

Turning Effects of Forces

Question Paper

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

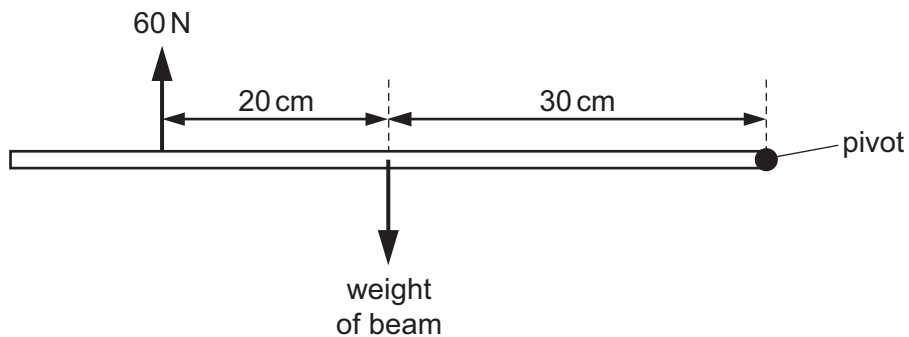
Time Allowed: 49 minutes

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.

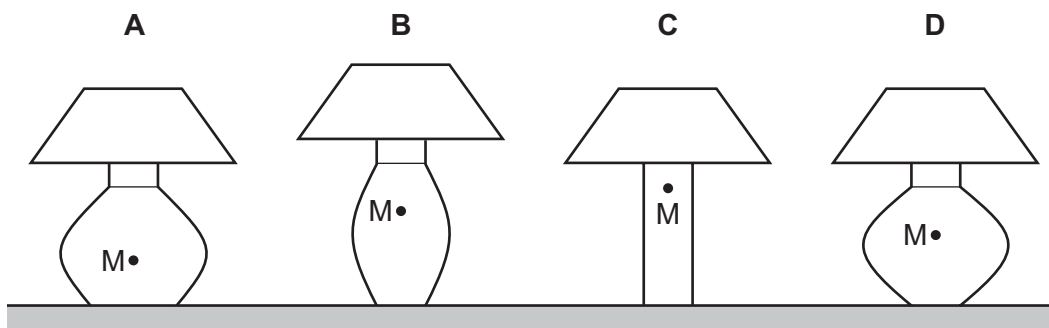


What is the weight of the beam?

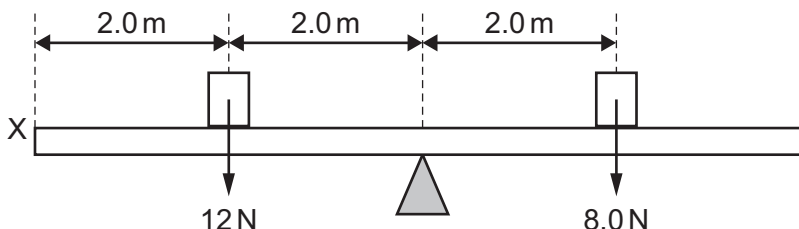
- A 36 N B 40 N C 90 N D 100 N

- 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.

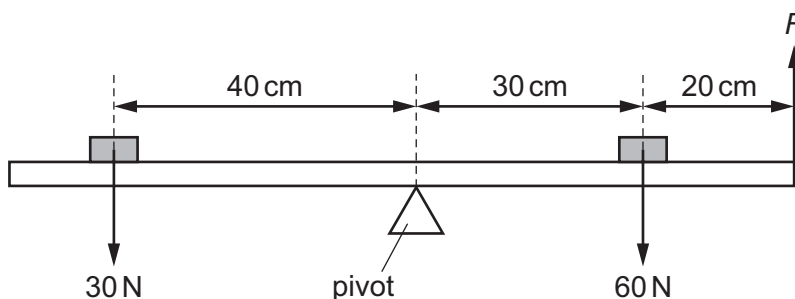


A vertical force is applied at point X to balance the plank.

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

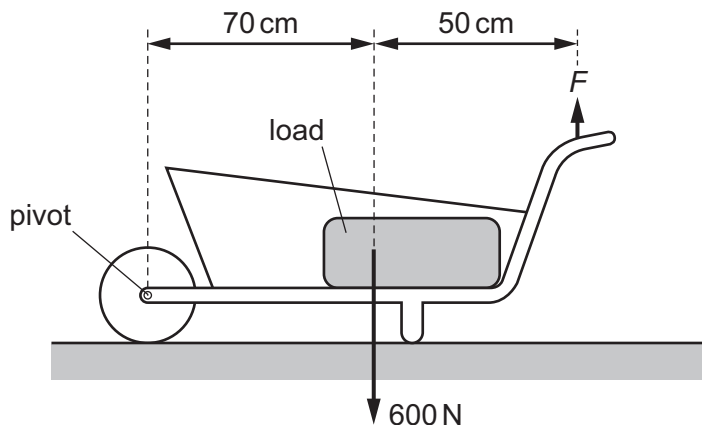
- 4 A uniform beam is pivoted at its centre. Two weights are placed on the beam in the positions shown and the beam is balanced by an upward force F .



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.

