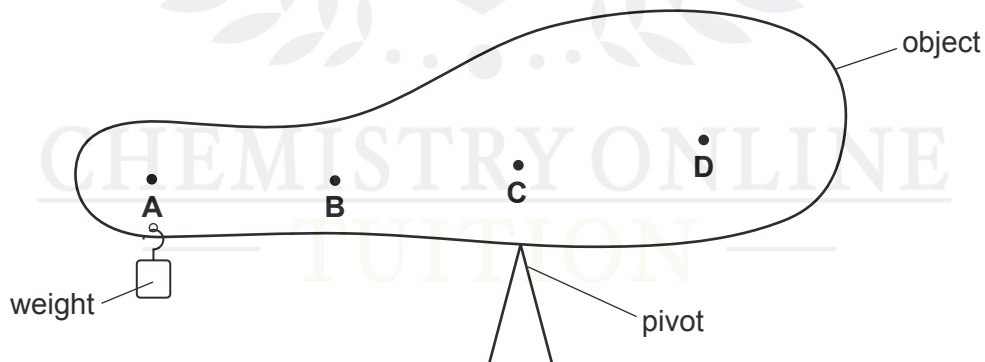

Which combination of masses and distances balances the rule?

	mass/g		distance /cm	
	X	Y	*p*	*s*
A	200	200	5	10
B	200	300	10	15
C	400	300	12	16
D	500	200	15	30

18 A student balances a non-uniform object on a pivot. To do this, a weight is suspended near the left-hand end of the object.

Where is the centre of mass of the object?

19 An object Y is in a fixed position on a rod. A weight X is moved and the position of a pivot is adjusted until the rod balances on the pivot, as shown.
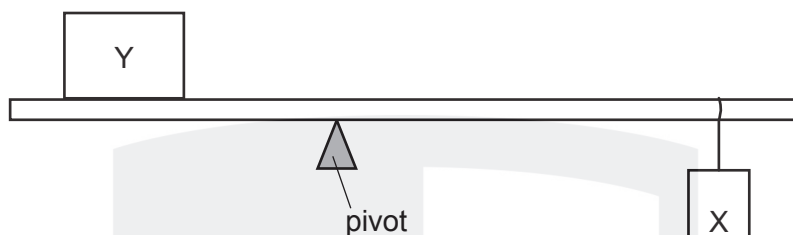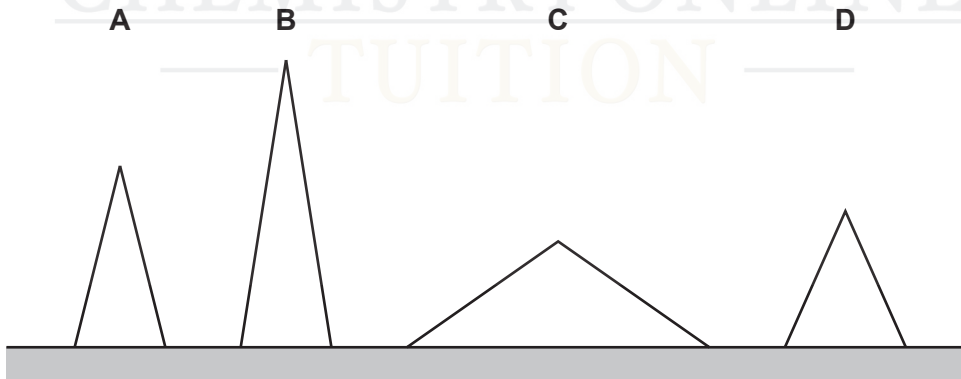

The experiment is repeated in a region where the gravitational field strength is lower.
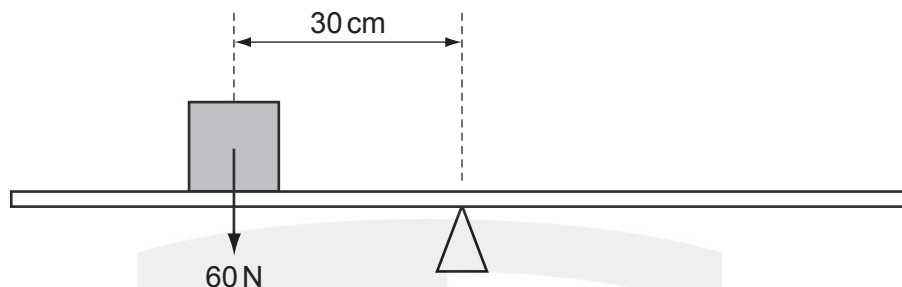
What is done to keep the rod balanced?

