1. Motion, forces and energy

1.5 Forces

Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 What is measured by the moment of a force?

A the acceleration produced by the force

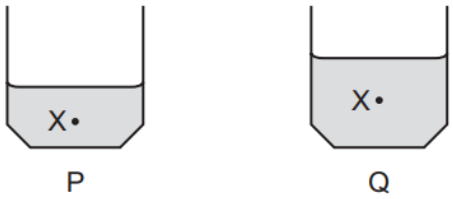
B the turning effect of the force

C the time for which the force acts

D the increase in energy caused by the force

2 Two identical containers, P and Q, are partly filled with different quantities of sand.

The position of the centre of gravity for each container is labelled X.



Which container is more stable and what is the reason why it is more stable?

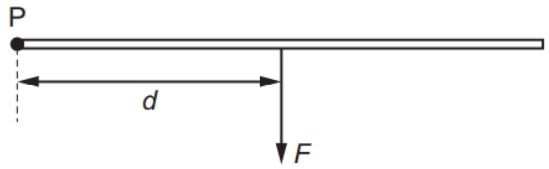
A P is more stable because it has a lower centre of gravity.

B P is more stable because it has a smaller mass.

C Q is more stable because it has a greater depth of sand.

D Q is more stable because it has a higher centre of gravity.

3 The diagram shows a force *F* acting at 90° to a bar at a distance *d* from the point P.



Which pair of changes causes the greatest increase in the moment of the force *F* about the point P?

A halving *F* and halving *d*

B halving *F* and doubling *d*

C doubling *F* and halving *d*

D doubling *F* and doubling *d*

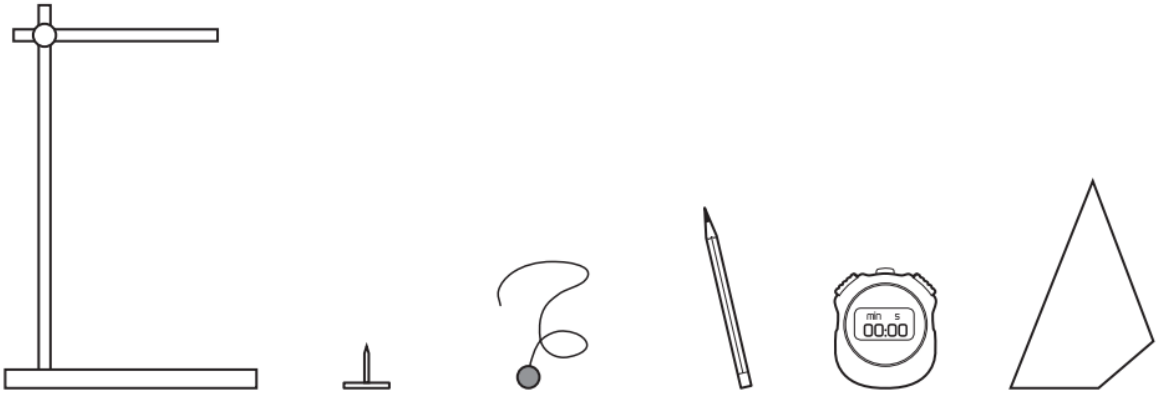
4 A child of weight 420 N is sitting on a swing with her feet on the ground.

The child experiences an upward force from the ground of 130 N and an upward force from the swing of 290 N.

What is the resultant force on the child?

A 0 N **B** 260 N **C** 580 N **D** 840 N

5 A student determines the position of the centre of gravity of a piece of card. The diagram shows the equipment that is available. The equipment is not drawn to scale.



Which piece of equipment is **not** needed?

A pencil

B pin

C weight on a thin string

D stop-watch

6 Which force between two solid surfaces opposes motion?

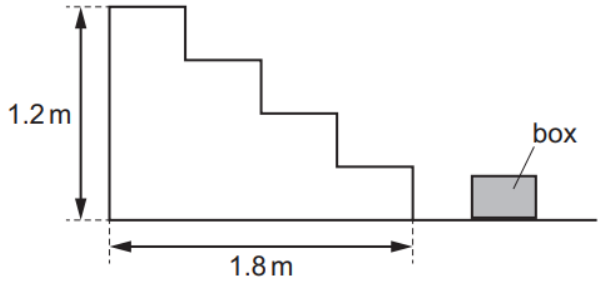
A friction

B gravity

C kinetic

D weight

7 A box of mass 2.0 kg and weight 20 N is carried to the top of some stairs.



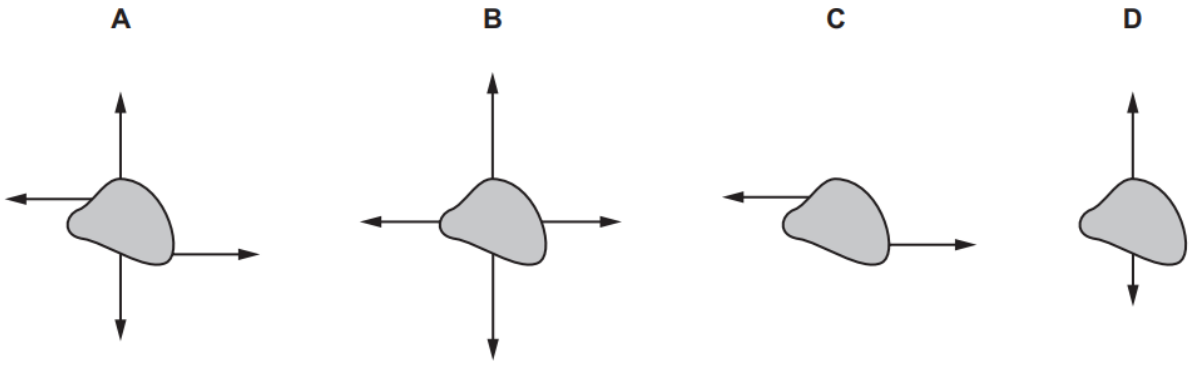
How is the work done against gravity on the box calculated?

A 2.0×1.8 **B** 20×1.2 **C** 2.0×1.2 **D** $20 \times 1.2 \times 1.8$

8 Forces are applied to four identical objects.

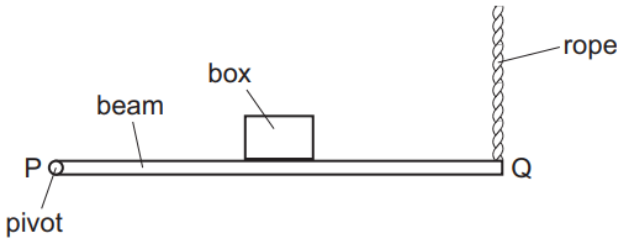
The length of each arrow indicates the magnitude of the force.

Which object is in equilibrium?



9 The diagram shows a wooden beam PQ which is attached to a wall by a pivot at P and kept in a horizontal position by a vertical rope attached at Q.

A box has been placed on the beam.



Which changes **must** reduce the tension in the rope at Q?

A Decrease the mass of the box and move it towards P.

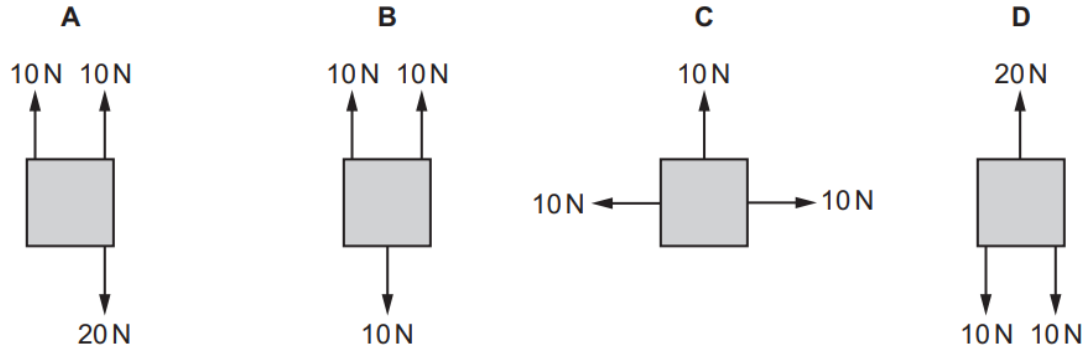
B Decrease the mass of the box and move it towards Q.

C Increase the mass of the box and move it towards P.

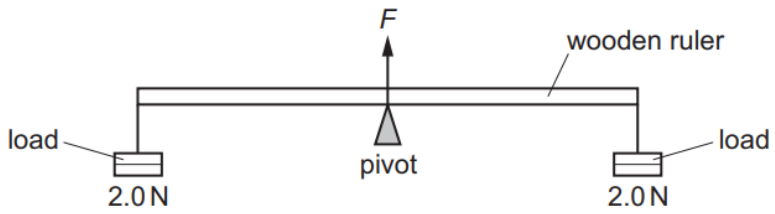
D Increase the mass of the box and move it towards Q.

10 The diagrams show four identical objects. Each object is acted on by only the forces shown.

Which diagram shows an object in equilibrium?



11 A uniform wooden ruler is pivoted at its centre. A load of 2.0 N is suspended from each end of the ruler.



The pivot exerts an upward force *F* on the ruler.

What is *F* equal to?

A 2.0 N

B the weight of the ruler

C 4.0 N

D 4.0 N plus the weight of the ruler

12 Four objects are moving.

Which object has a zero resultant force acting on it?

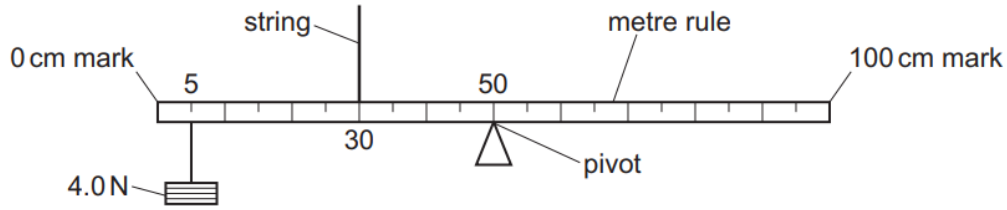
A the object moving at a decreasing speed

B the object moving at an increasing speed

C the object moving at a constant speed in a circle

D the object moving at a constant speed in a straight line

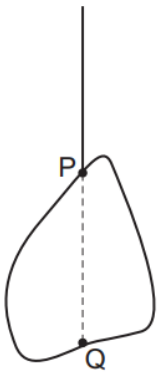
13 The diagram shows a uniform metre rule. The rule is pivoted at its mid-point. A weight of 4.0 N is suspended from the rule at the 5 cm mark. The rule is held by a string at the 30 cm mark. The rule is in equilibrium.



What is the upward force that the string exerts on the rule?

A 0.67 N **B** 4.0 N **C** 6.0 N **D** 9.0 N

14 An irregularly shaped metal plate is freely suspended from a point P and is in equilibrium, as shown. Point Q is vertically below P.



Which statement about the position of the centre of gravity of the metal plate is correct?

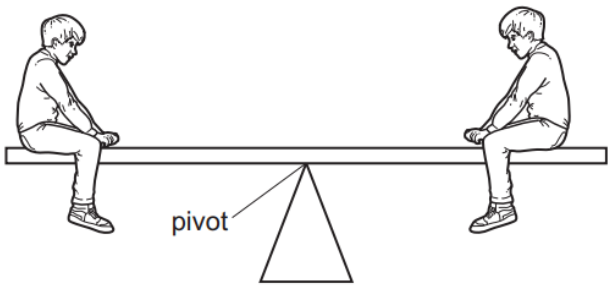
A It is at P.

