1 **(a)** Fig. 4.1 shows a top view of a tourist vehicle in a game park and two elephants pushing against the vehicle. The two forces indicated are at right angles to each other.

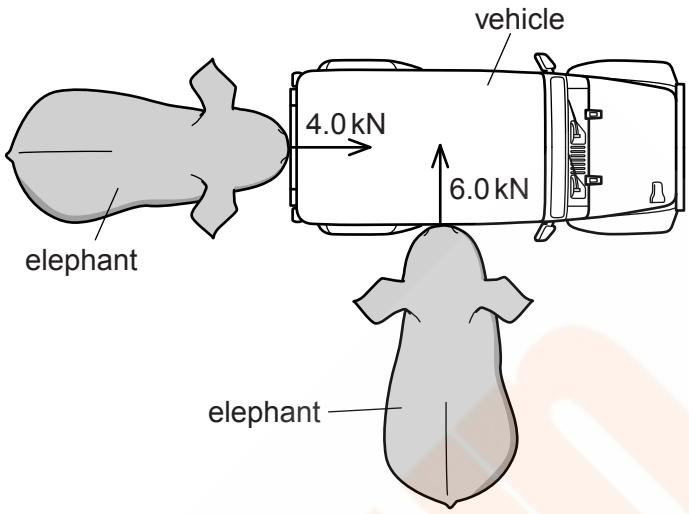


Fig. 4.1

In the space below, draw a scale vector diagram to determine the magnitude of the resultant force. Label the two forces applied and the resultant, and clearly state the scale you use.

magnitude of resultant force = ...[3]

(b) Fig. 4.2 shows another elephant pushing horizontally against a vehicle with a force of 11 kN at a distance 1.8 m above the ground. Point M is the centre of mass of the vehicle.

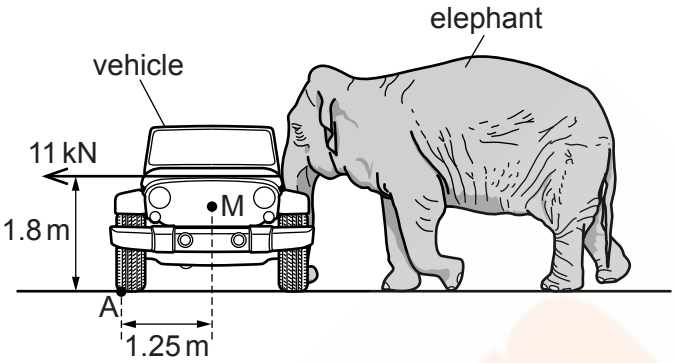


Fig. 4.2

(i) Calculate the moment about point A of the force exerted by the elephant.

moment = ...[2]

(ii) The mass of the vehicle is 1900 kg, and it does not slide when pushed by the elephant.

Determine whether the elephant tips the vehicle over. Show your working.

calculation

conclusion .....[2]

[Total: 7]

2 **(a)** Complete the following statement.

An object is in equilibrium when both the ..... and the

..... on the object are zero. [2]

(b) Fig. 3.1 shows a ladder AB. End A of the ladder rests against a vertical wall. End B rests on rough ground.

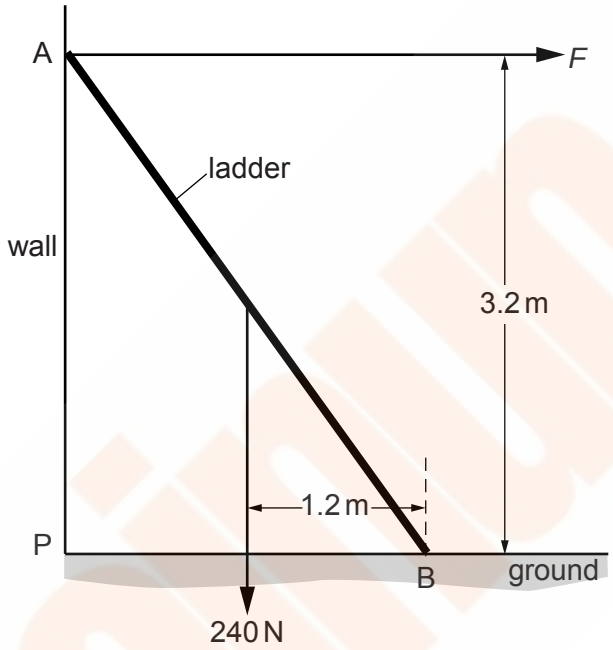


Fig. 3.1

Fig. 3.1 shows two of the forces acting on the ladder. The only force on the ladder at A is *F*, which acts at right-angles to the wall. The weight of the ladder is 240 N acting at the centre of mass of the ladder.

(i) **1.** Calculate the moment of the weight of the ladder about point B.

moment = ... [1]

2. Write an expression, in terms of *F*, for the moment of *F* about point B.

moment = ... [1]

(ii) Use your answers from **(i)** to calculate *F*.

F = ... [2]

(iii) Explain why there must be an upwards force acting on the ladder at B.

.....

..... [1]

[Total: 7]

3 A metre rule balances when the 50 cm mark is directly above a pivot.

(a) State where in the rule its centre of mass is located.

.....

..... [1]

(b) Fig. 3.1 shows an apple and a 0.40 N weight placed on the rule so that the rule remains balanced at the 50 cm mark.

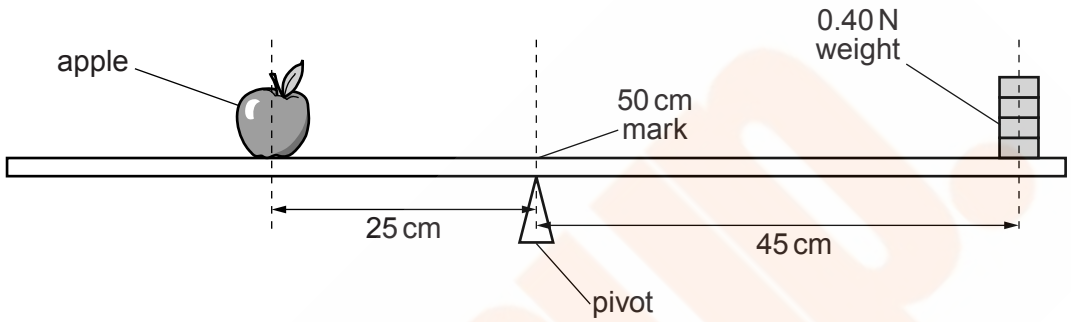


Fig. 3.1 (not to scale)

The centre of mass of the apple is 25 cm from the pivot and the centre of mass of the weight is 45 cm from the pivot.