	pivot	X
A	move left	no movement
B	move right	move left
C	no movement	move right
D	no movement	no movement

20 Four solid uniform cones have equal weight. They are placed on a bench as shown in the scale diagram.

Which cone is the most stable?

21 A uniform beam is balanced at its midpoint. An object is placed on the beam, as shown.

Which force will rebalance the beam?

A   30 N acting upwards, 60 cm to the left of the midpoint

B   30 N acting upwards, 60 cm to the right of the midpoint

C   45 N acting downwards, 45 cm to the right of the midpoint

D   90 N acting downwards, 20 cm to the left of the midpoint

22 A student finds the centre of mass of a triangular lamina PQR.

He drills a small hole at Q. He suspends the lamina from a pin through the hole at Q so that the lamina swings freely. He then hangs a plumb-line from the pin at Q, as shown. He marks the position of the plumb-line on the lamina.
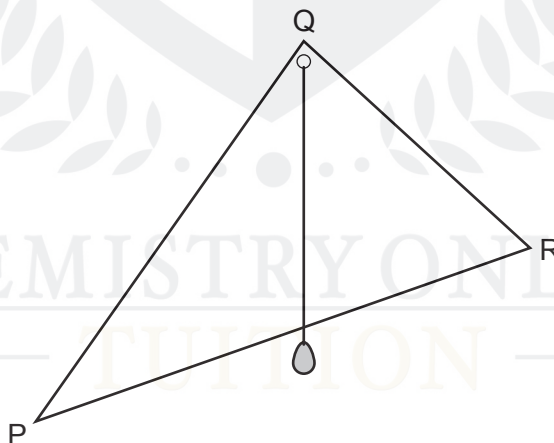
To determine the location of the centre of mass, the student then repeats the experiment but with one change.

What is the change?

A He suspends the lamina from the hole at Q, with R on the left and P on the right.

B He suspends the lamina from a pin through a hole at R.

C He uses a heavier weight on the plumb-line.

D He uses a longer plumb-line.

23 A metal cone with a circular base is placed on a flat surface.
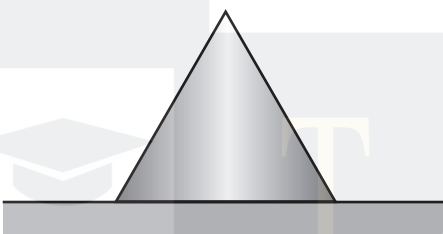
The stability of the cone depends on

A its weight only.

B the diameter of its base and the position of its centre of mass.

C the diameter of its base only.

**D** the position of its centre of mass only.

24 Coal is burned as fuel to heat water in a boiler, producing steam. The steam drives a turbine, which is connected to an electric generator.

In which order do the major energy transformations take place?