B It is at Q.

C It is halfway between P and Q.

D Further investigation is needed to determine its position.

15 Two boys are sitting on a see-saw. The see-saw is in equilibrium and remains horizontal.



What affects the moment of each boy about the pivot?

A his distance from the pivot only

B his height above the ground and his weight

C his weight only

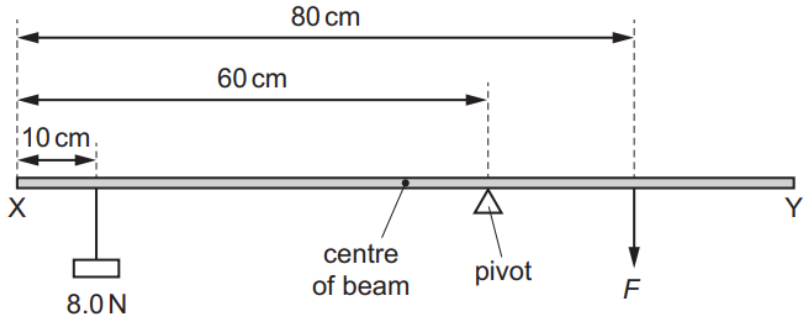
D his weight and distance from the pivot

16 A uniform metre rule is pivoted in equilibrium at the 50 cm mark. A mass of 25 g is placed at the 30 cm mark on the rule.

What is the smallest mass that can be placed on the rule to restore equilibrium?

A 5 g **B** 10 g **C** 15 g **D** 25 g

17 A uniform beam XY is 100 cm long and weighs 4.0 N.



The beam rests on a pivot 60 cm from end X.

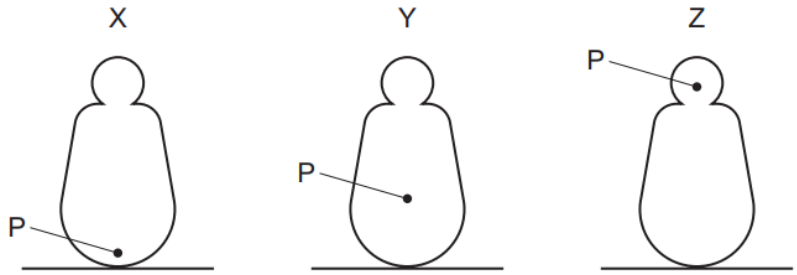
A load of 8.0 N hangs from the beam 10 cm from end X.

The beam is kept balanced by a force *F* acting on the beam 80 cm from end X.

What is the magnitude of force *F*?

A 8.0 N **B** 18 N **C** 22 N **D** 44 N

18 Three children's toys, X, Y and Z, are the same size and shape. They have weights at different positions inside so that the position of the centre of gravity of each toy is different. Each toy's centre of gravity is marked P.



Which toy is the most stable and which toy is the least stable when balanced in the positions shown?

	most stable	least stable
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

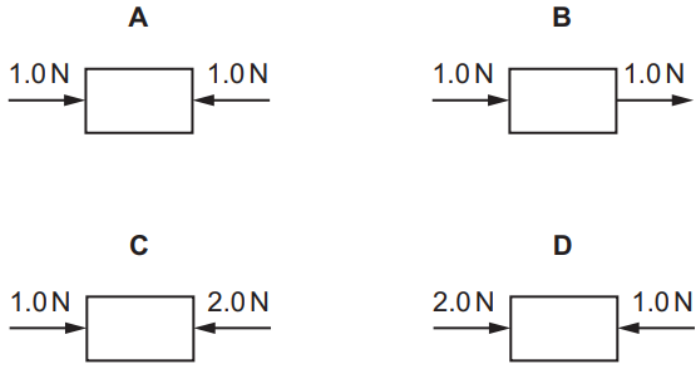
19 A force *F* acts on an object at a distance *x* from a pivot.

Which two changes both increase the moment of the force about the pivot?

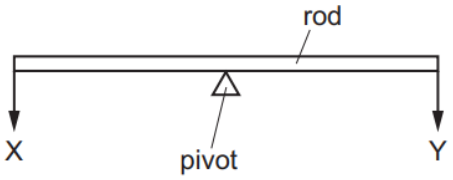
	change 1	change 2
A	decrease *F*	decrease *x*
B	decrease *F*	increase *x*
C	increase *F*	decrease *x*
D	increase *F*	increase *x*

20 The diagrams represent the only two forces acting on an object.

Which object could be moving to the right at constant speed?



21 The diagram shows a uniform rod with its midpoint on a pivot. Two weights X and Y are hung from the rod. The rod is in equilibrium.



Which statement is correct?

A The forces at X and Y have different values.

B There is a resultant turning effect on the rod.

C The resultant force on the rod is zero.

D The rod does not have a centre of mass.

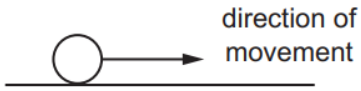
22 What is the unit for the moment of a force about a point?

A W **B** Ns **C** N/m **D** Nm

23 On which ball is a non-zero resultant force acting?

A

a ball moving at constant speed on a smooth surface

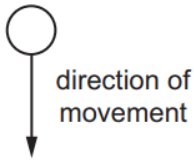


B

a ball at rest on a bench

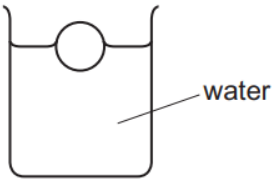
C

a free-falling ball which has just been released



D

a ball floating on water



24 Which statements **must** be correct for an object to be in equilibrium?

1 The object is moving in a straight line.

2 There is no resultant force on the object.

3 There is no resultant moment on the object.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

25 Which pieces of apparatus are the most appropriate for an experiment to plot an extension–load graph of a spring?

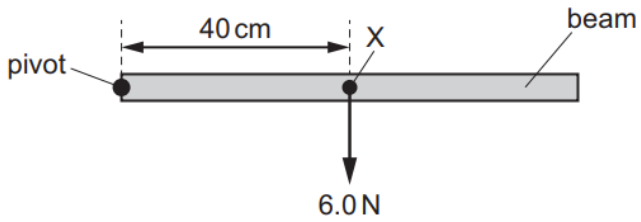
A ruler, newton meter, clamp and stand

B balance, stop-watch, ruler

C light gate, ruler, newton meter

D stop-watch, balance, measuring cylinder

26 A beam is pivoted at one end, as shown.



The beam weighs 6.0 N and its weight acts at a point X 40 cm from the pivot.

A force of 4.0 N is applied to the beam causing it to balance horizontally.

In which direction and where is the 4.0 N force applied?

A vertically downwards at 20 cm to the left of X

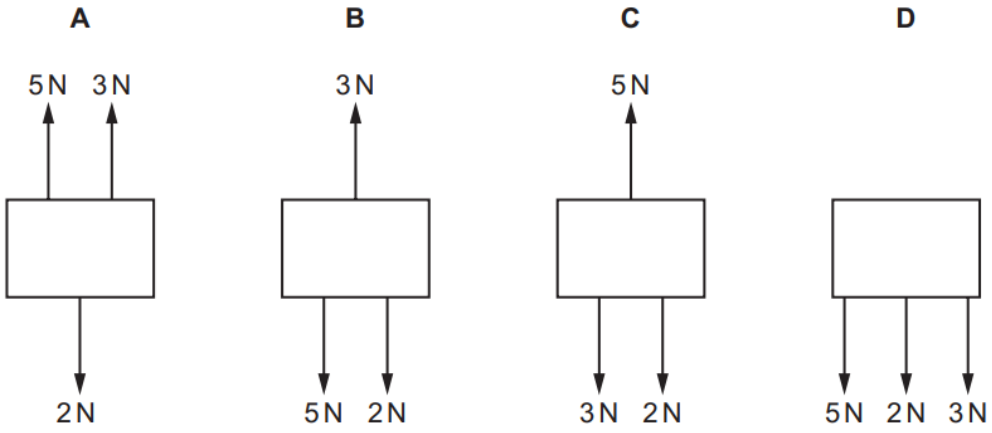
B vertically downwards at 20 cm to the right of X

C vertically upwards at 20 cm to the left of X

D vertically upwards at 20 cm to the right of X

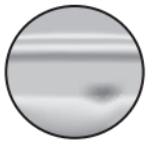
27 The diagrams show the forces acting on four moving objects.

Which object is moving at a constant speed?



28 A spaceship approaches and passes a planet.

spaceship



planet

What can the force of gravity between the spaceship and planet achieve?

A It can change the direction of the spaceship, or slow it down, but not speed it up.

B It can change the direction of the spaceship, or speed it up, but not slow it down.

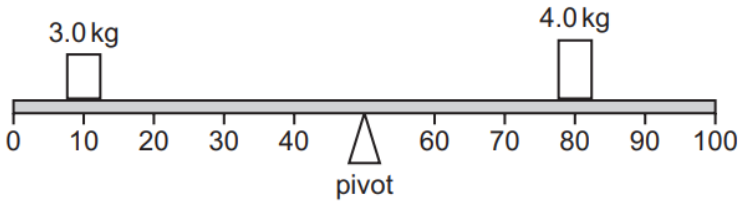
C It can slow down the spaceship, or speed it up, but not change its direction.

D It can change the direction of the spaceship, slow it down, or speed it up.

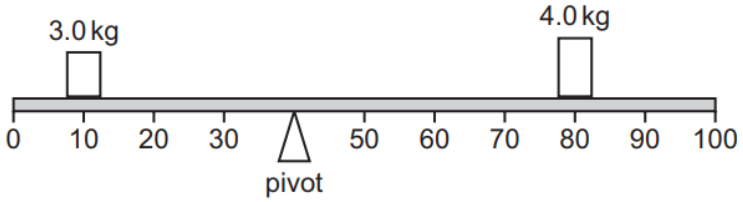
29 What are the conditions for an object to be in equilibrium?

	forces on object	moment on object
A	no resultant force	no resultant moment
B	no resultant force	resultant moment
C	resultant force	no resultant moment
D	resultant force	resultant moment

30 A 100 cm beam balances as shown.



The pivot is moved 10 cm to the left.



What will be the effect of this change on the anticlockwise and clockwise moments about the pivot?

	anticlockwise moment	clockwise moment
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

31 A spacecraft is travelling in space with no resultant force and no resultant moment acting on it.

Which statement about the spacecraft is correct?

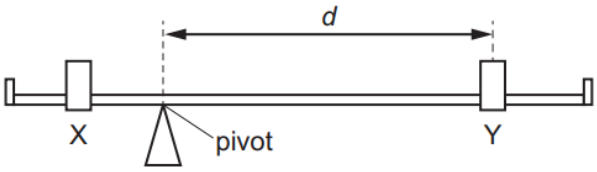
A Its direction is changing.

B It is in equilibrium.

C Its speed is decreasing.

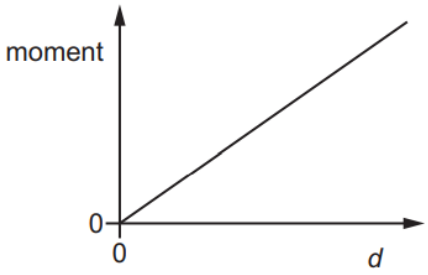
D Its speed is increasing.

32 The diagram shows a simple balance. The two loads, X and Y, can be moved along the beam.

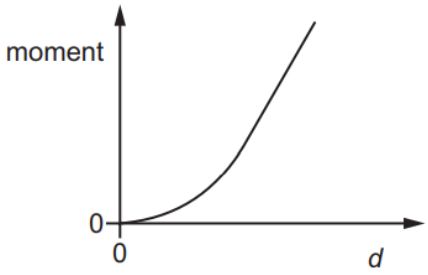


Which graph shows how the moment produced by load Y varies as the perpendicular distance *d* from the pivot changes?