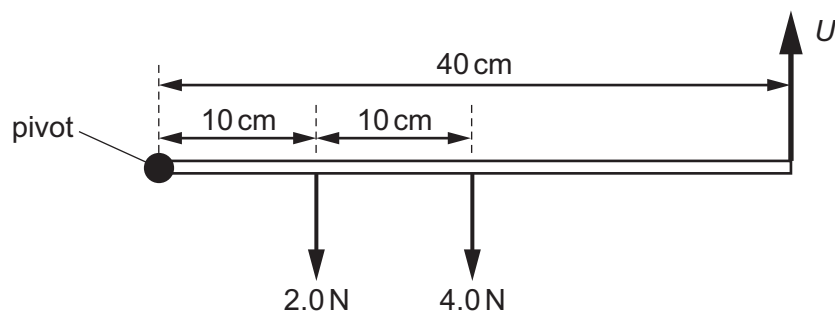


What is the size of force F needed just to lift the loaded wheelbarrow?

- 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.

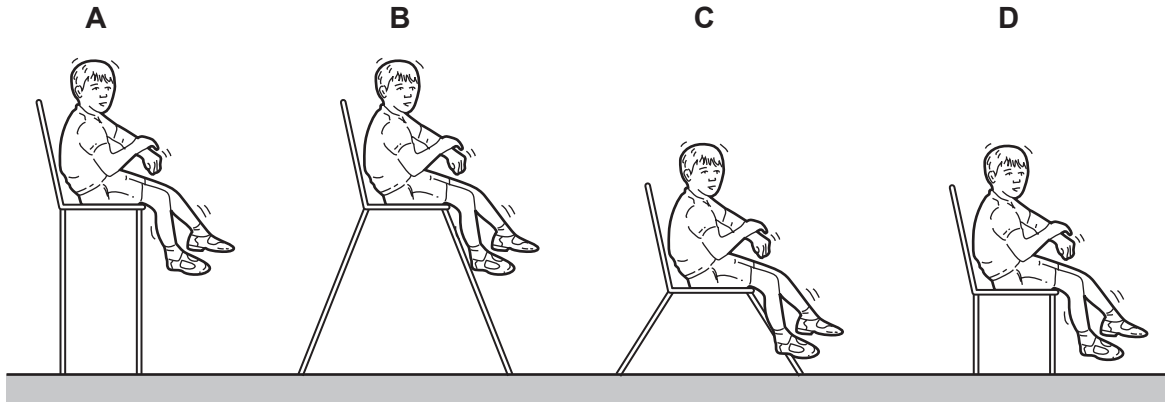
Which two features of the pot must the man consider?

- 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?

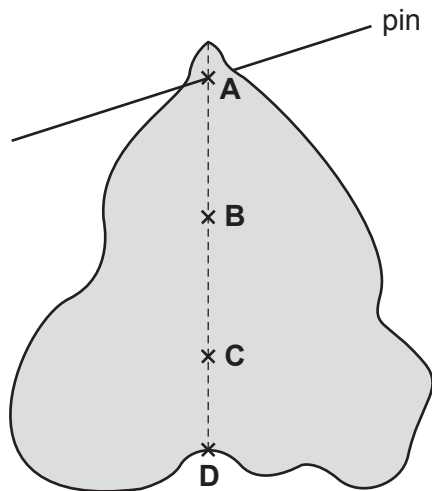
- A** only its base area and the location of its centre of mass
- B** only its weight and its base area
- C** only the location of its centre of mass
- D** only its weight

10 Which chair is the **least** stable if the child moves?

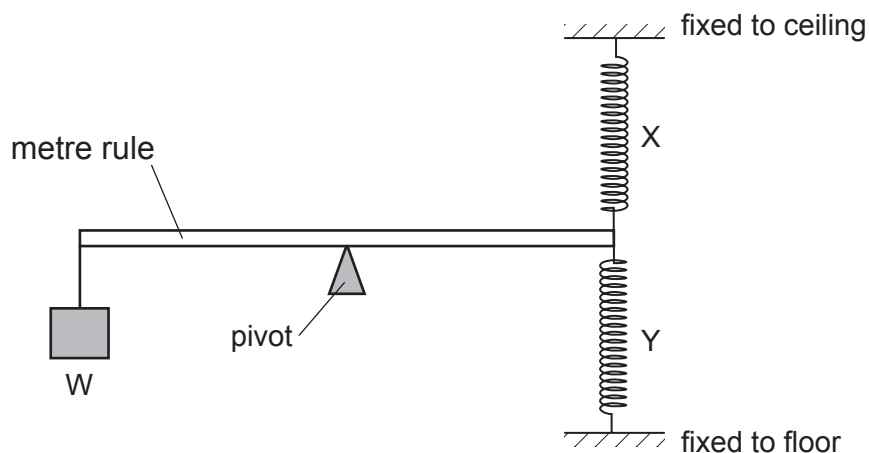


11 A piece of uniform card is suspended freely from a horizontal pin.

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.