A chemical energy → heat energy → electrical energy → kinetic energy

B chemical energy → heat energy → kinetic energy → electrical energy

C heat energy → chemical energy → electrical energy → kinetic energy

D heat energy → chemical energy → kinetic energy → electrical energy

25 A wooden trapdoor is hinged along one side and, when closed, is supported on the other side by a ledge.
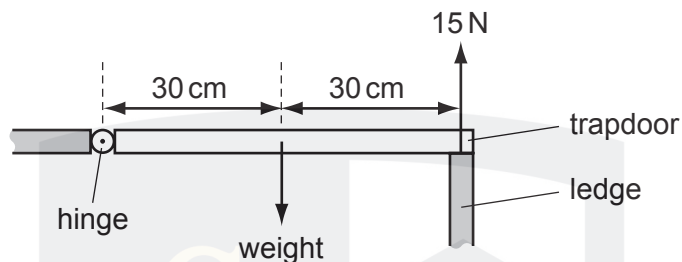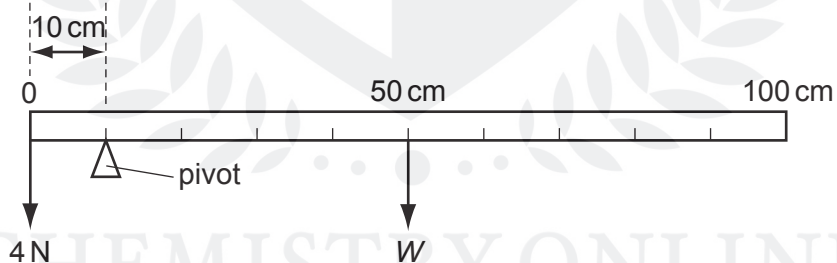

When the trapdoor is closed, the ledge exerts an upward force of 15 N on the trapdoor. The gravitational field strength is 10 N/kg.

What is the mass of the trapdoor?

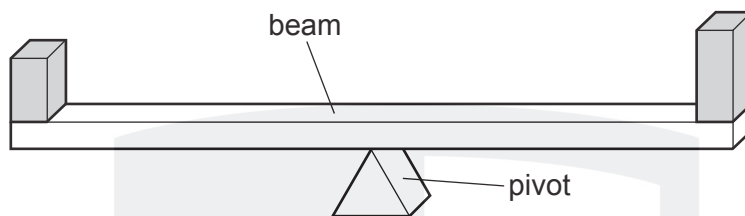**A** 1.5 kg **B** 3.0 kg **C** 30 kg **D** 150 kg

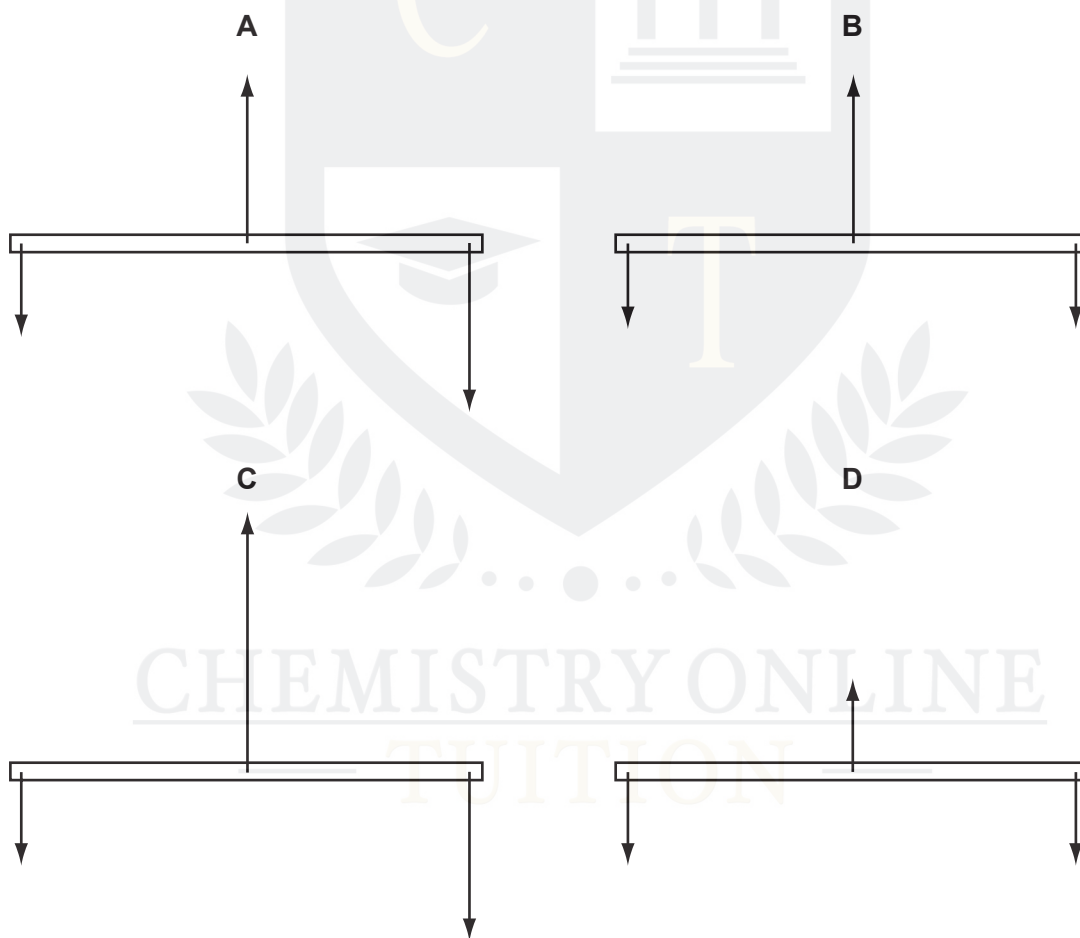26 A uniform metre rule is balanced by a 4 N weight as shown in the diagram.