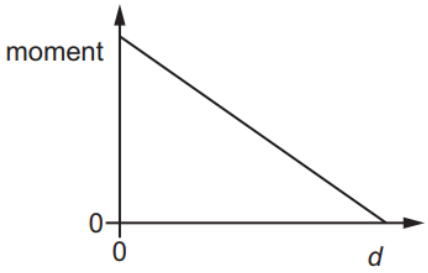
A



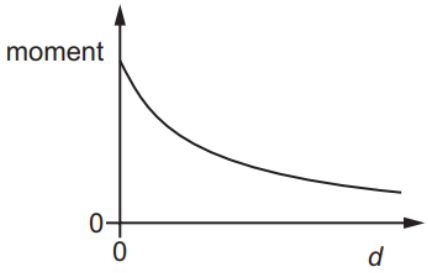
B



C



D



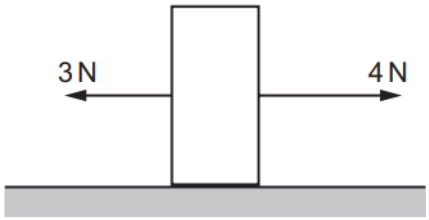
33 A student carries out an investigation by pulling four different boxes across the floor.

The results are shown in the table.

On which box is the most work done?

	frictional force needed to pull the box / N	distance moved across the floor / m
A	5	4
B	10	2
C	15	2
D	20	4

34 The diagram shows a solid object on a flat surface, with two forces acting on the object.



What is the resultant force on the object?

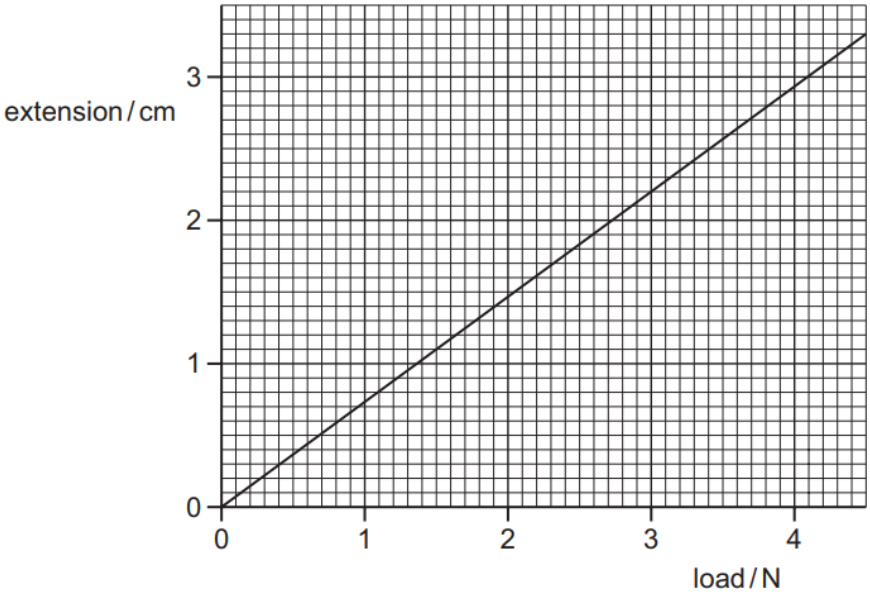
A 1 N to the left

B 1 N to the right

C 7 N to the left

D 7 N to the right

35 The extension–load graph for a spring is shown. The unstretched length of the spring is 17.0 cm.

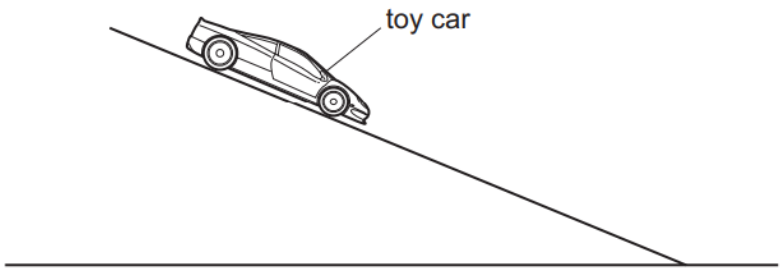


When an object is suspended from the spring, the length of the spring is 19.2 cm.

What is the weight of the object?

A 1.4 N **B** 1.6 N **C** 2.6 N **D** 3.0 N

36 A toy car travels down a sloping ramp at constant speed.



Which statement about the forces acting on the car is correct?

A There are no forces acting on the car vertically.

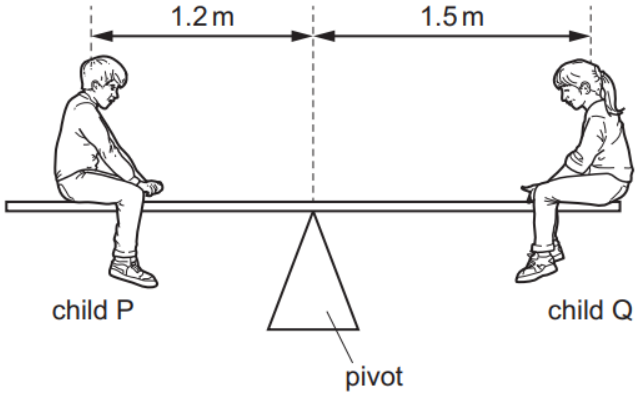
B There is no resultant force acting on the car.

C There is no gravitational force acting on the car.

D There is no frictional force acting on the car.

37 A uniform plank rests on a pivot at its centre.

Two children P and Q sit on the plank in the positions shown.



The mass of child P is 25 kg.

The plank is balanced.

What is the mass of child Q?

A 20 kg **B** 25 kg **C** 31 kg **D** 45 kg

38 An object is in equilibrium on the Earth.

Which statement is correct?

A All the forces acting on the object are in the same direction.

B All the forces acting on the object have the same value.

C The object is weightless.

D The resultant force acting on the object is zero.

39 A man jumps from a stationary balloon. After falling several hundred metres, he opens his parachute.

At which position is his kinetic energy greatest?

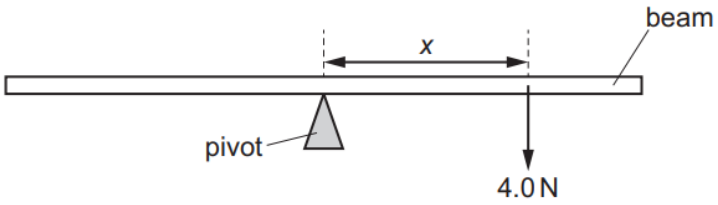
A just after he jumps from the balloon

B just before he opens his parachute

C just after his parachute opens

D just before he lands

40 A force of 4.0 N acts on a beam as shown.

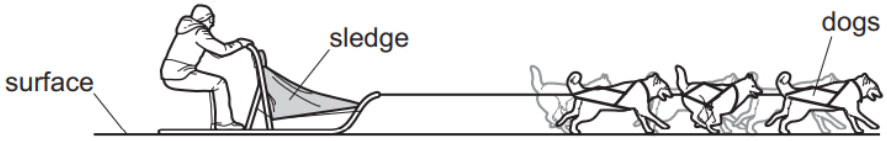


The line of action of the force is a distance *x* from a pivot. The moment of this force about this pivot is 8.0 N cm.

What is distance *x*?

A 0.50 cm **B** 2.0 cm **C** 12 cm **D** 32 cm

41 A sledge is pulled in a straight line by dogs, as shown.



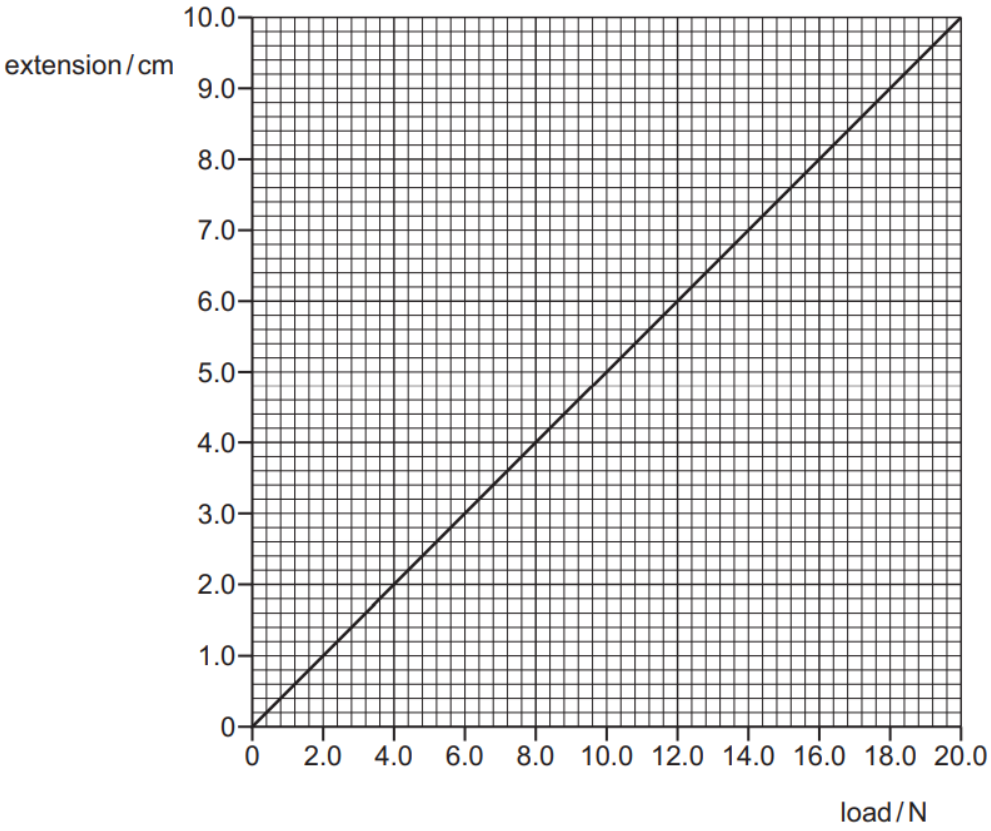
The dogs produce a total horizontal driving force of 600 N.

The frictional force between the sledge and the surface is 150 N and the air resistance on the sledge is 450 N.

What is the resultant force acting on the sledge?

A 0 N **B** 300 N **C** 900 N **D** 1200 N

42 The diagram shows an extension–load graph for a spring.



An empty can of weight 3.0 N is suspended from the spring.

Liquid is poured into the can until the extension is 8.0 cm.

What is the weight of the liquid?

A 4.0 N **B** 10.0 N **C** 13.0 N **D** 16.0 N

43 What is meant by the moment of a force on an object?

A the magnitude of the force on the object

B the direction of the force on the object

C the time for which the force acts on the object

D the turning effect of the force on the object

44 A student measures the length of a spring. She then attaches different weights to the spring. She measures the length of the spring for each weight.

The table shows her results.

weight / N	length / mm
0	520
1.0	524
2.0	528
3.0	533
4.0	537
5.0	540

What is the extension of the spring with a weight of 3.0 N attached to it?

A 4 mm **B** 5 mm **C** 12 mm **D** 13 mm

45 Which statement gives a complete description of any object that is in equilibrium?

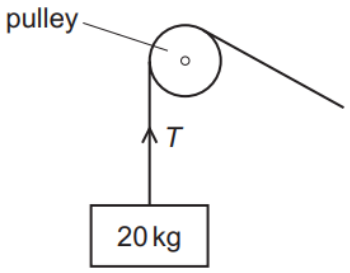
A There are no forces acting.