Calculate

(i) the weight of the apple,

weight = ... [2]

(ii) the mass of the apple.

mass = ... [1]

(c) The apple is not moved. The weight is removed from the rule and the pivot is moved to the left until the rule balances as shown in Fig. 3.2.

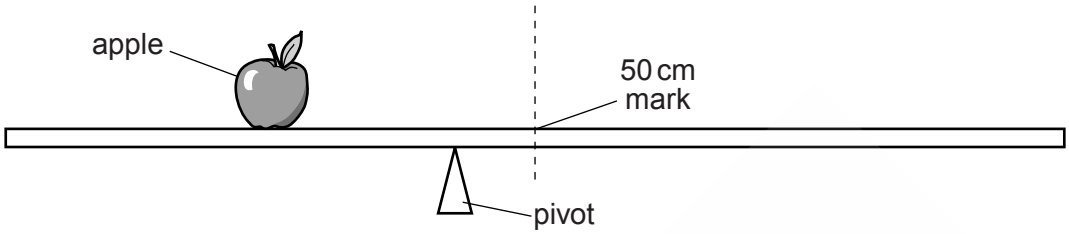


Fig. 3.2 (not to scale)

(i) Explain why the arrangement in Fig. 3.2 balances.

.....

.....

..... [2]

(ii) The pivot in Fig. 3.2 is closer to the 50 cm mark than to the centre of mass of the apple.

Compare the weight of the rule to the weight of the apple.

.....

..... [1]

[Total: 7]

4 **(a)** State the two conditions necessary for a system of forces acting on a body to be in equilibrium.

1. .....

.....

2. .....

.....

[2]

(b) Fig. 1.1 shows a loaded wheelbarrow held in equilibrium by a gardener. The wheel of the wheelbarrow is in contact with the ground at point C.

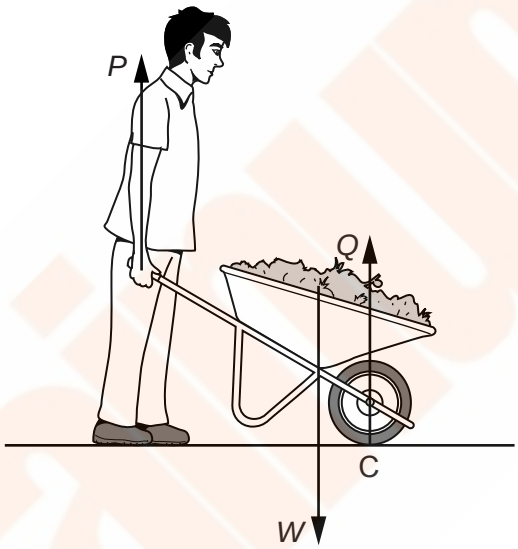


Fig. 1.1

In Fig. 1.1, there are three vertical forces acting on the wheelbarrow.

P is the upward force applied by the gardener.
Q is the upward force of the ground on the wheel at point C.
W is the weight of the wheelbarrow and its contents.

Explain why the force *P* is less than the force *W*

(i) by considering the forces *P*, *Q* and *W*,

.....

..... [2]

(ii) by considering the moments of the forces *P* and *W* about point C.

.....

..... [2]

(c) Fig. 1.2 shows a kitchen cupboard resting on a support and attached to a wall by a screw.

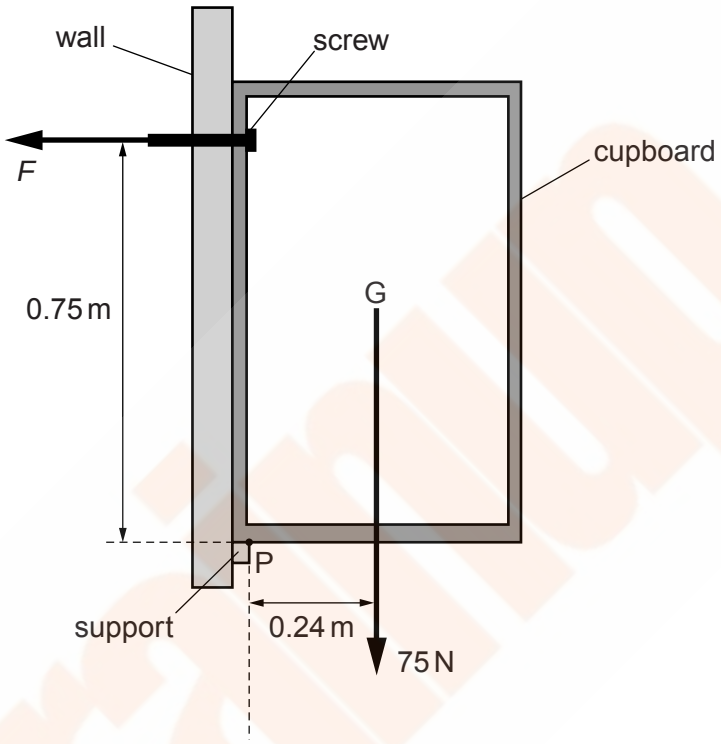


Fig. 1.2

The weight of the cupboard and its contents is 75 N. G is the position of the centre of mass of the cupboard.

The clockwise and anticlockwise moments about point P are equal.

Calculate the force *F* exerted by the screw.

F = ... [3]

[Total: 9]

5 Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.

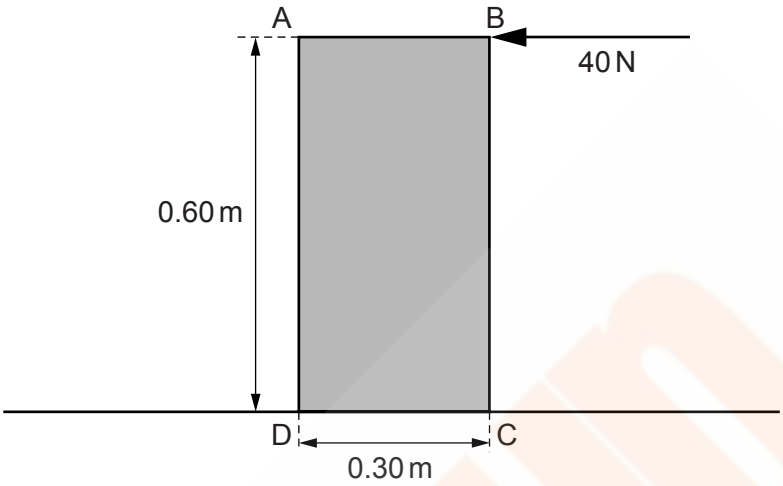


Fig. 2.1

(a) (i) Calculate the weight *W* of the concrete slab.