What is the weight W of the metre rule?

A 1 N **B** 4 N **C** 16 N **D** 40 N

27 Two blocks are placed on a beam which balances on a pivot at its centre. The weight of the beam is negligible.

Which diagram shows the forces acting on the beam?
(The length of each arrow represents the size of a force.)

A

B

C

D

28 The stability of a bus is tested by tilting it on a ramp. The diagram shows a bus that is just about to topple over.
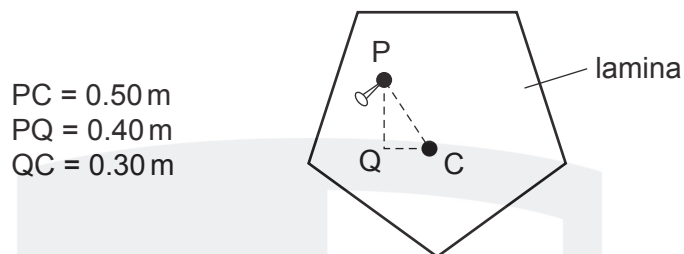
Where is the centre of mass of the bus?
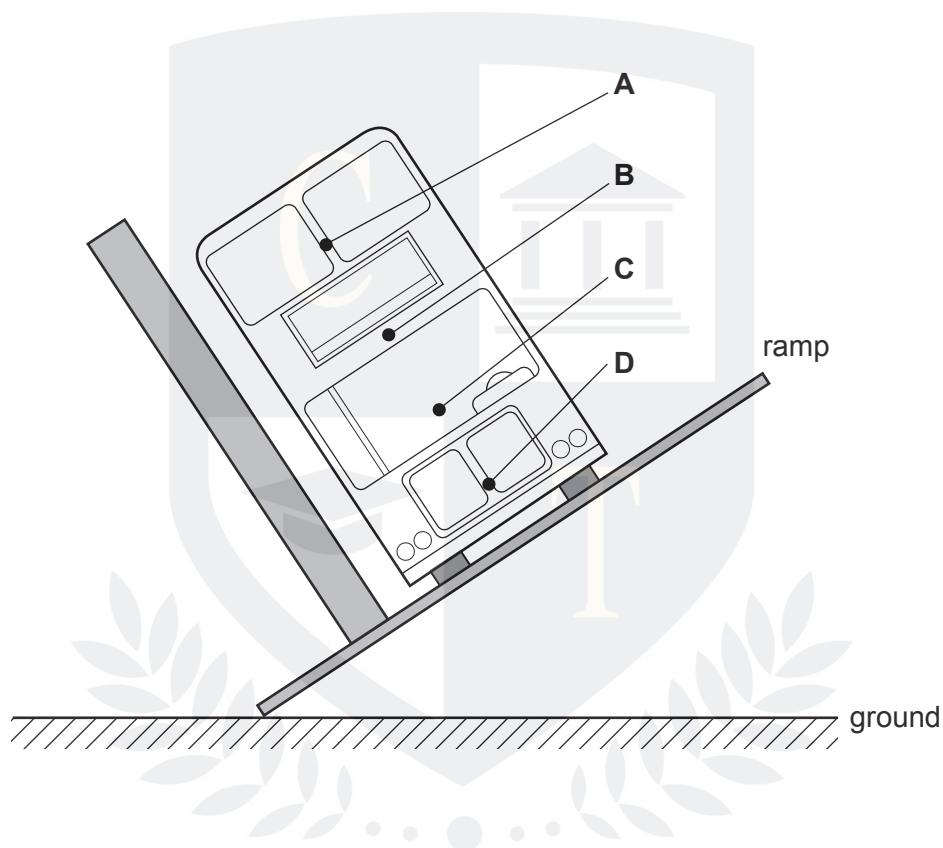
29 A flat lamina is freely suspended from point P.