B There is no resultant force.

C There is no resultant force and no resultant turning effect.

D There is no resultant turning effect.

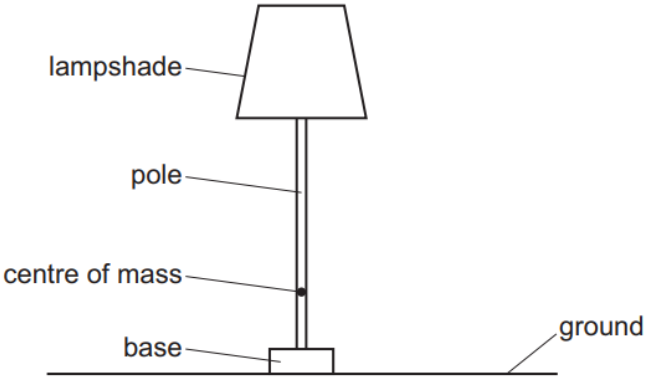
46 A mass of 20 kg is held stationary by a rope passing over a frictionless pulley.



What is the tension *T* in the rope?

A 10 kg **B** 20 kg **C** 100 N **D** 200 N

47 The diagram shows a lamp.



Changing which feature increases the stability of the lamp?

A a larger lampshade

B a longer pole

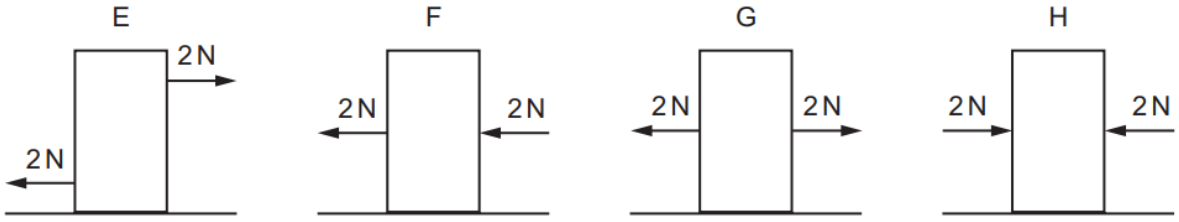
C a heavier base

D a higher centre of mass

48 What is the unit of the moment of a force?

A N **B** N/kg **C** N/m **D** Nm

49 The diagrams show a block of wood on a frictionless surface. In each diagram, the block has two forces acting on its sides.



Which diagrams show the block in equilibrium?

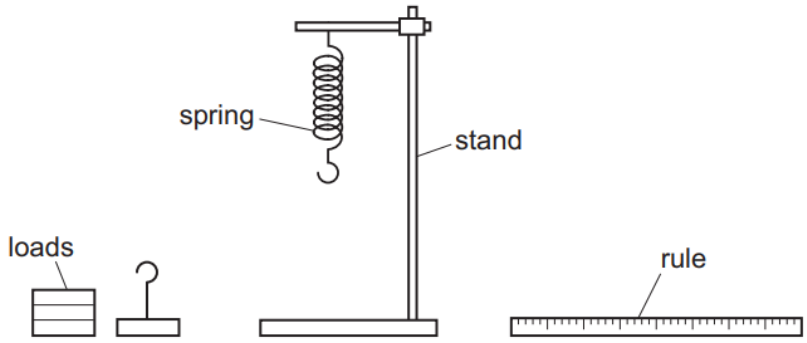
A E, G and H only

B E and F only

C G and H only

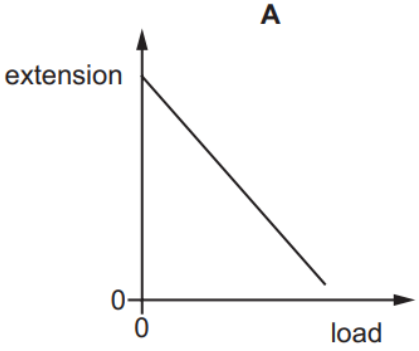
D E, F, G and H

50 A spring is suspended from a stand. Loads are added and the extensions are measured.

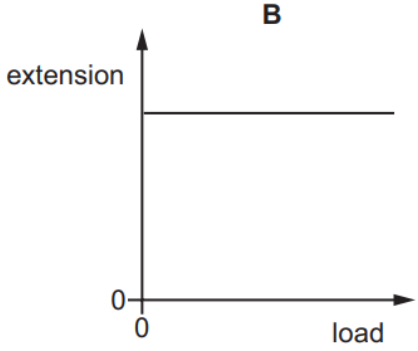


Which graph shows the result of plotting extension against load?

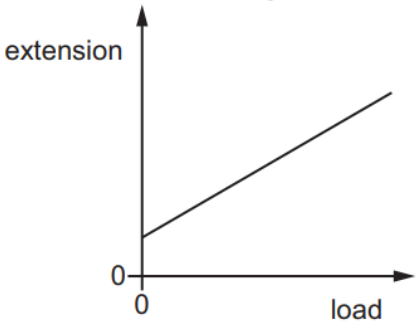
A



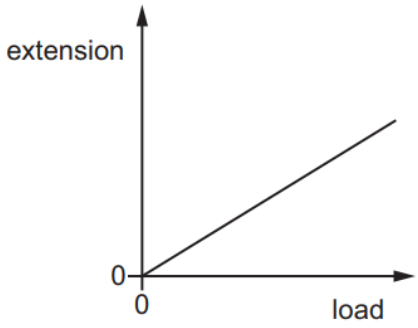
B



C



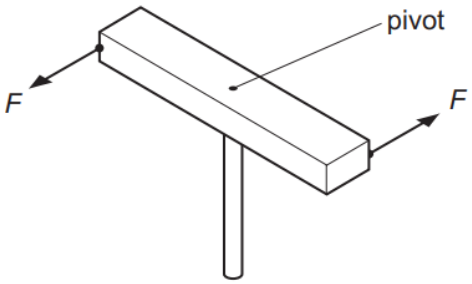
D



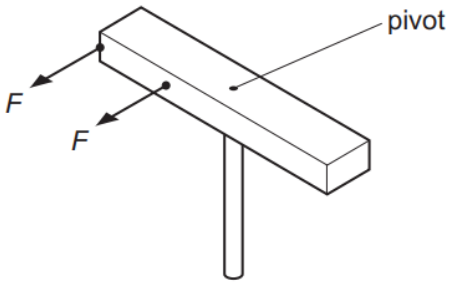
51 A wooden bar is pivoted at its centre so that it can rotate freely. Two equal forces *F* are applied to the bar.

In which diagram is the turning effect greatest?

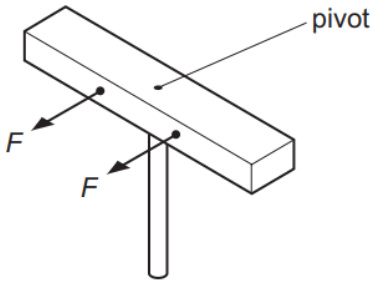
A



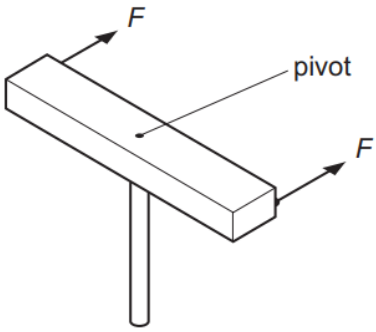
B



C

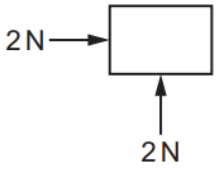


D

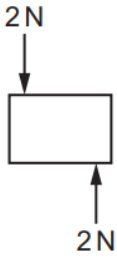


52 Which object is in equilibrium?

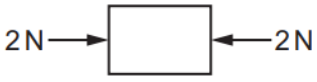
A



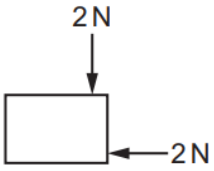
B



C



D

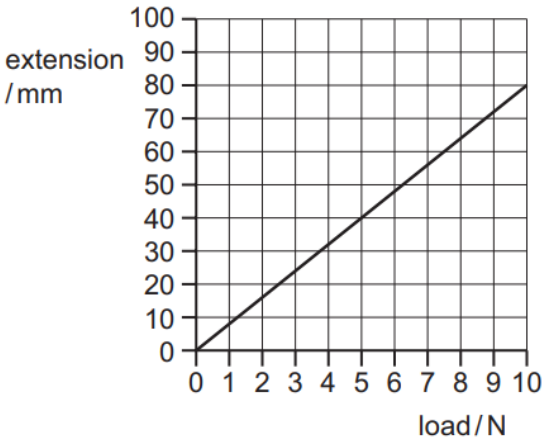


53 The unstretched lengths and extension-load graphs are shown for each of four different springs.

Which spring is the longest when a load of 5.0 N is hung from each spring?

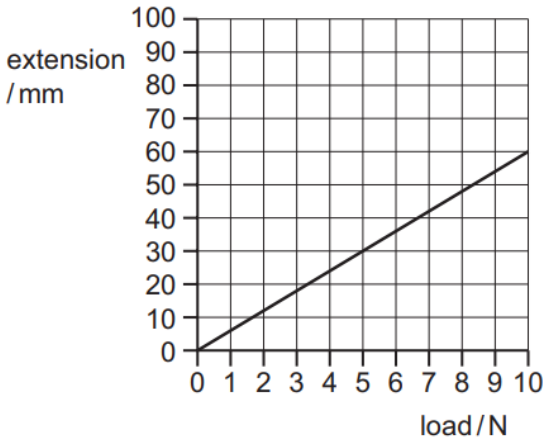
A

unstretched length 65 mm



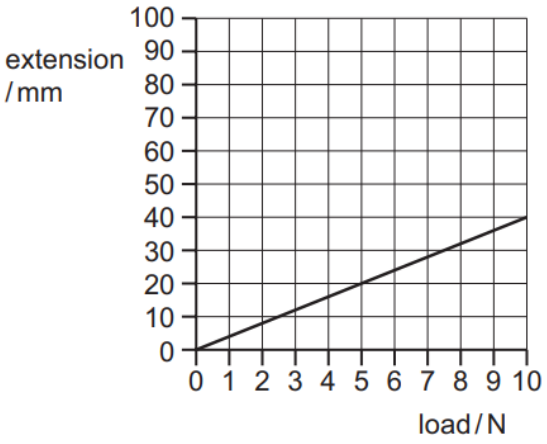
B

unstretched length 90 mm



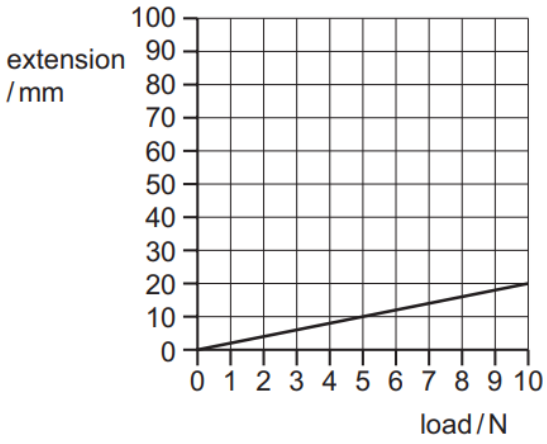
C

unstretched length 105 mm



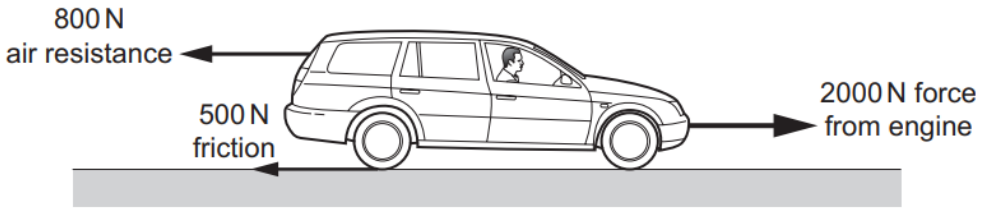
D

unstretched length 110 mm



54 A car moves along a level road.

The diagram shows all of the horizontal forces acting on the car.