W = ... [1]

(ii) The thickness of the slab is 0.040 m.

Calculate the pressure exerted by the slab on the ground.

pressure = ... [2]

(b) **(i)** On Fig. 2.1, draw and label an arrow to show the weight *W* of the slab acting at its centre of mass. [1]

(ii) Calculate

1. the moment of the 40 N force about point D,

moment = ...

2. the moment of *W* about point D.

moment = ...
[3]

(iii) The ground is rough so that the slab does not slide.

State and explain what happens to the slab as the horizontal force at B is gradually increased.

.....

.....

.....[2]

[Total: 9]

6 A large crane has a mass of 8500 kg. Fig. 4.1 shows the crane on a muddy building-site.

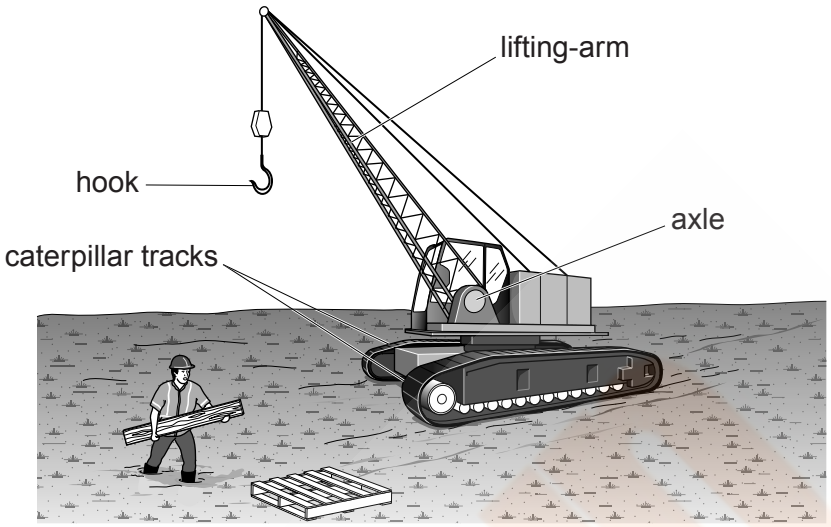


Fig. 4.1

(a) Calculate the weight of the crane.

weight = ... [1]

(b) The crane rests on two caterpillar tracks each of which has a contact area with the ground of 3.4 m^2.

(i) Calculate the pressure that the crane exerts on the ground.

pressure = ... [2]

(ii) As the crane driver walks towards the crane, he starts to sink into the mud. He lays a wide plank of wood on the mud and he walks along the plank.

Explain why he does not sink into the mud when he walks along the plank.

.....

.....

..... [2]

(c) When the crane lifts a heavy load with its hook, the load exerts a moment on the lifting-arm about the axle.

(i) Explain what is meant by *moment* of a force.

.....

..... [1]

(ii) Despite the moment exerted on the lifting-arm, the crane remains in equilibrium.

State the two conditions required for any object to be in equilibrium.

1. .....

2. .....

[2]

[Total: 8]

7 **(a)** **(i)** Write down the names of **three** man-made devices in everyday use that depend, for their action, upon the moments of forces.

1. .....

2. .....

3. .....

[2]

(ii) Fig. 3.1 shows a uniform rod AB acted upon by three equal forces *F*.

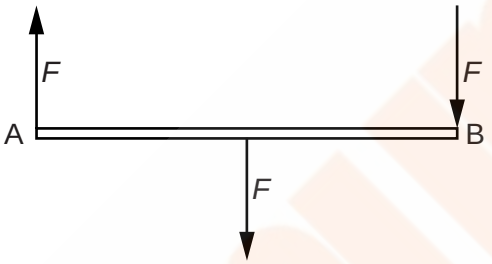


Fig. 3.1

State **two** reasons why the rod is **not** in equilibrium.

1. .....

2. .....

[2]

(b) Fig. 3.2 shows a uniform rod PQ, supported at its centre and held in a horizontal position. The length of PQ is 1.00 m.

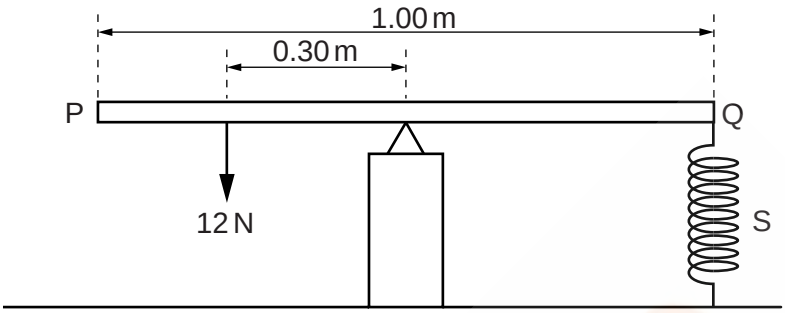


Fig. 3.2

A force of 12 N acts at a distance of 0.30 m from the support. A spring S, fixed at its lower end, is attached to the rod at Q.

(i) Calculate the force exerted on PQ by the spring.

force = ... [2]

(ii) Explain why it is not necessary to know the weight of PQ.

.....

..... [1]

[Total: 7]