The weight of the lamina is 2.0 N and the centre of mass is at C.

PC = 0.50 m
PQ = 0.40 m
QC = 0.30 m

The lamina is displaced to the position shown.

What is the moment that will cause the lamina to swing?

A   0.60 N m clockwise

B   0.80 N m anticlockwise

C   1.0 N m clockwise

D   1.0 N m anticlockwise

30 A piece of uniform card is suspended freely from a horizontal pin.

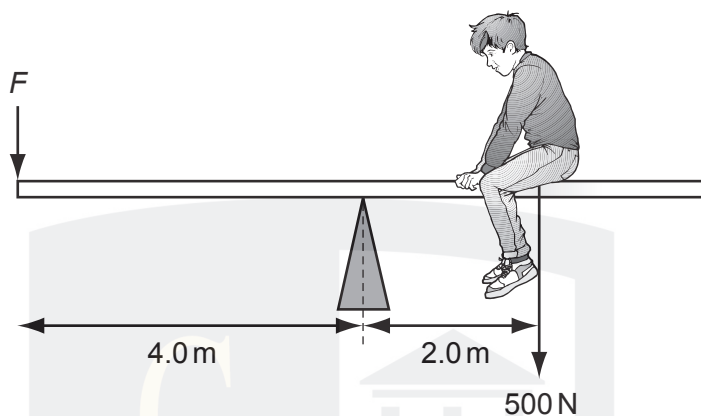At which of the points shown is its centre of gravity?
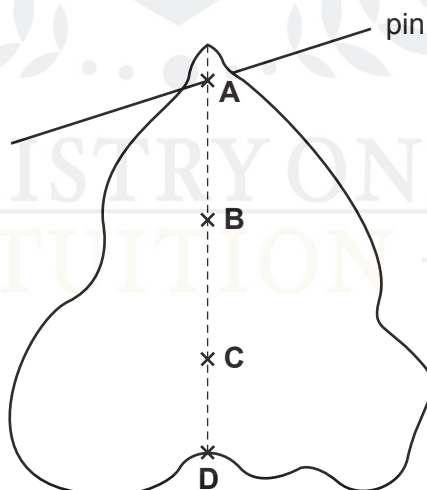
31   Forces are applied to a uniform beam pivoted at its centre.