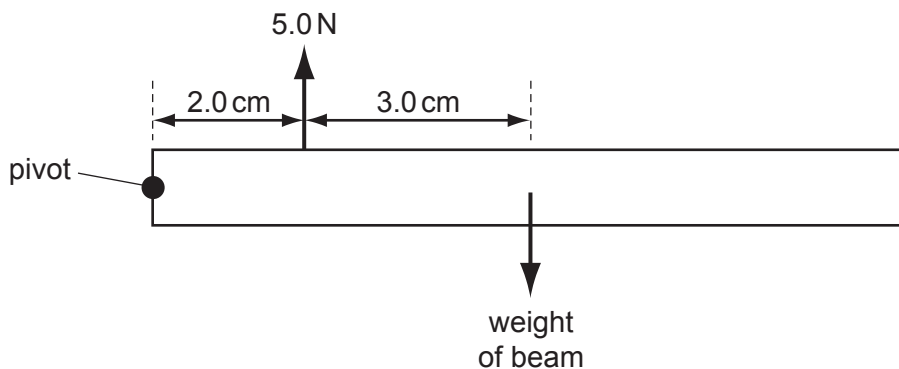


The weight W is moved towards the pivot.

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.

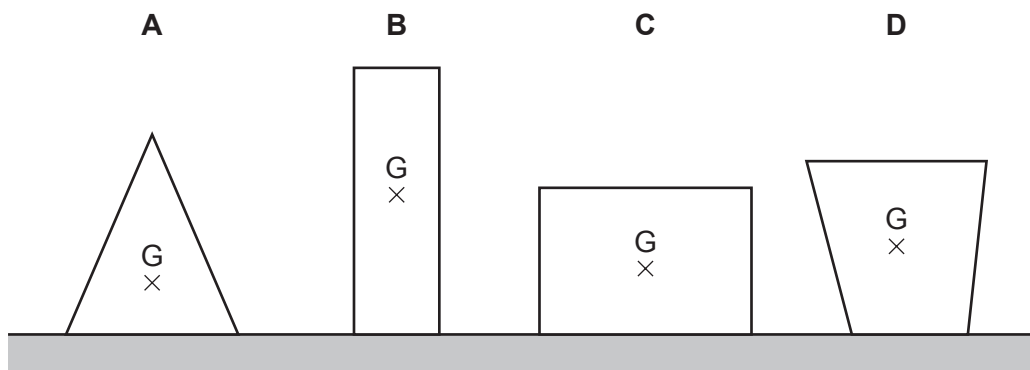


What is the weight of the beam?

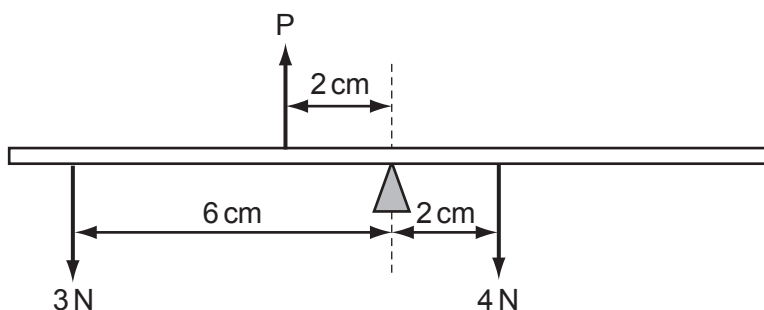
- A** 2.0 N **B** 3.0 N **C** 3.3 N **D** 5.0 N

- 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.

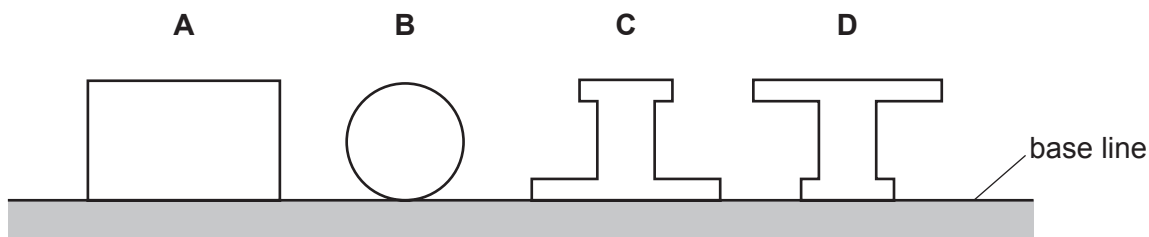


What is the value of force P?

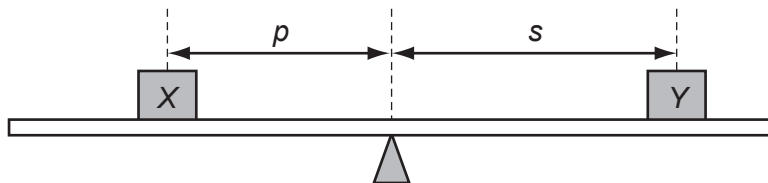
- A 5 N B 7 N C 10 N D 13 N

- 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.