1 Fig. 3.1 shows an early water-powered device used to raise a heavy load. The heavy load rests on piston B.

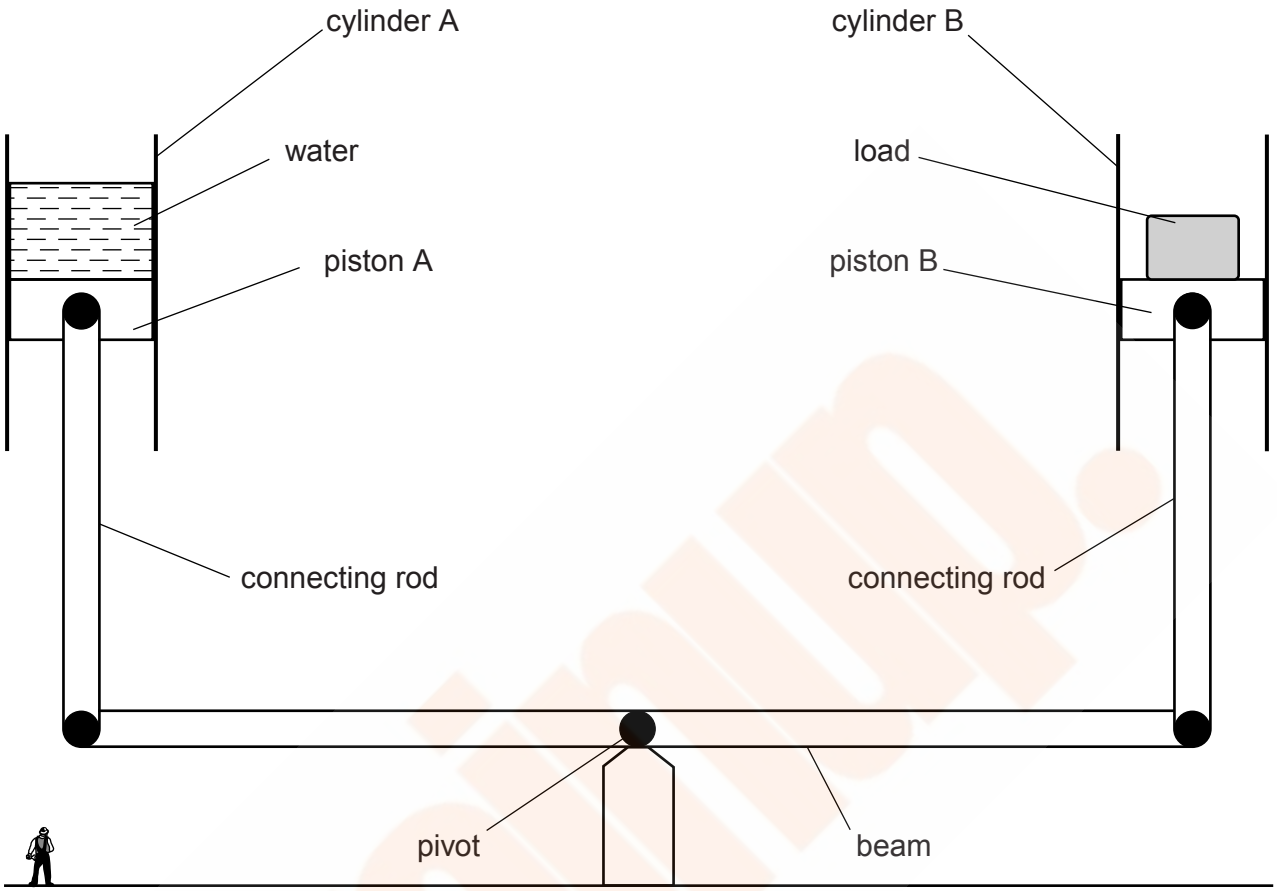


Fig. 3.1 (not to scale)

Initially, a large weight of water in cylinder A pushes piston A down. This causes the left-hand end of the beam to move down and the right-hand end of the beam to move up. Piston B rises, lifting the heavy load.

(a) The weight of water in cylinder A is 80 kN.

Calculate the mass of water in cylinder A.

mass = ... [2]

(b) The density of water is 1000 kg / m^3.

Calculate the volume of water in cylinder A.

volume = ... [2]

(c) Piston A moves down a distance of 4.0 m.

Calculate the gravitational potential energy lost by the water.

loss of gravitational potential energy = ... [2]

(d) The heavy load lifted by piston B gains 96 kJ of gravitational potential energy.

Calculate the efficiency of the device.

efficiency = ... [2]

[Total: 8]

2 **(a)** A water tank has a rectangular base of dimensions 1.5 m by 1.2 m and contains 1440 kg of water.

Calculate

(i) the weight of the water,

weight = ... [1]

(ii) the pressure exerted by the water on the base of the tank.

pressure = ... [2]

(b) Fig. 5.1 shows two water tanks **P** and **Q** of different shape. Both tanks are circular when viewed from above. The tanks each contain the same volume of water. The depth of water in both tanks is 1.4 m.

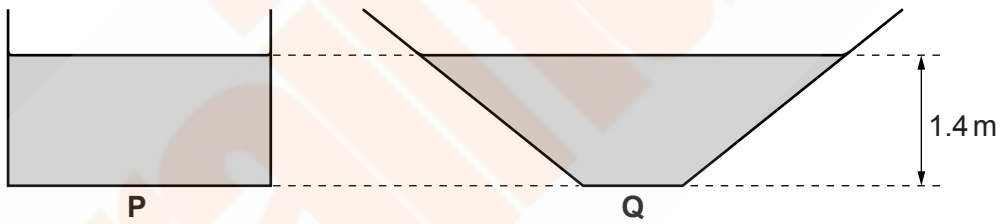


Fig. 5.1

(i) The density of water is 1000 kg / m^3. The pressures exerted by the water on the base of the two tanks are equal.

Calculate this pressure.

pressure = ... [2]

(ii) Equal small volumes of water are removed from each tank.

State which tank, **P** or **Q**, now has the greater water pressure on its base. Explain your answer.

.....

.....

..... [2]

[Total: 7]

3 Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.

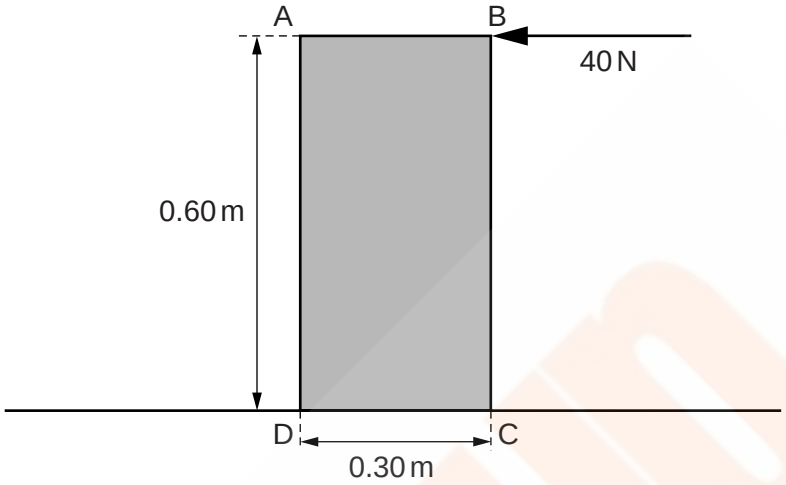


Fig. 2.1

(a) (i) Calculate the weight *W* of the concrete slab.

W = ... [1]

(ii) The thickness of the slab is 0.040 m.

Calculate the pressure exerted by the slab on the ground.

pressure = ... [2]

(b) **(i)** On Fig. 2.1, draw and label an arrow to show the weight *W* of the slab acting at its centre of mass. [1]

(ii) Calculate

1. the moment of the 40 N force about point D,

moment = ...

2. the moment of *W* about point D.

moment = ...
[3]

(iii) The ground is rough so that the slab does not slide.

State and explain what happens to the slab as the horizontal force at B is gradually increased.

.....

.....