Which statement is correct?

A The car is slowing down.

B The car is speeding up.

C The car is moving at a constant speed.

D The car is moving backwards.

55 Which force and distance produce the smallest moment about a pivot?

A a 6.0 N force at a perpendicular distance of 4.0 m from the pivot

B a 7.0 N force at a perpendicular distance of 6.0 m from the pivot

C a 10 N force at a perpendicular distance of 4.0 m from the pivot

D a 12 N force at a perpendicular distance of 3.0 m from the pivot

56 Which is an example of a force?

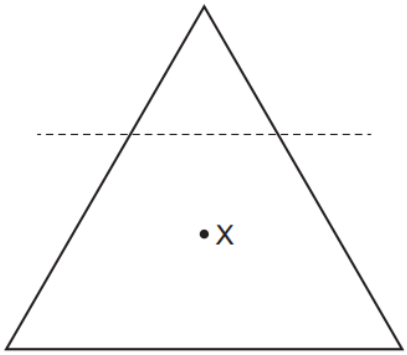
A density

B mass

C volume

D weight

57 Point X is the centre of mass of a lamina in the shape of a triangle with sides of equal length. The top of the triangle is cut off along the dotted line shown.



What happens to the centre of mass, X?

A moves towards the bottom of the page

B moves to the left

C moves to the right

D moves towards the top of the page

58 A car is moving in a straight line on a level road. Its engine provides a forward force on the car. A second force of equal size acts on the car due to resistive forces.

Which statement describes what happens?

A The car changes direction.

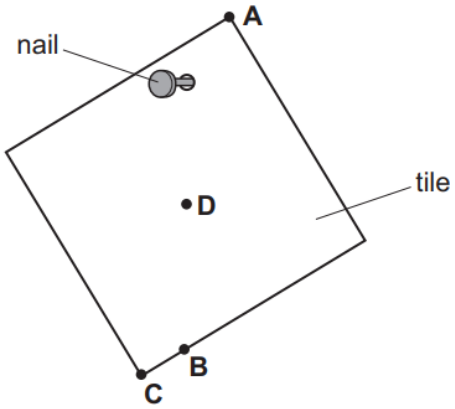
B The car moves at a constant speed.

C The car slows down.

D The car speeds up.

59 A hole is drilled in a square tile. The diagram shows the tile hanging freely on a nail.

Where is the centre of mass of the tile?

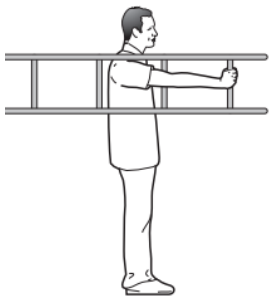


60 A man holds a short ladder in four different positions.

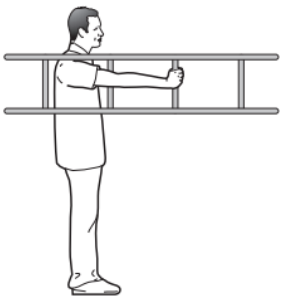
The weight of the ladder causes a moment about the man's shoulder.

In which position is the moment greatest?

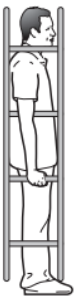
A



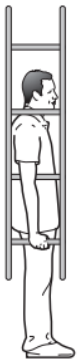
B



C



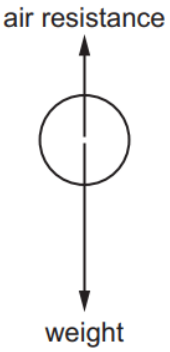
D



Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

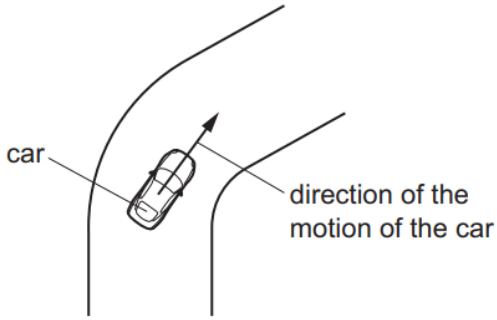
61 The diagram shows the vertical forces acting on a ball as it falls vertically through the air. The ball does not reach terminal velocity.



Which row describes what happens to the resultant force on the ball and what happens to the acceleration of the ball as it falls through the air?

	resultant force	acceleration
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

62 A car is driven round a bend in the road at a constant speed. **(extended only)**



What is the direction of the resultant force on the car when it is going round the bend?

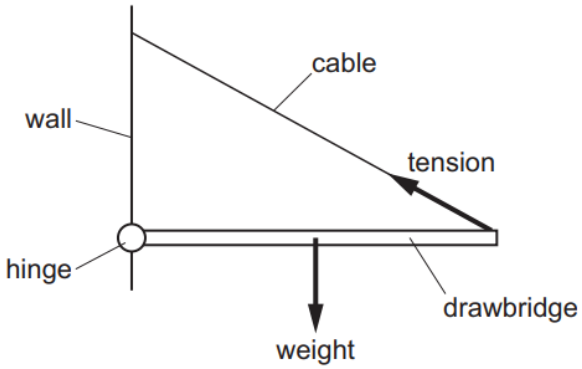
A parallel to the motion and in the same direction as the motion

B parallel to the motion and in the opposite direction to the motion

C perpendicular to the motion and towards the inside of the bend

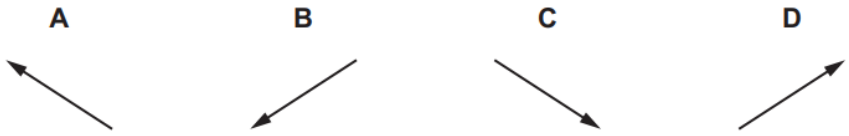
D perpendicular to the motion and towards the outside of the bend

63 The diagram shows a drawbridge that is attached to a wall by a hinge at one end and a cable at the other.



The weight of the drawbridge and the tension in the cable are represented by the labelled arrows in the diagram. There is a third force at the hinge, which is not shown. The drawbridge is in equilibrium.

Which arrow shows a possible direction for the force at the hinge?



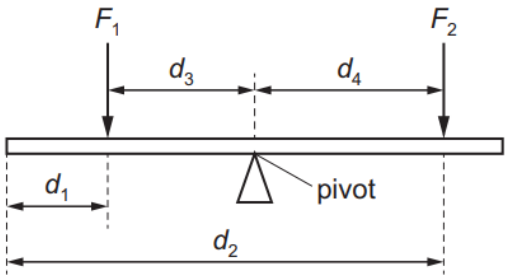
64 Two forces with magnitudes F_1 and F_2 act on an object at right angles to each other. **(extended only)**

What is the magnitude of the resultant force?

A $\sqrt{F_1^2 + F_2^2}$ **B** $\sqrt{F_1} + \sqrt{F_2}$ **C** $\sqrt{F_1^2} + \sqrt{F_2^2}$ **D** $\sqrt{F_1 + F_2}$

65 The diagram shows a uniform beam pivoted at its centre.

A student applies two forces, F_1 and F_2, as shown.

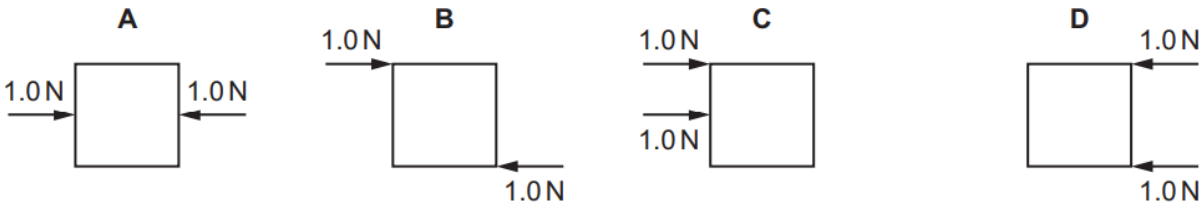


Which row is correct?

	clockwise moment about the pivot	anticlockwise moment about the pivot
A	F_2d_2	F_1d_1
B	F_2d_2	F_1d_3
C	F_2d_4	F_1d_1
D	F_2d_4	F_1d_3

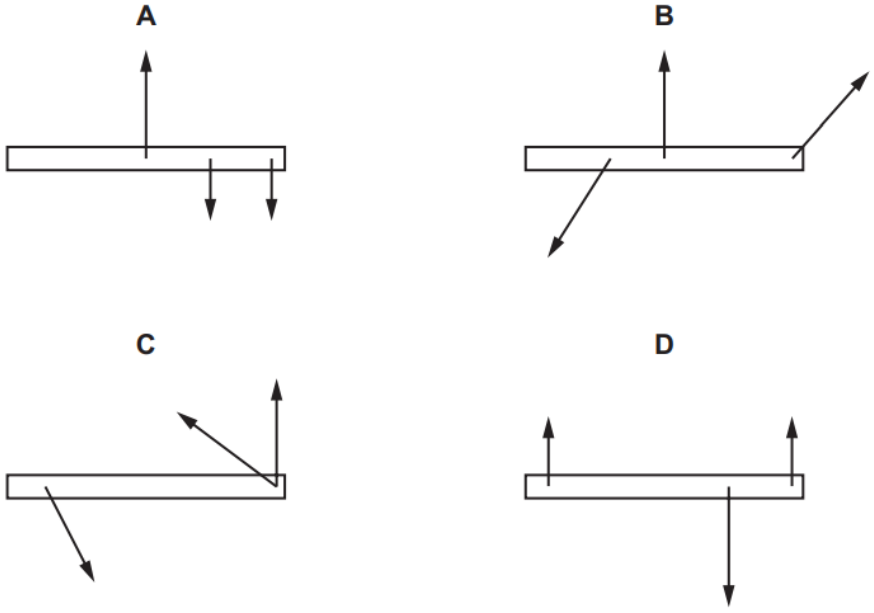
66 Four objects each have two forces acting on them.

Which object is in equilibrium?



67 Each diagram shows three forces on a beam.

In which situation is it possible for the three forces shown to be in equilibrium?