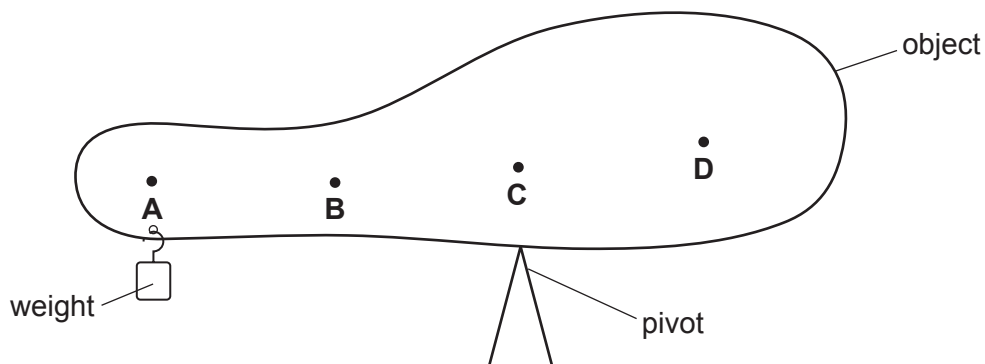


Which combination of masses and distances balances the rule?

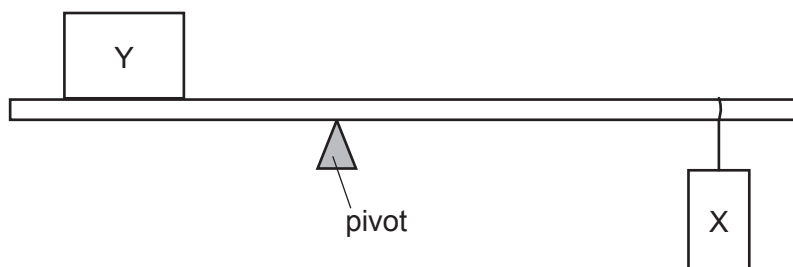
	mass / g		distance / cm	
	X	Y	p	s
A	200	200	5	10
B	200	300	10	15
C	400	300	12	16
D	500	200	15	30

- 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.



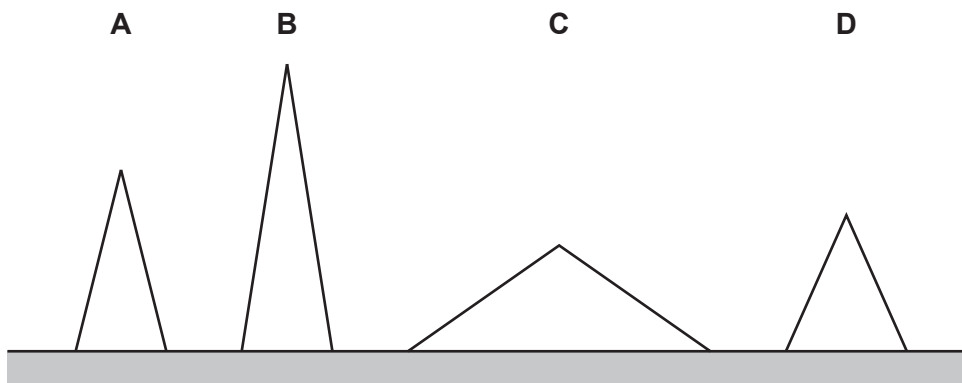
The experiment is repeated in a region where the gravitational field strength is lower.

What is done to keep the rod balanced?

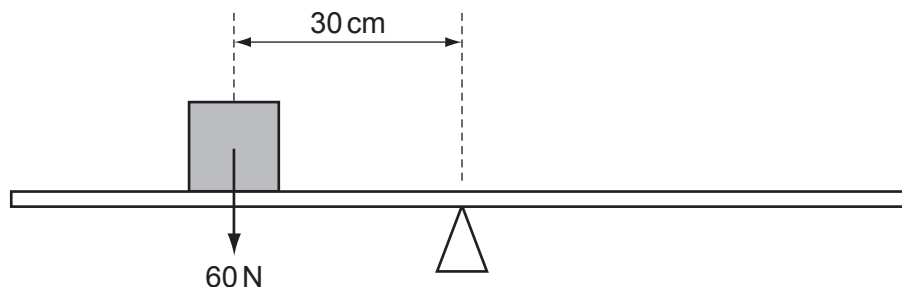
	pivot	X
A	move left	no movement
B	move right	move left
C	no movement	move right
D	no movement	no movement

- 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?

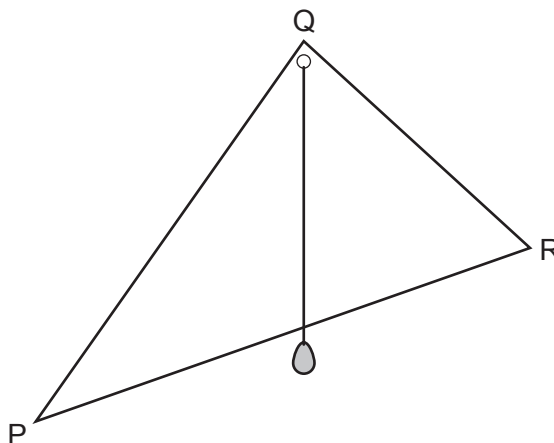


- 21 A uniform beam is balanced at its midpoint. An object is placed on the beam, as shown.



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.