.....[2]

[Total: 9]

4 A large crane has a mass of 8500 kg. Fig. 4.1 shows the crane on a muddy building-site.

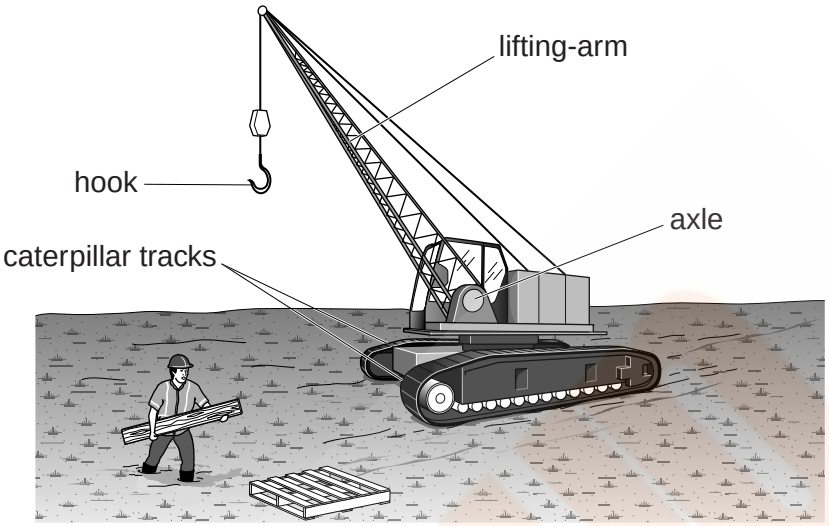


Fig. 4.1

(a) Calculate the weight of the crane.

weight = ... [1]

(b) The crane rests on two caterpillar tracks each of which has a contact area with the ground of 3.4 m^2.

(i) Calculate the pressure that the crane exerts on the ground.

pressure = ... [2]

(ii) As the crane driver walks towards the crane, he starts to sink into the mud. He lays a wide plank of wood on the mud and he walks along the plank.

Explain why he does not sink into the mud when he walks along the plank.

.....

.....

..... [2]

(c) When the crane lifts a heavy load with its hook, the load exerts a moment on the lifting-arm about the axle.

(i) Explain what is meant by *moment* of a force.

.....

..... [1]

(ii) Despite the moment exerted on the lifting-arm, the crane remains in equilibrium.

State the two conditions required for any object to be in equilibrium.

1. .....

2. .....

[2]

[Total: 8]

5 Fig. 2.1 shows a mobile bird sculpture that has been created by an artist.

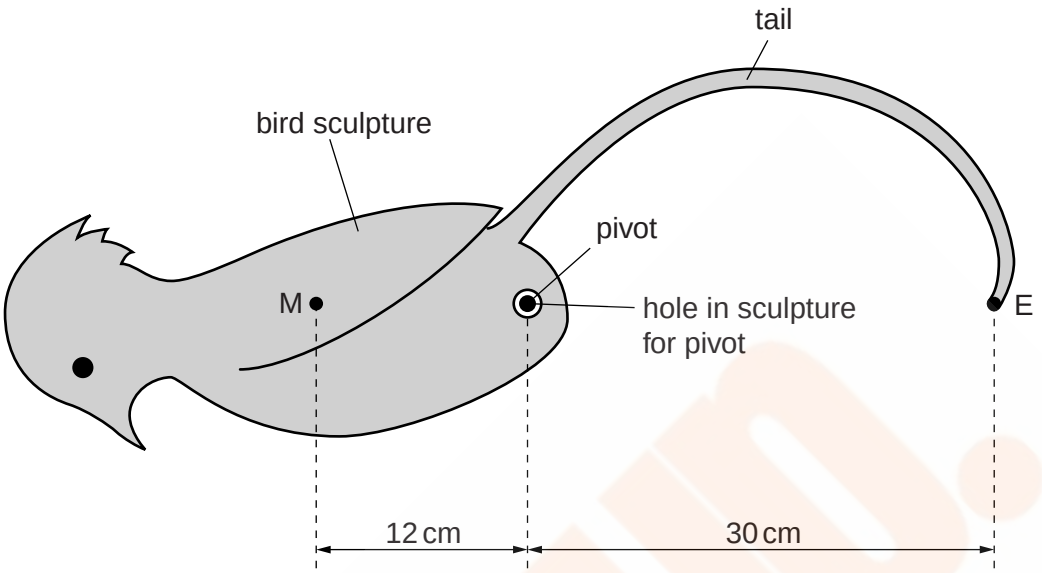


Fig. 2.1

M is the centre of mass of the bird sculpture, including its tail (but not including the counter-weight that will be added later). The mass of the bird and tail is 1.5 kg.

The bird sculpture is placed on a pivot.

The artist adds the counter-weight at the end E of the tail so that the bird remains stationary in the position shown.

(a) Calculate the mass of the counter-weight.

mass = ... [2]

(b) The centre of mass of the sculpture with counter-weight is at the pivot.

Calculate the upward force acting at the pivot.

force = ... [1]

(c) The sculpture is rotated clockwise to the position shown in Fig. 2.2. It is held still, then carefully released.