68 Which moving object has a resultant force acting on it?

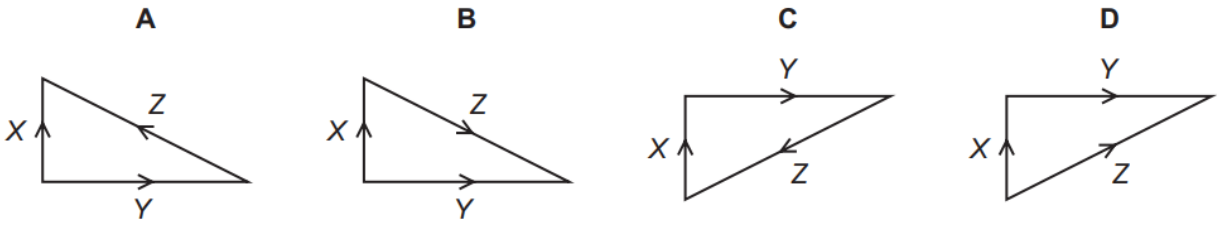
A a diver rising vertically through water at constant speed

B an aircraft circling an airport at constant speed

C a train going up a straight incline at constant speed

D a parachutist descending vertically at terminal velocity

69 Which vector diagram correctly shows the force *Z* as the resultant of forces *X* and *Y*? **(extended only)**



70 On the Earth, a spring stretches by 5.0 cm when a mass of 3.0 kg is suspended from one end. **(extended only)**

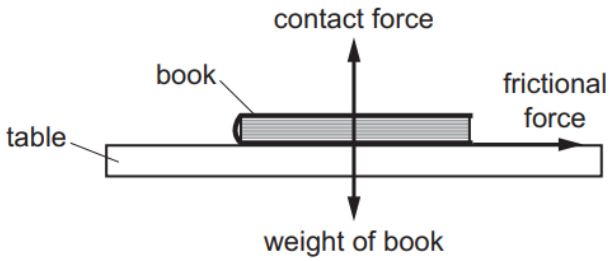
The gravitational field strength on the Moon is $\frac{1}{6}$ of that on the Earth.

Which mass, on the Moon, would stretch the spring by the same extension?

A 0.50 kg **B** 3.0 kg **C** 5.0 kg **D** 18 kg

71 A train is travelling horizontally in a straight line. A book is on a table in the train.

The diagram shows all the forces acting on the book.



How is the train moving?

A accelerating to the left of the diagram

B accelerating to the right of the diagram

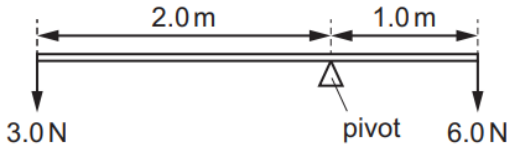
C moving at uniform speed to the left of the diagram

D moving at uniform speed to the right of the diagram

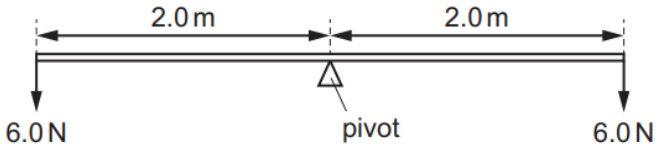
72 The diagrams show four beams, each of negligible weight and freely pivoted. **(extended only)**

Which beam is **not** in equilibrium?

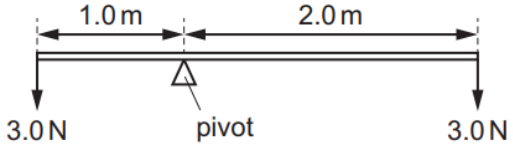
A



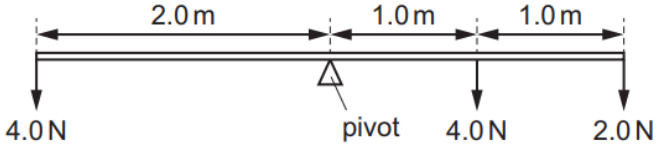
B



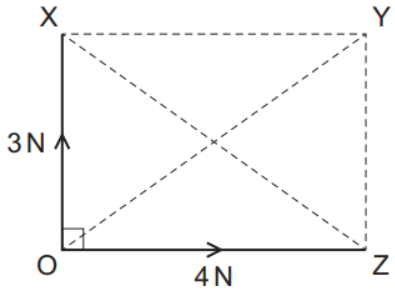
C



D



73 Forces of 3 N and 4 N act at right angles, as shown. **(extended only)**



What is the resultant force?

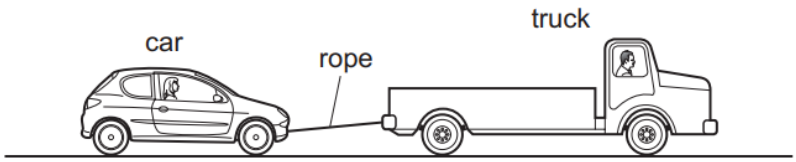
A 1 N along XZ

B 5 N along XZ

C 5 N along OY

D 7 N along OY

74 A truck is towing a car along a straight horizontal road at a constant speed.



The rope breaks.

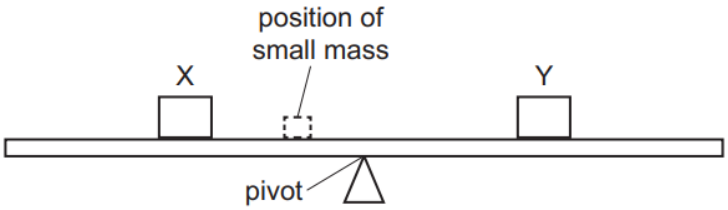
Which row gives the direction of the initial acceleration of the truck after the rope breaks and the reason for the acceleration?

	direction of acceleration of the truck	reason
A	left	the driving force is greater than the resistive forces on the truck
B	left	the driving force is smaller than the resistive forces on the truck
C	right	the driving force is greater than the resistive forces on the truck
D	right	the driving force is smaller than the resistive forces on the truck

75 A uniform beam is pivoted at the centre and two identical masses, X and Y, are placed so that the beam balances.

(extended only)

A smaller mass is then added at the position shown.



How can the masses be positioned so the beam balances again?

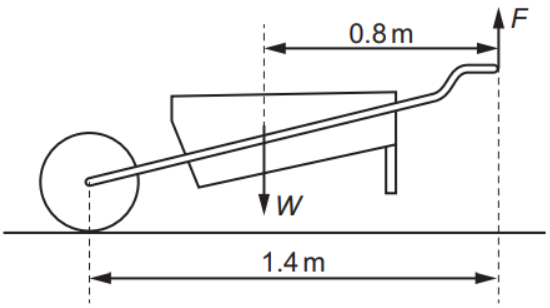
A Move X away from the pivot.

B Move X towards the pivot.

C Move Y towards the pivot.

D Move the small mass away from the pivot.

76 A wheelbarrow has a weight *W* of 140 N. **(extended only)**

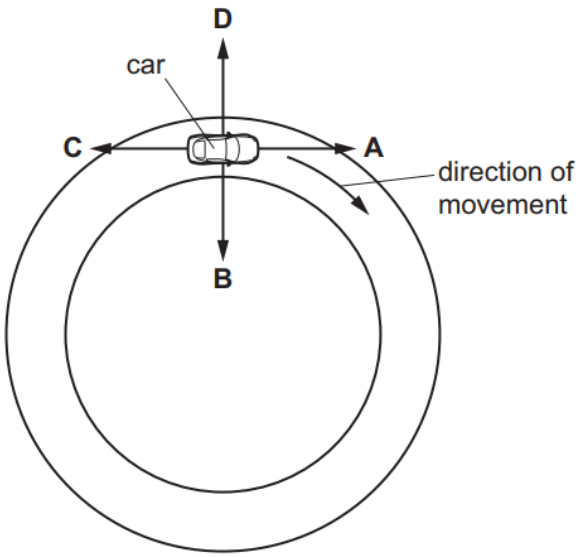


Which vertical force *F* is needed to support the wheelbarrow in the position shown?

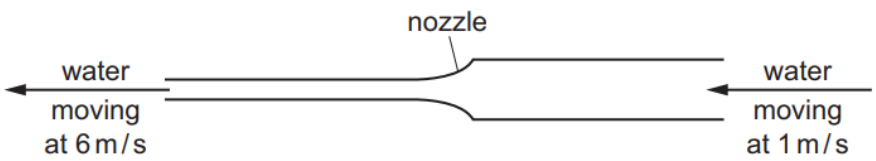
A 60 N **B** 80 N **C** 140 N **D** 245 N

77 A car is travelling around a circular track at a constant speed, as shown. **(extended only)**

In which direction is the resultant force on the car?



78 The diagram shows part of a hose used by a firefighter. **(extended only)**



NOT TO SCALE

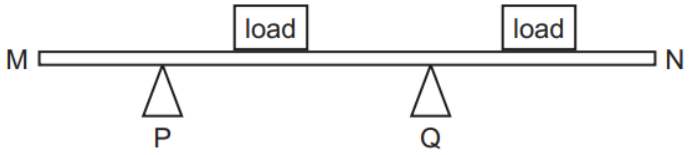
15 kg of water flows through the hose each second.

Which force is applied to the hose by the water?

A 15 N **B** 75 N **C** 90 N **D** 105 N

79 The diagram shows a metre rule MN on two supports, P and Q. **(extended only)**

Two loads are placed on the rule, as shown.



The rule rests steadily on the supports.

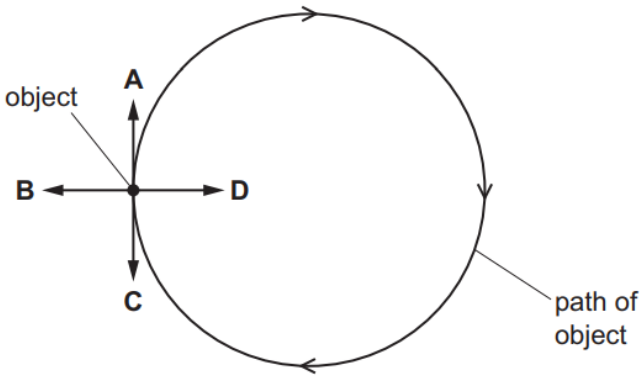
Which row is correct?

	total moment about M	total moment about N
A	is clockwise	is anticlockwise
B	is clockwise	is zero
C	is zero	is clockwise
D	is zero	is zero

80 The diagram shows an object moving at a constant speed in a circular path in the direction shown. **(extended only)**

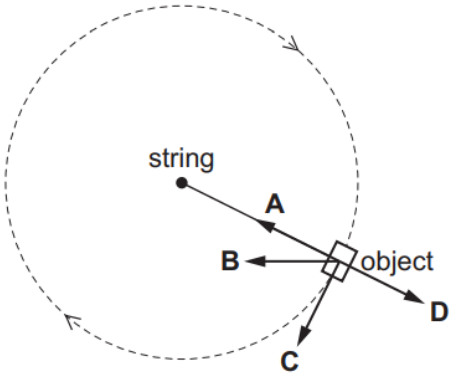
A force acts on the object to keep it in the circular path.

In which labelled direction does this force act, when the object is in the position shown?

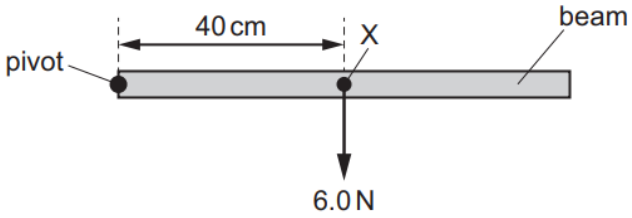


81 An object on the end of a string moves in a clockwise circular path at constant speed. The diagram shows the object as viewed from above. **(extended only)**

What is the direction of the resultant force on the object when it is in the position shown?



82 A beam is pivoted at one end, as shown.



The beam weighs 6.0 N and its weight acts at a point X 40 cm from the pivot.

A force of 4.0 N is applied to the beam causing it to balance horizontally.

In which direction and where is the 4.0 N force applied?