Which beam is balanced?
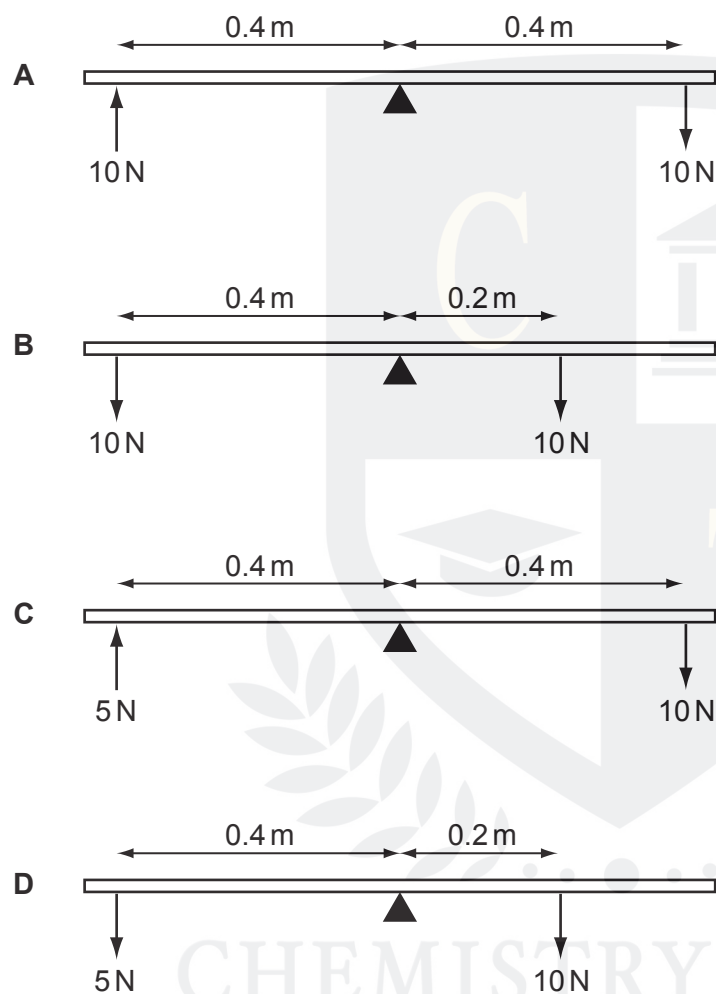
32 The diagram shows a boy of weight 500 N sitting on a see-saw. He sits 2.0 m from the pivot.

What is the force *F* needed to balance the see-saw?

A 250 N   **B** 750 N   **C** 1000 N   **D** 3000 N

33 If a nut and bolt are difficult to undo, it may be easier to turn the nut by using a longer spanner.

This is because the longer spanner gives

A a larger turning moment.

B a smaller turning moment.

C less friction.

D more friction.

34 How much energy would be released if 1×10^{-20} kg of matter was entirely converted to energy? (The speed of light is 3×10^8 m / s.)