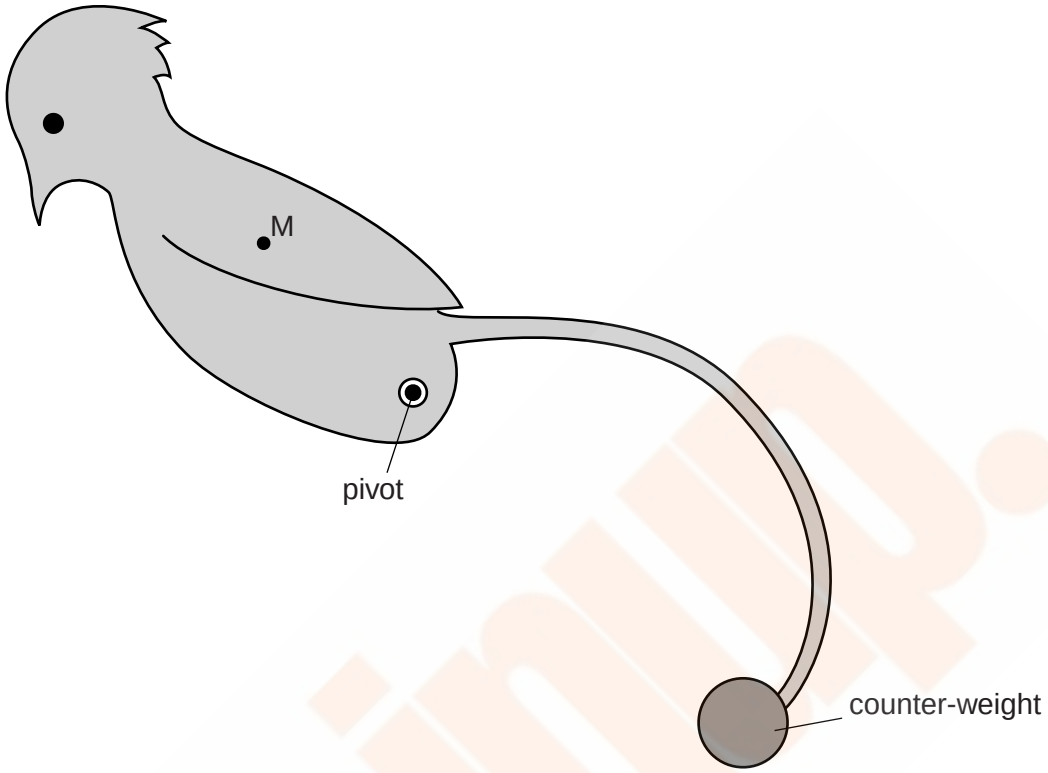


Fig. 2.2

(i) State whether the sculpture will stay in that position, rotate further clockwise or rotate back anticlockwise.

.....

.....

(ii) Explain your answer to **(i)**.

.....

.....

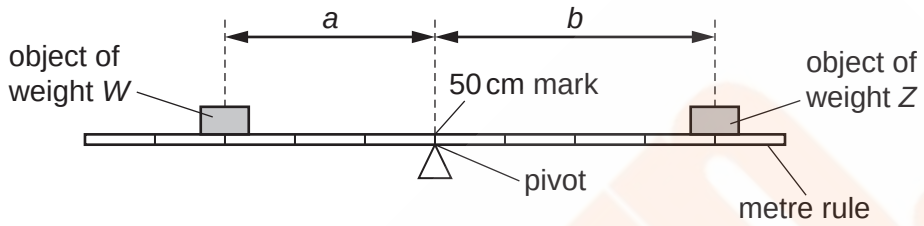
.....

.....

[3]

[Total: 6]

1 The diagram shows an object of weight *W* and an object of weight *Z* balanced on a uniform metre rule.



Which equation relating to *W*, *Z*, *a* and *b* is correct?

A $\frac{W}{a} \quad \frac{Z}{b}$

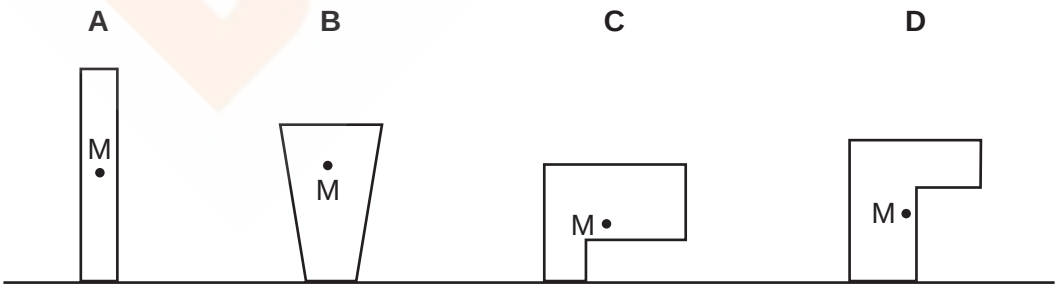
B $W \times Z = a \times b$

C $W \times a = Z \times b$

D $W \times (a + b) = Z$

2 The diagrams show four objects **A**, **B**, **C** and **D**. The centre of mass M of each object is marked on the diagrams.

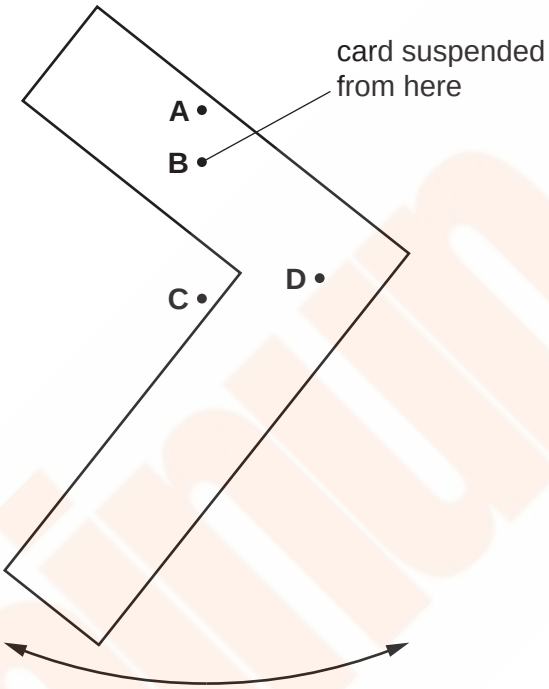
Which object is **not** in equilibrium?



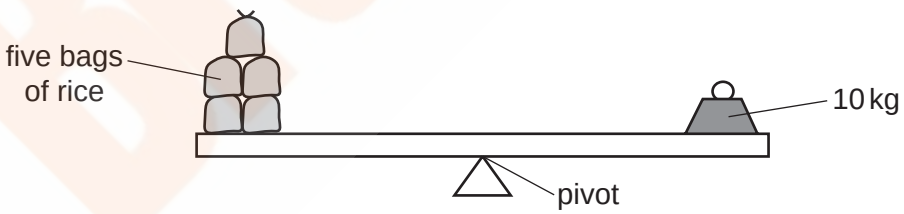
3 The diagram shows an L-shaped piece of card suspended freely from a pin at **B**.

When the card is pushed, it swings and then comes to a stop in the position shown.

At which labelled point is the centre of mass of the card?



4 Five identical bags of rice are balanced on a uniform beam by an object of mass 10 kg.

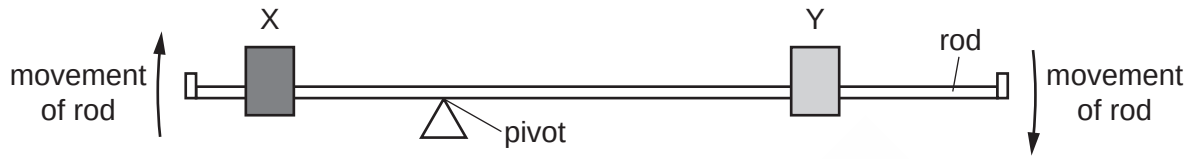


Two more identical bags of rice are added to the other five. The average position of the bags on the beam does not change.

What mass now balances the bags?