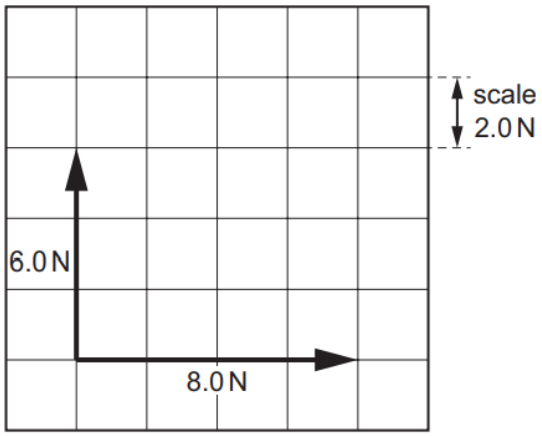
A vertically downwards at 20 cm to the left of X

B vertically downwards at 20 cm to the right of X

C vertically upwards at 20 cm to the left of X

D vertically upwards at 20 cm to the right of X

83 On the diagram shown, what is the magnitude of the resultant force of the two vectors? **(extended only)**



A 2.0 N **B** 7.0 N **C** 10 N **D** 14 N

84 An object moves at constant speed around a circular path. **(extended only)**

Which statement is correct?

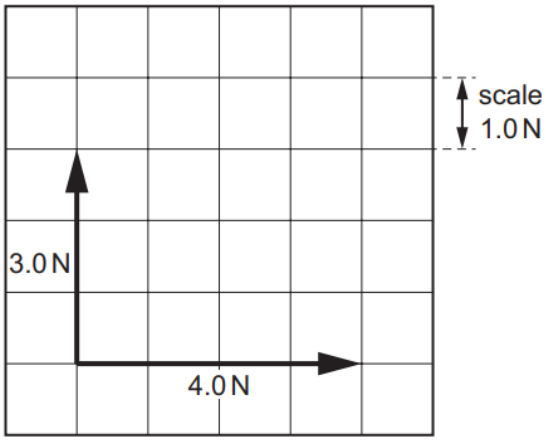
A A resultant force acts on the object outwards from the centre of the circle.

B A resultant force acts on the object in the direction it is travelling.

C A resultant force acts on the object towards the centre of the circle.

D There is no resultant force acting on the object because it is moving at constant speed.

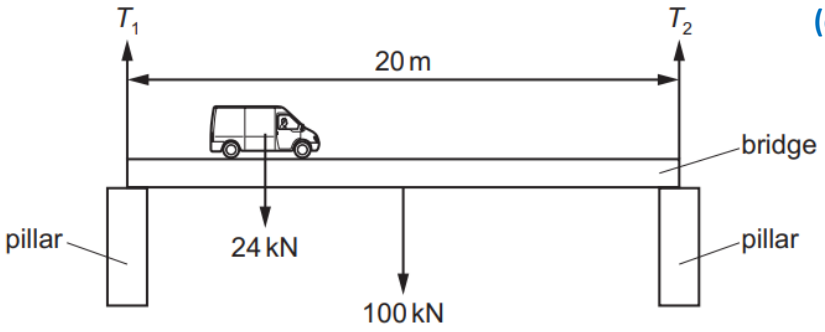
85 The diagram shows two forces acting at right angles to each other. **(extended only)**



What is the resultant of the two forces?

A 1.0 N **B** 5.0 N **C** 7.0 N **D** 12.0 N

86 A 20 m long, uniform bridge of weight 100 kN is supported at each end by pillars, as shown. **(extended only)**



The pillars exert forces T_1 and T_2 on the ends of the bridge.

What are the values of T_1 and T_2 when a van of weight 24 kN is on the bridge, 5 m from the left-hand pillar?

	T_1 / kN	T_2 / kN
A	56	68
B	62	62
C	68	56
D	74	50

87 A spring, which obeys Hooke's law, has an unstretched length of 10 cm. **(extended only)**

A load of 20 N is suspended from the spring.

The new length of the spring is 36 cm.

What is the spring constant k of the spring?

A 0.56 N / cm **B** 0.77 N / cm **C** 1.3 N / cm **D** 1.8 N / cm

88 Three simple machines are shown.

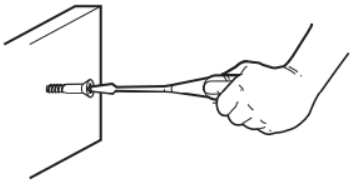
1

moving soil with a wheelbarrow

2

cutting string with scissors

3



screwing a screw with a screwdriver

Which machines are an application of the moment of a force?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

89 A rocket is launched upwards from the surface of the Moon. **(extended only)**

Hot gases are ejected downwards over a very short period of time.

Which statement is **not** correct?

A The rocket experiences a downward force.

B The rocket experiences an upward force.

C The total momentum of the hot gases is equal to the momentum of the rocket.

D The total momentum of the hot gases and rocket when the hot gases have been ejected is zero.

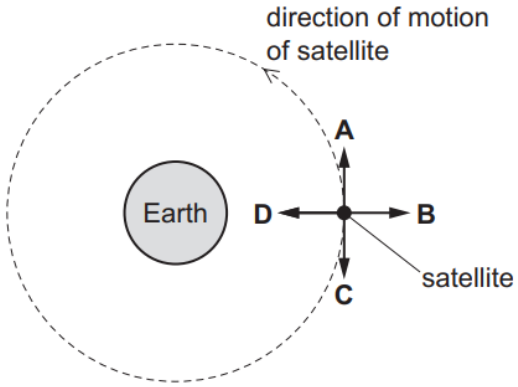
90 A cart has a mass of 10 kg. A boy pushes on the cart horizontally with a force of 50 N. The cart accelerates at 0.50 m/s^2. **(extended only)**

What is the frictional force acting on the cart?

A 5.0 N **B** 20 N **C** 30 N **D** 45 N

91 A satellite orbits the Earth in an anticlockwise direction at constant speed, as shown. **(extended only)**

When the satellite is in the position shown, in which direction does the resultant force act upon it?



92 A tennis ball has a mass of 57 g. **(extended only)**

A tennis player hits the tennis ball with a tennis racket. The tennis ball has a velocity of 25 m/s when it hits the racket.

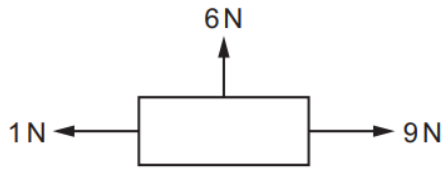
The velocity of the tennis ball when it leaves the player's racket is 15 m/s in the opposite direction from its approaching direction.

The average force exerted by the tennis racket on the ball is 35 N.

For how long is the tennis ball in contact with the tennis racket?

A 0.015 s **B** 0.016 s **C** 0.065 s **D** 0.65 s

93 The diagram shows three forces acting on an object. **(extended only)**

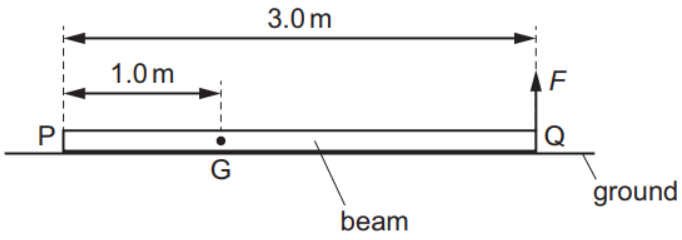


What is the value of the resultant force acting on the object?

A 2 N **B** 10 N **C** 14 N **D** 16 N

94 The diagram shows a beam lying on the ground. End Q is lifted from the ground by the force *F*.

End P of the beam remains on the ground.



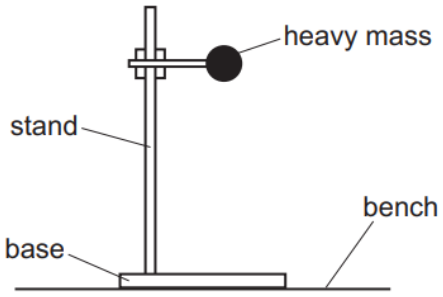
The length of the beam is 3.0 m and its weight is 600 N.

The centre of mass of the beam at G is 1.0 m from end P.

What is the size of the force *F* when it just raises end Q from the ground?

A 200 N **B** 300 N **C** 400 N **D** 600 N

95 The diagram shows a stand. The stand holds a heavy mass above the bench.



Which two changes would definitely make the stand more stable?

A Lower the mass and make the base narrower.

B Lower the mass and make the base wider.

C Raise the mass and make the base narrower.

D Raise the mass and make the base wider.

96 A footballer kicks a stationary football. **(extended only)**

His foot is in contact with the ball for 0.050 s.

The mass of the ball is 0.40 kg.

The speed of projection of the ball is 25 m / s.

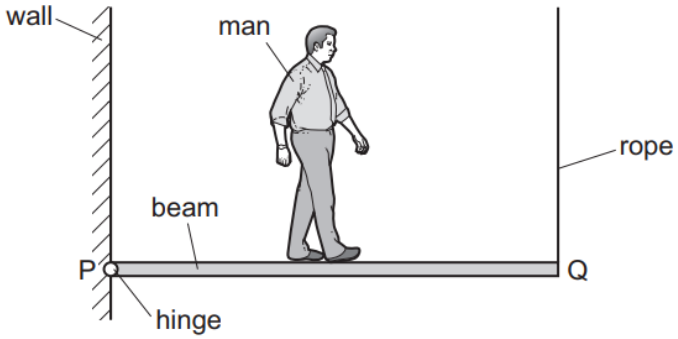
What is the average force exerted on the ball by his foot?

A 0.32 N **B** 0.50 N **C** 200 N **D** 1300 N

97 The diagram shows a wooden beam PQ, of negligible weight, which is attached to a wall by a hinge at P and kept in a horizontal position by a vertical rope attached at Q.

The beam is 3.0 m in length.

A man of weight 800 N walks along the beam from P to Q.



What is the distance of the man from P when the tension in the rope at Q becomes equal to 500 N?

A 0.53 m **B** 1.1 m **C** 1.9 m **D** 2.5 m

98 A satellite orbits the Earth at constant speed in a circular orbit. **(extended only)**

Which statement is correct?

A The resultant force on the satellite is zero.

B The resultant force on the satellite is towards the Earth.

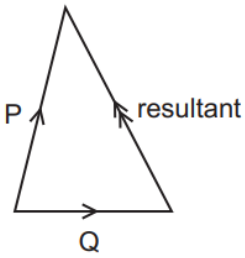
C The resultant force on the satellite is away from the Earth.

D The resultant force on the satellite is in the direction of motion.

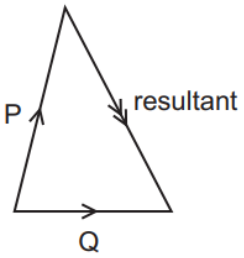
99 Two forces P and Q act on an object. **(extended only)**

Which diagram shows the resultant of these two forces?

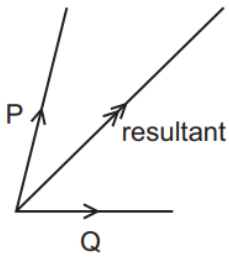
A



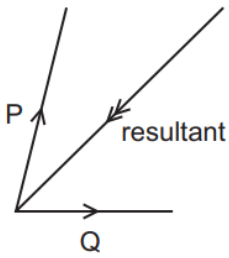
B



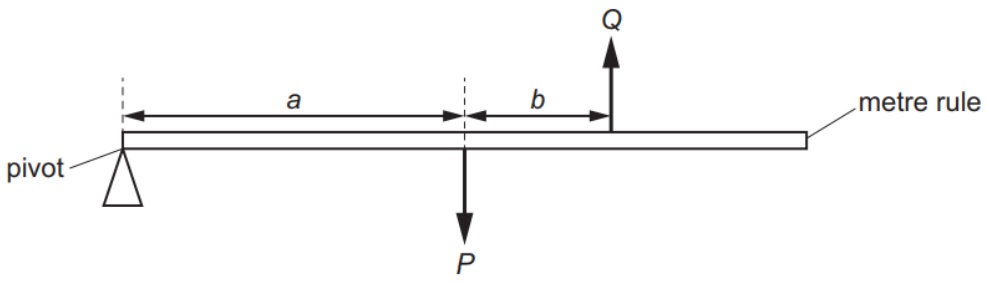
C



D



100 Two forces *P* and *Q* act on a metre rule as shown. The metre rule is pivoted at one end. The rule starts to rotate in a clockwise direction.