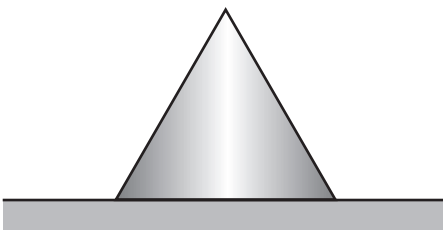


To determine the location of the centre of mass, the student then repeats the experiment but with one change.

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.



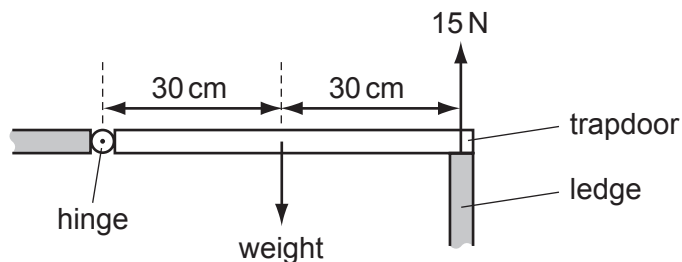
The stability of the cone depends on

- 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

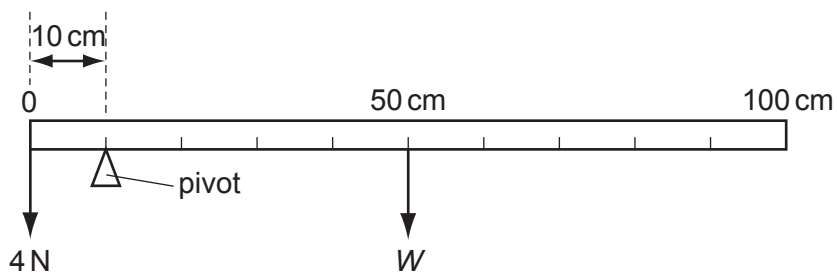
- 25 A wooden trapdoor is hinged along one side and, when closed, is supported on the other side by a ledge.



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?

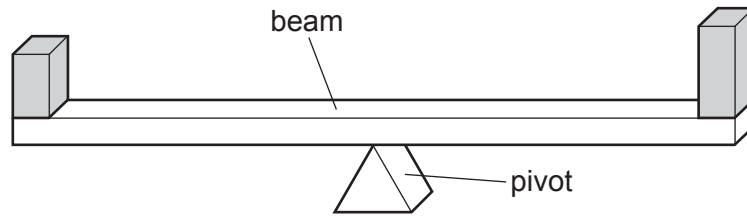
- A** 1.5 kg **B** 3.0 kg **C** 30 kg **D** 150 kg
- 26 A uniform metre rule is balanced by a 4 N weight as shown in the diagram.



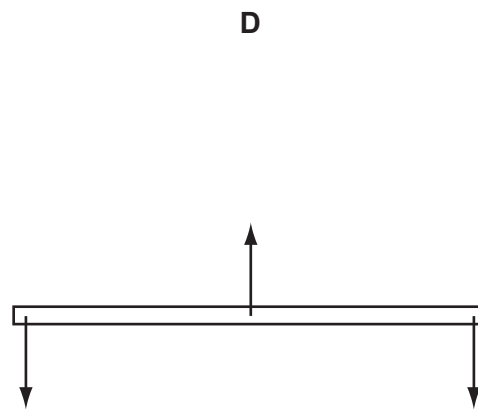
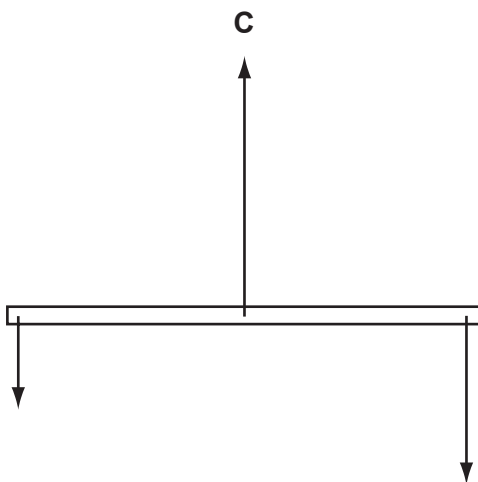
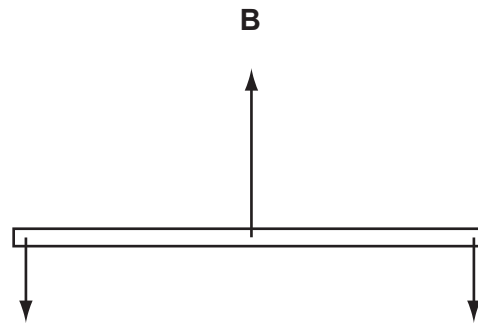
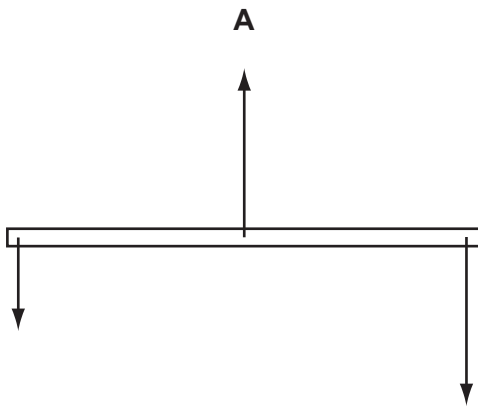
What is the weight W of the metre rule?