A 3.5 kg **B** 7.0 kg **C** 12 kg **D** 14 kg

5 The diagram shows an unbalanced rod. Two loads X and Y can be moved along the rod.



The rod turns in a clockwise direction as shown.

Which action could make the rod balance?

A moving X to the left

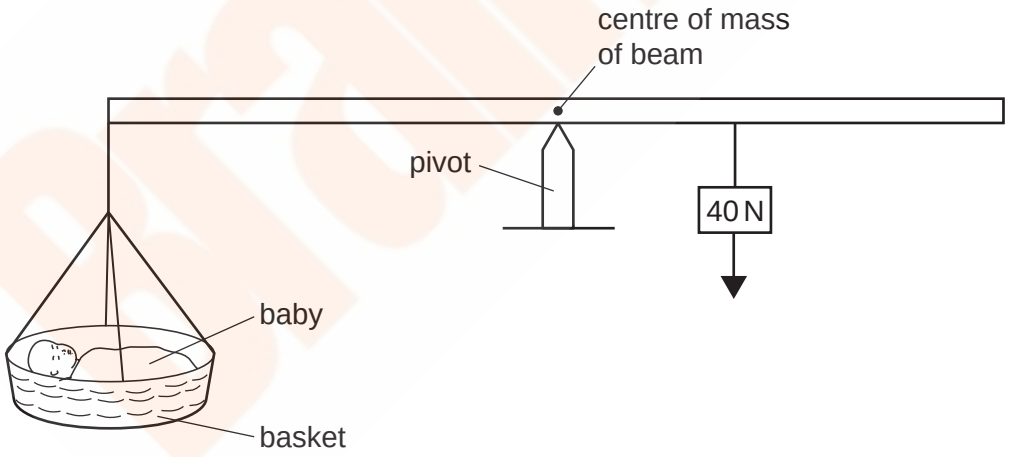
B moving X to the right

C moving Y to the right

D moving the pivot to the left

6 The diagram shows a balance being used to find the weight of a baby. The weight of the basket can be ignored.

At equilibrium, the pivot is nearer to the 40 N balancing weight than to the baby.



What is the weight of the baby?

A less than 40 N

B 40 N

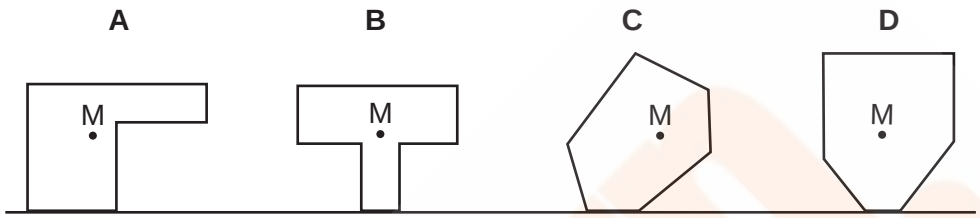
C more than 40 N

D impossible to tell without a scale on the beam

7 The diagram shows four objects on a flat surface.

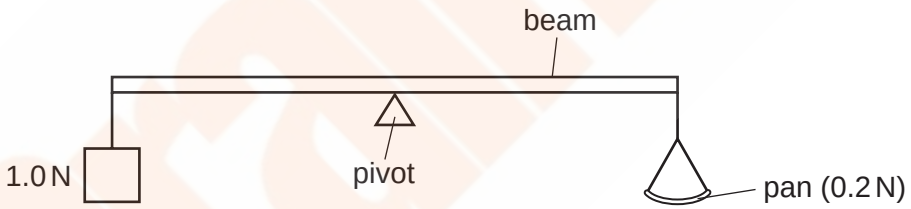
The centre of mass of each object is marked M.

Which object is about to fall over?



8 The diagram shows a uniform beam being used as a balance. The beam is pivoted at its centre.

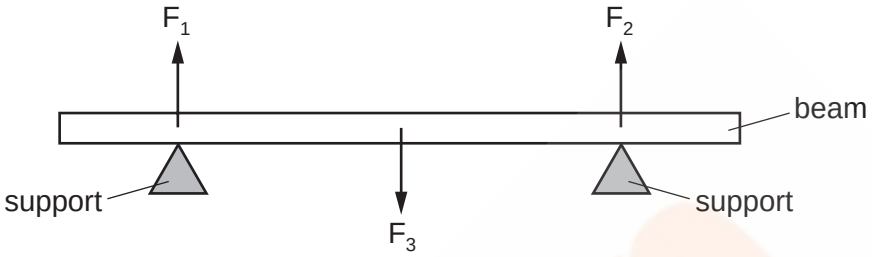
A 1.0 N weight is attached to one end of the beam. An empty pan weighing 0.2 N is attached to the other end of the beam.



How many 0.1 N weights must be placed on the pan in order to balance the beam?

A 5 **B** 8 **C** 10 **D** 12

9 A heavy beam rests on two supports. The diagram shows the only three forces F_1, F_2 and F_3 acting on the beam.



The beam is in equilibrium.

Which statement is correct?

A All the forces are equal in size.

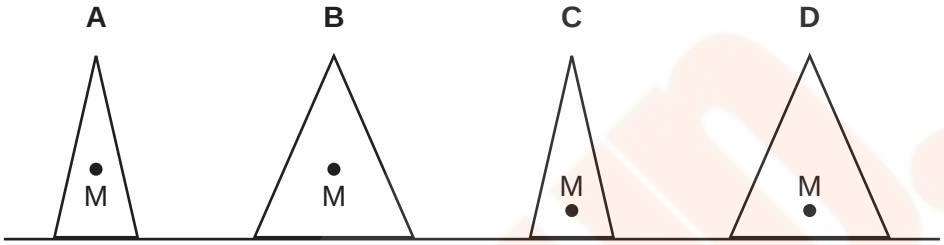
B The resultant force on the beam is in the opposite direction to the resultant turning effect.

C The resultant force on the beam is zero and the resultant turning effect on the beam is zero.

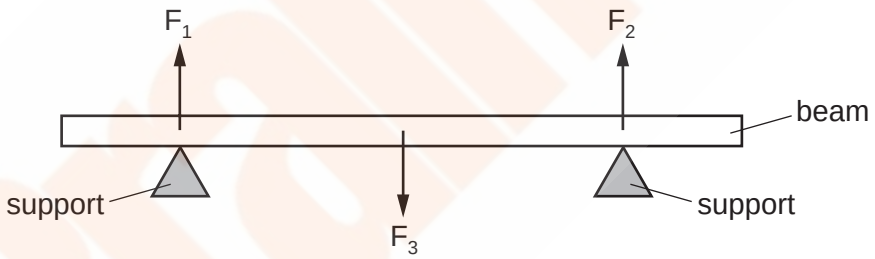
D The total upward force is twice the total downward force.