A 3×10^{-12} J   **B** 9×10^{-7} J   **C** 4.5×10^{-4} J   **D** 9×10^{-4} J
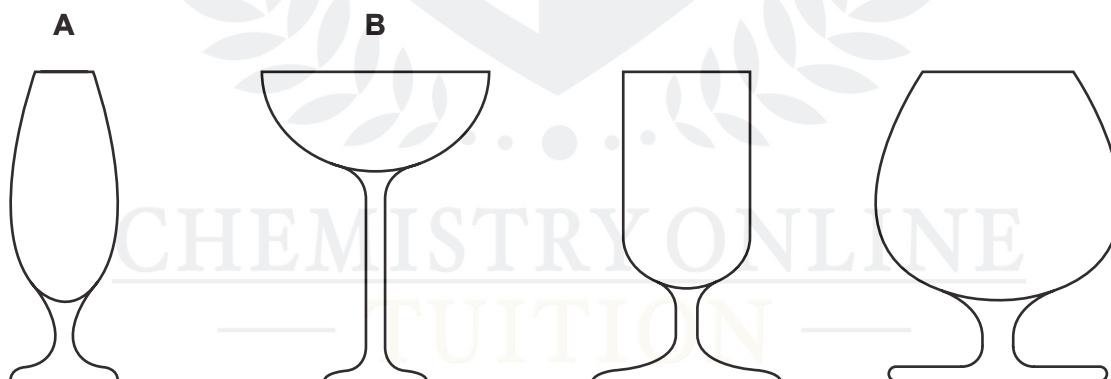
35   The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by a vertical force F at the ends of the handles.
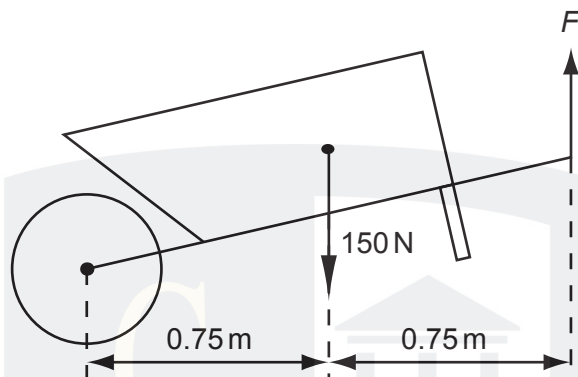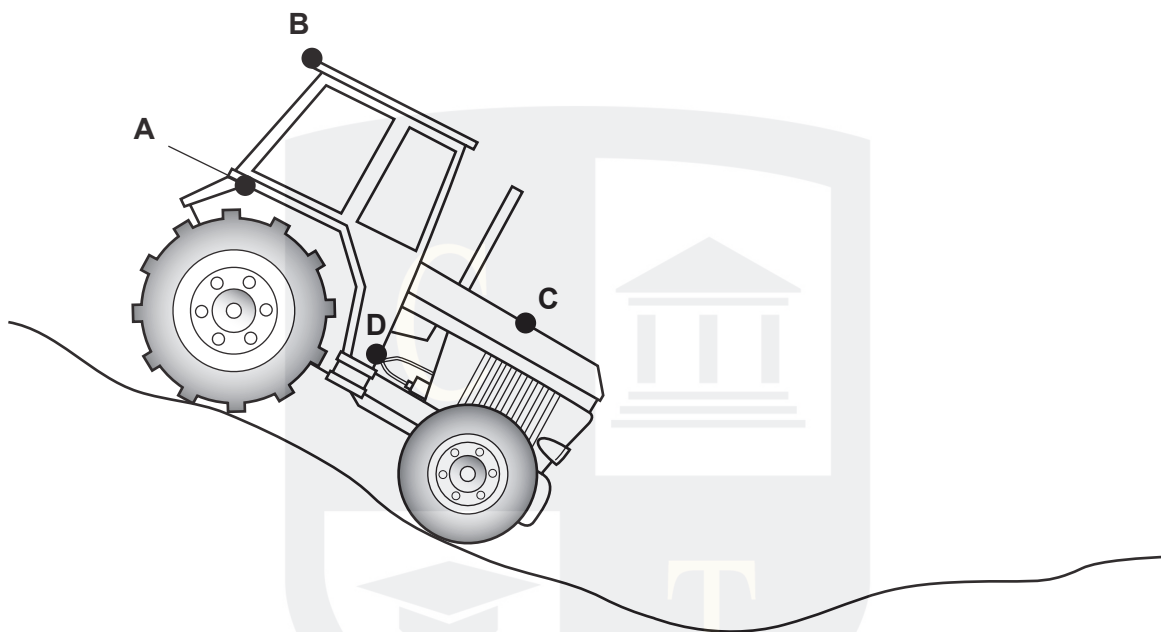

What is the value of F?

A	75 N	**B**	150 N	**C**	225 N	**D**	300 N

36   The diagrams show the cross-sections of different glasses.

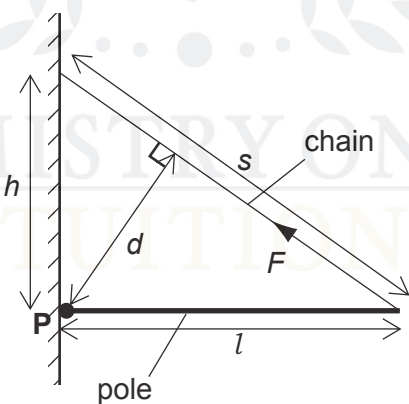Which one is the least stable when filled with a liquid?

37 A tractor is being used on rough ground.

What is the safest position for its centre of mass?

38 A horizontal pole is attached to the side of a building. There is a pivot **P** at the wall and a chain is connected from the end of the pole to a point higher up the wall.
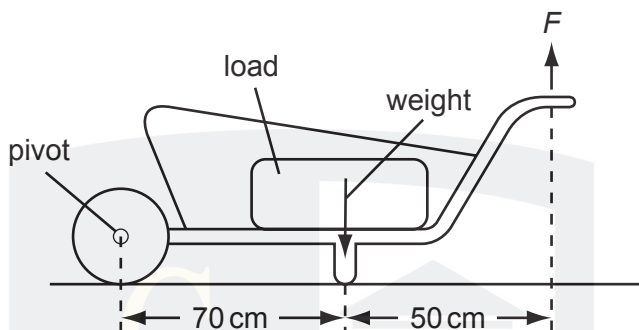

There is a tension force *F* in the chain.