- 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.

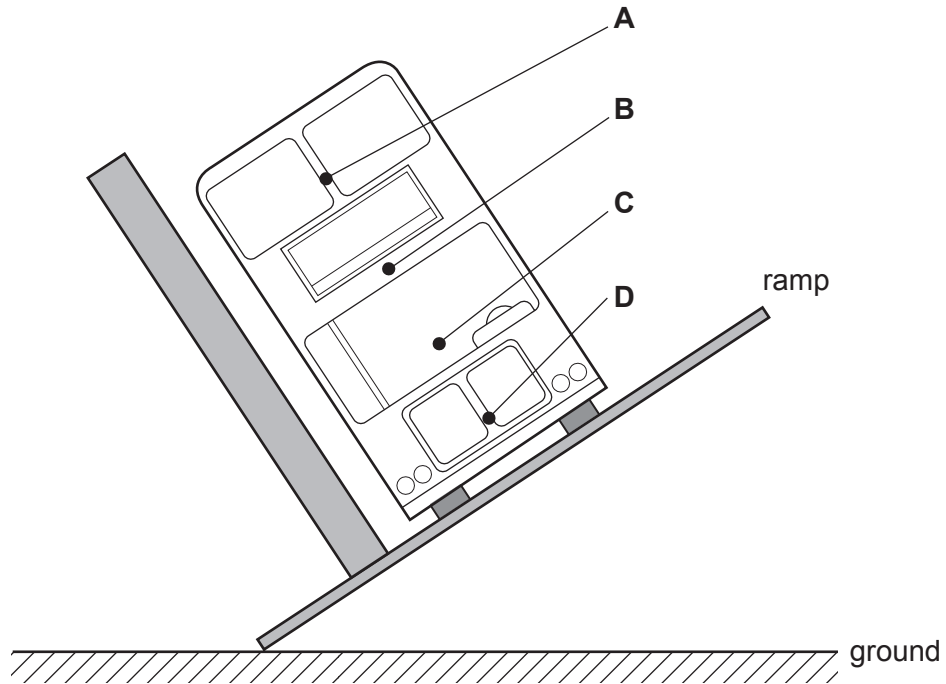


Which diagram shows the forces acting on the beam?
(The length of each arrow represents the size of a force.)



- 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.

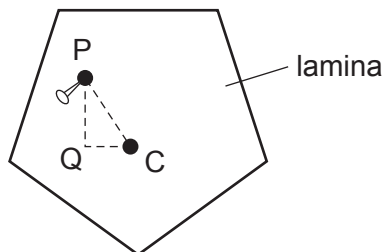
Where is the centre of mass of the bus?



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



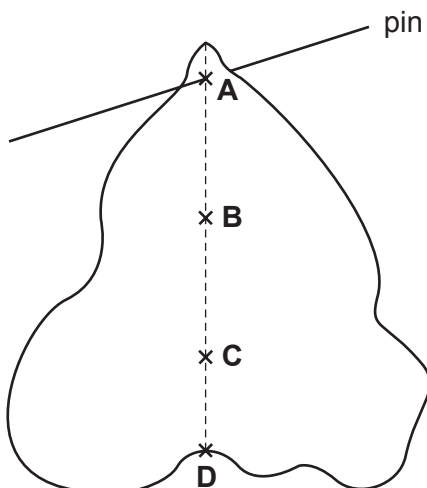
The lamina is displaced to the position shown.

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

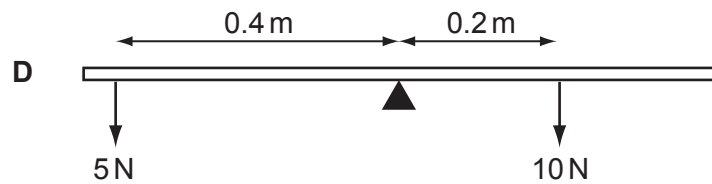
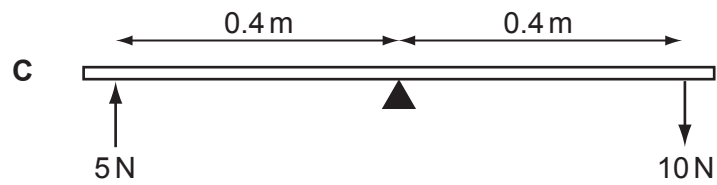
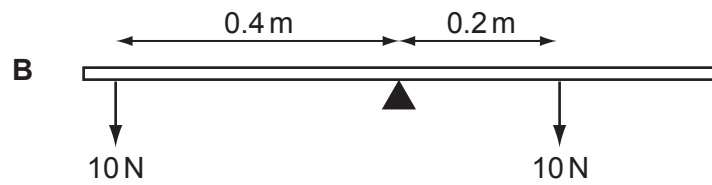
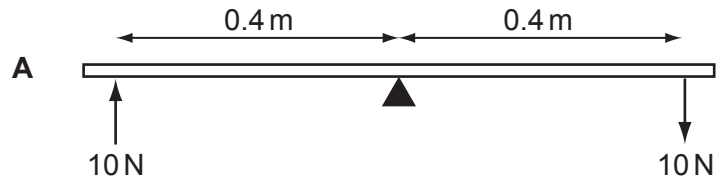
30 A piece of uniform card is suspended freely from a horizontal pin.