Which statement is correct?

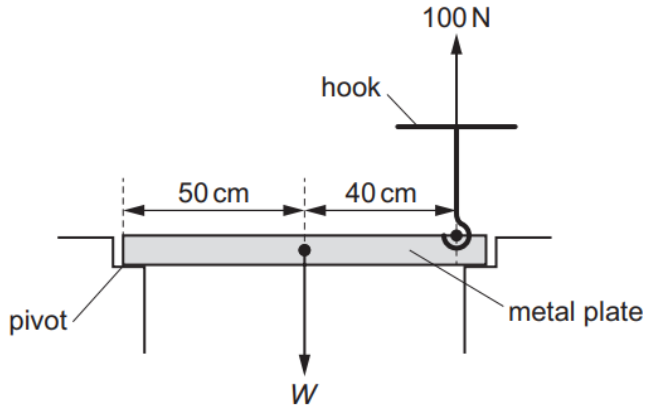
A *P* equals *Q*

B *P* is less than *Q*

C $(P \times a)$ is equal to $(Q \times b)$

D $(P \times a)$ is greater than $(Q \times (a + b))$

101 A hook is used to lift a metal plate, as shown.



An upward force of 100 N is needed to lift the metal plate about the pivot, as shown.

What is the weight *W* of the metal plate?

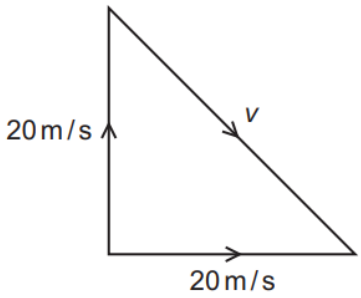
A 80 N **B** 100 N **C** 180 N **D** 225 N

102 A ship travels due North through still water at a speed of 20 m/s. **(extended only)**

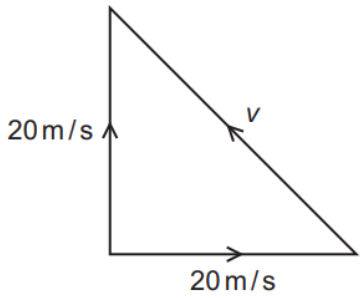
It enters a channel where there is a current in the water from West to East. The speed of the current is 20 m/s.

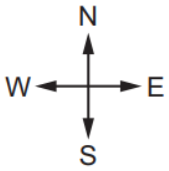
Which diagram shows the resultant velocity *v* of the ship?

A

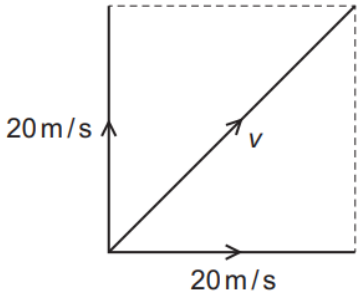


B

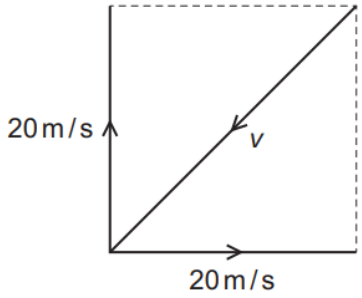




C



D



103 A student wishes to determine the spring constant of a spring where it obeys Hooke's law.

Different loads are hung from the spring and its length is measured for each different load.

The table shows the results of the experiment. **(extended only)**

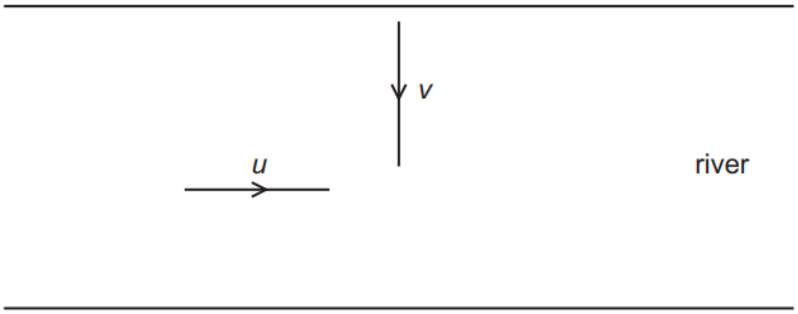
weight of load / N	0	2.0	4.0	5.0
length of spring / cm	12	20	28	38

What is the value of the spring constant of the spring?

A 0.13 N/cm **B** 0.14 N/cm **C** 0.19 N/cm **D** 0.25 N/cm

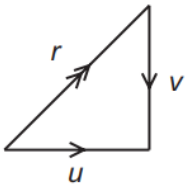
104 A boat starts moving across a river at velocity *v* perpendicular to the river bank. **(extended only)**

The boat encounters a current along the river of velocity *u*, as shown.

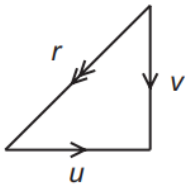


Which vector diagram shows the resultant velocity *r* of the boat?

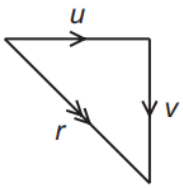
A



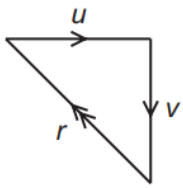
B



C



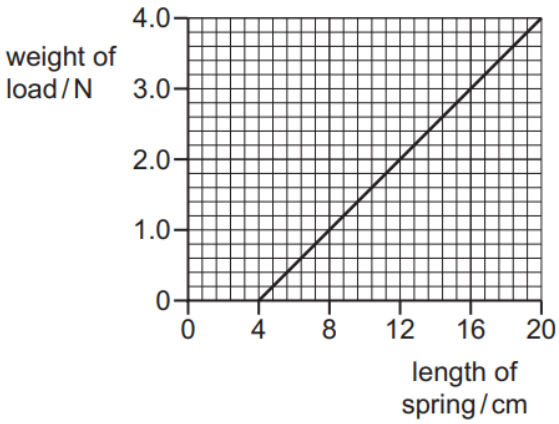
D



105 An experiment is done to determine the spring constant for a spring. **(extended only)**

Different loads are hung from the spring and its length is measured for each different load.

The graph shows how its length varies with load.

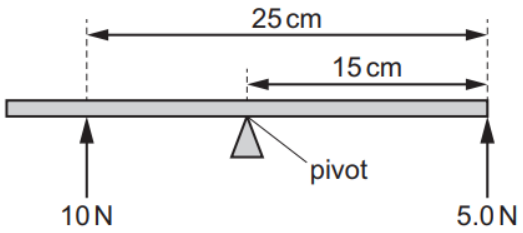


What is the value of the spring constant?

A 0.20 N / cm **B** 0.25 N / cm **C** 4.0 N / cm **D** 5.0 N / cm

106 A beam is pivoted at its centre of mass.

It is acted upon by two forces, 10 N and 5.0 N, as shown.



What is the resultant moment about the pivot?

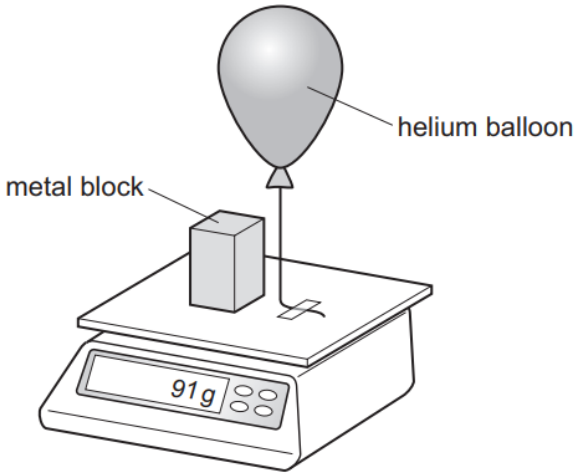
A 25 N cm anticlockwise

B 25 N cm clockwise

C 175 N cm anticlockwise

D 175 N cm clockwise

107 A helium balloon is tied to a top-pan balance. A metal block of mass 100 g is placed on the balance. The reading on the balance is 91 g.



Which statement can be deduced from this experiment?

A The balloon exerts a downward force of 0.09 N on the top-pan balance.

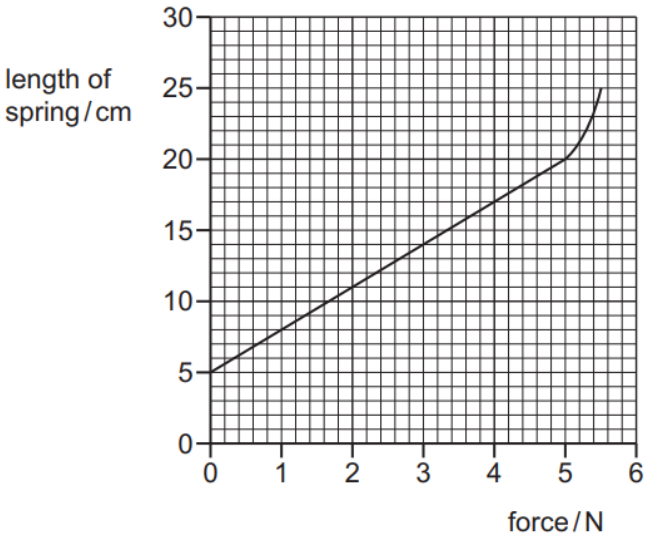
B The helium has a mass of –9 g.

C The helium has a mass of +9 g.

D The resultant downward force on the top-pan balance is 0.91 N.

108 The graph shows how the length of a spring changes when the stretching force is increased.

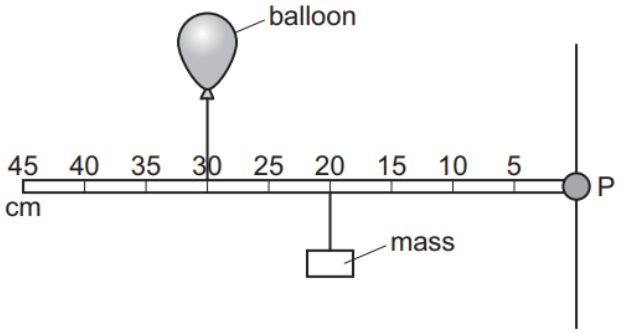
(extended only)



In the Hooke's law region, what is the spring constant for this spring?

A 0.20 N / cm **B** 0.22 N / cm **C** 0.28 N / cm **D** 0.33 N / cm

109 A balloon and a mass are attached to a rod that is pivoted at P.



The balloon is filled with helium, a gas less dense than air, so that it applies an upward force on the rod.

The rod is horizontal and stationary.

Which action causes the rod to rotate clockwise?

A Move both the balloon and mass 10 cm to the left.

B Move both the balloon and mass 10 cm to the right.

C Move both the balloon and mass to the 25 cm mark.

D Move the balloon to the 20 cm mark and the mass to the 30 cm mark.

110 An object decelerates from 25.0 m/s to 5.0 m/s in a time of 4.0 s. **(extended only)**

It has a mass of 50 kg.

What is the resultant force on the object?

A 0.63 N **B** 10 N **C** 250 N **D** 4000 N