What is the moment of the force *F* about the pivot **P**?

A *F* x *d*   **B** *F* x *h*   **C** *F* x *l*   **D** *F* x *s*

39 A load is to be moved using a wheelbarrow. The total mass of the load and wheelbarrow is 60 kg. The gravitational field strength is 10 N / kg.

What is the size of force *F* needed just to lift the loaded wheelbarrow?

A   350 N   **B**   430 N   **C**   600 N   **D**   840 N

40 A girl uses paper-clips to balance a toy bird on her finger as shown.
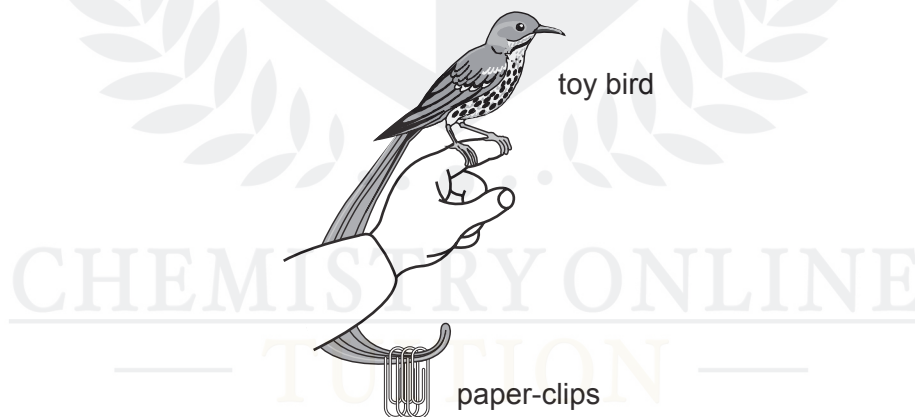
What is the effect of the paper-clips?

A   They help to raise the centre of mass above her finger.

B   They help to raise the centre of mass to her finger.

C   They help to lower the centre of mass below her finger.

D   They do not affect the centre of mass but increase the weight.

41   A driver's foot presses with a steady force of 20 N on a pedal in a car as shown.
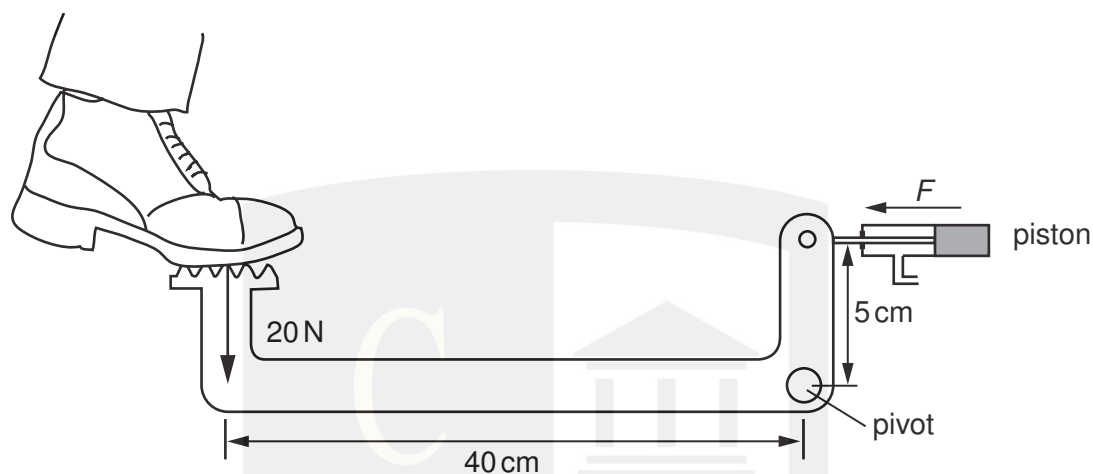
What is the force *F* pulling on the piston?

A   2.5 N   **B**   10 N   **C**   100 N   **D**   160 N