At which of the points shown is its centre of gravity?

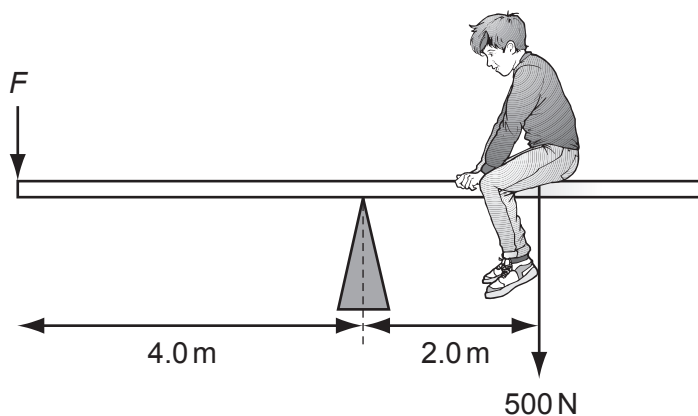


31 Forces are applied to a uniform beam pivoted at its centre.

Which beam is balanced?



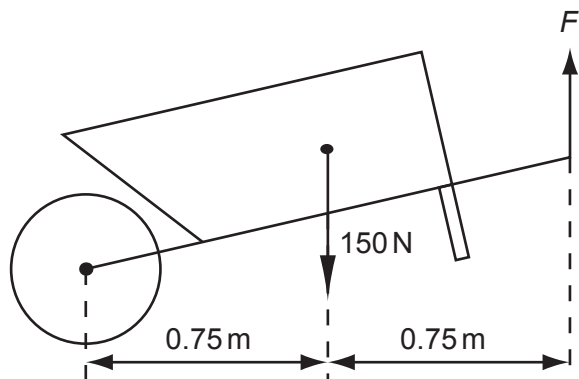
- 32 The diagram shows a boy of weight 500 N sitting on a see-saw. He sits 2.0 m from the pivot.



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

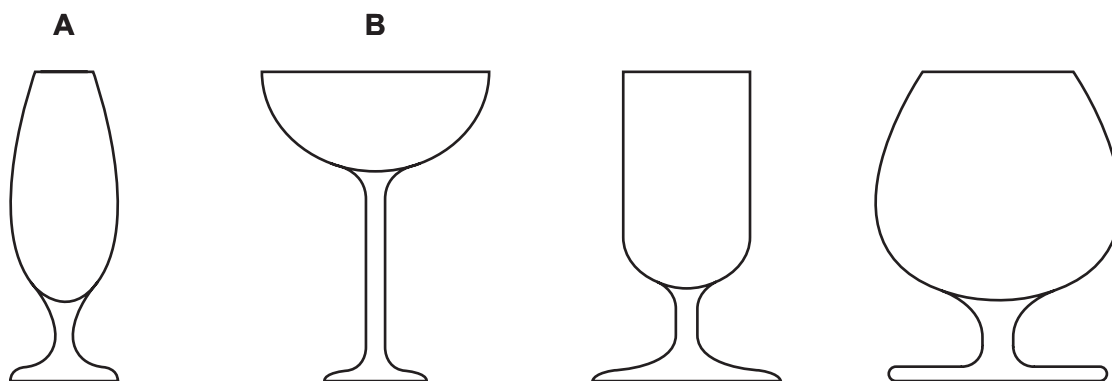
- 35 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by a vertical force F at the ends of the handles.



What is the value of F ?

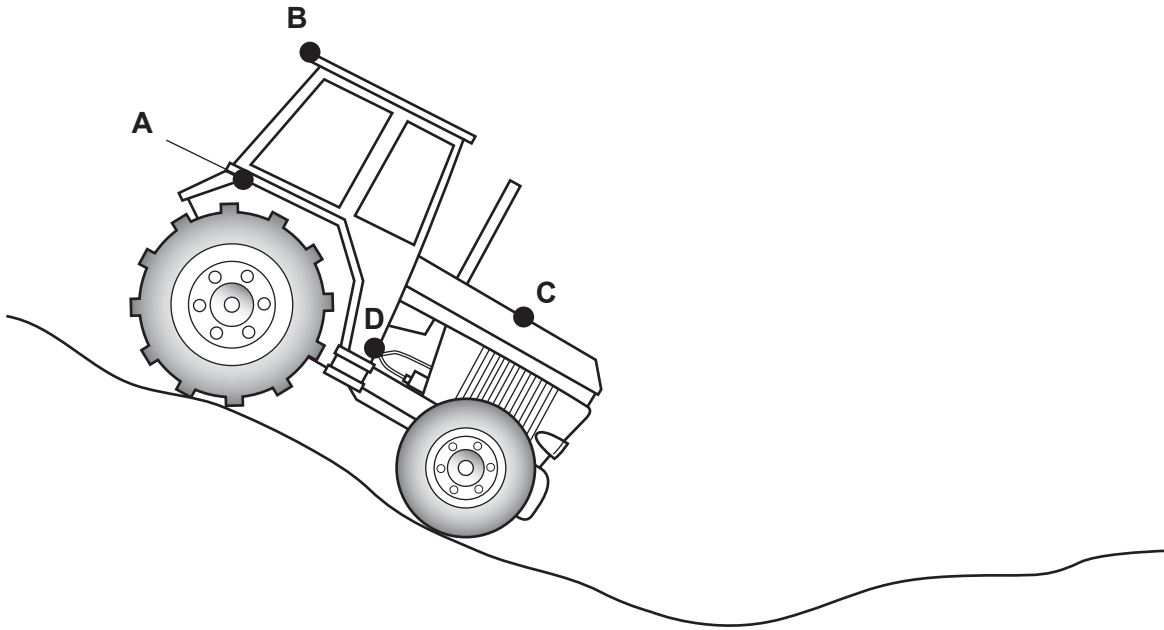
- A** 75 N **B** 150 N **C** 225 N **D** 300 N
- 36 The diagrams show the cross-sections of different glasses.

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

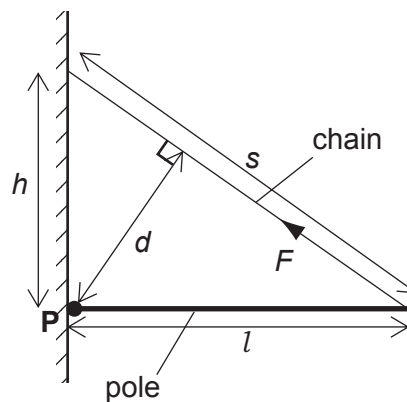


37 A tractor is being used on rough ground.

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.

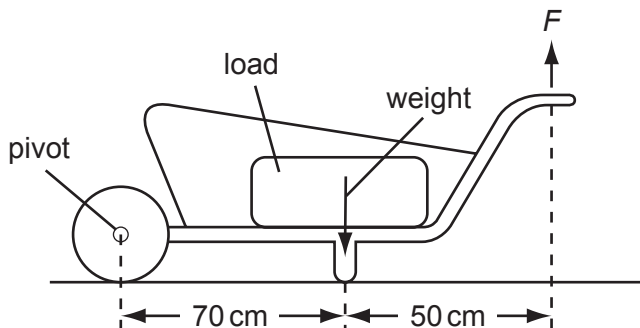


There is a tension force F in the chain.

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

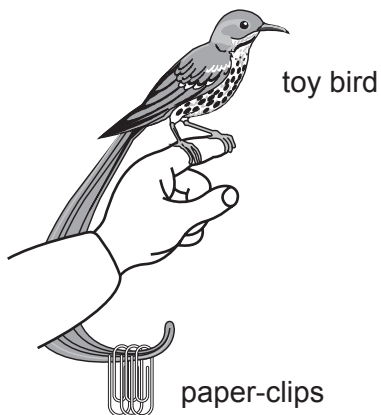
- A** $F \times d$ **B** $F \times h$ **C** $F \times l$ **D** $F \times s$

- 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?

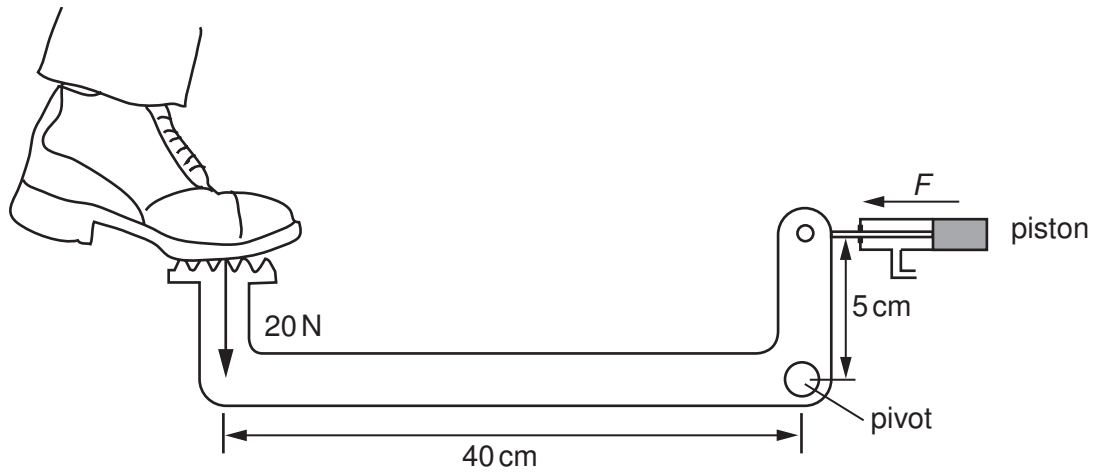
- A** 350 N **B** 430 N **C** 600 N **D** 840 N
- 40 A girl uses paper-clips to balance a toy bird on her finger as shown.



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