10 The diagrams show four solid cones. The centre of mass of each cone is marked by a point labelled M.

Which cone is the most stable?



11 A heavy beam rests on two supports. The diagram shows the only three forces F_1, F_2 and F_3 acting on the beam.



The beam is in equilibrium.

Which statement is correct?

A All the forces are equal in size.

B The resultant force on the beam is in the opposite direction to the resultant turning effect.

C The resultant force on the beam is zero and the resultant turning effect on the beam is zero.

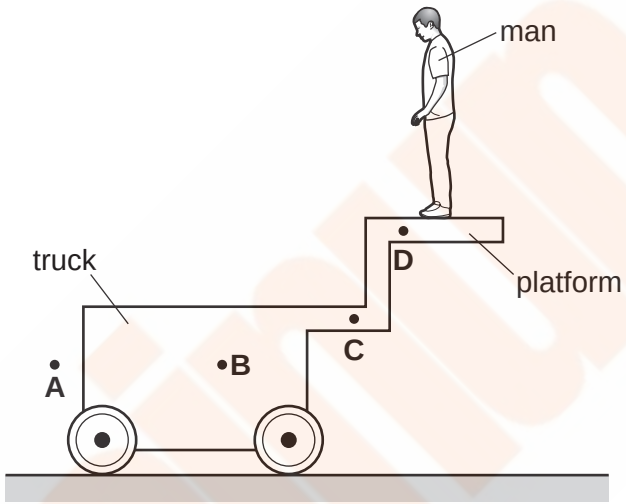
D The total upward force is twice the total downward force.

12 A heavy truck on wheels has a platform attached to it.

A man stands on the platform.

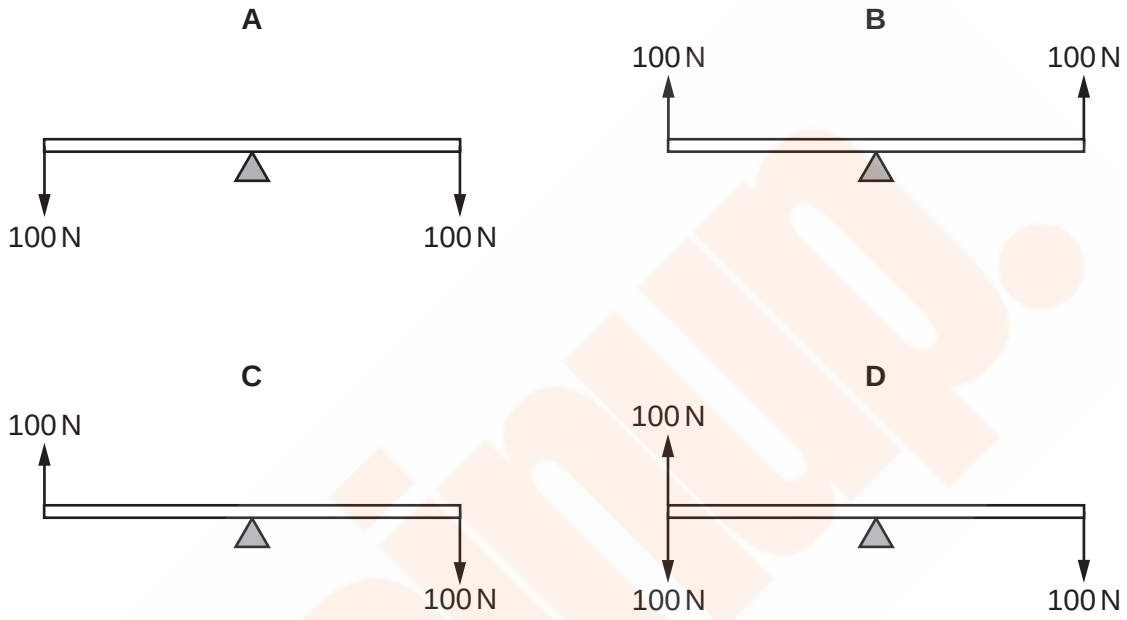
The truck does not fall over.

Which position **A**, **B**, **C** or **D** could be the centre of mass of the whole system (truck, platform and man)?



13 A uniform rod rests on a pivot at its centre. The rod is not attached to the pivot. Forces are then applied to the rod in four different ways, as shown. The weight of the rod can be ignored.

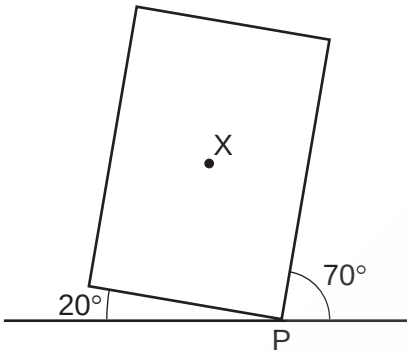
Which diagram shows the rod in equilibrium?



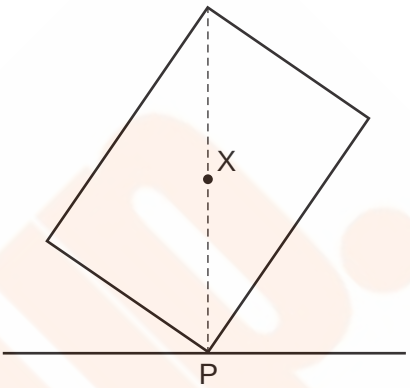
14 A plane lamina with centre of mass X touches the ground at point P.

Which diagram shows the lamina in equilibrium?

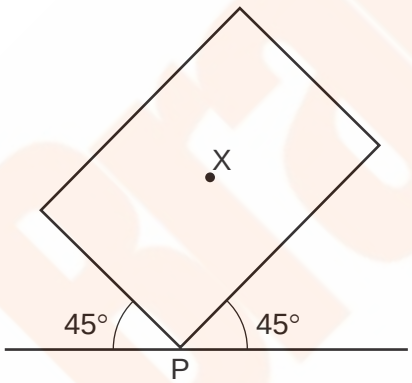
A



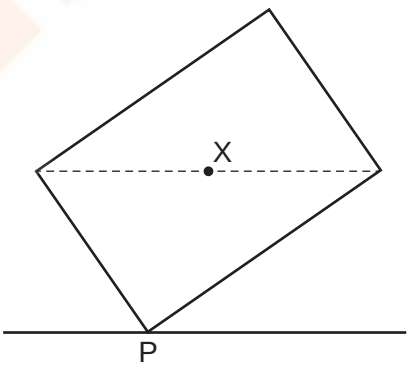
B



C

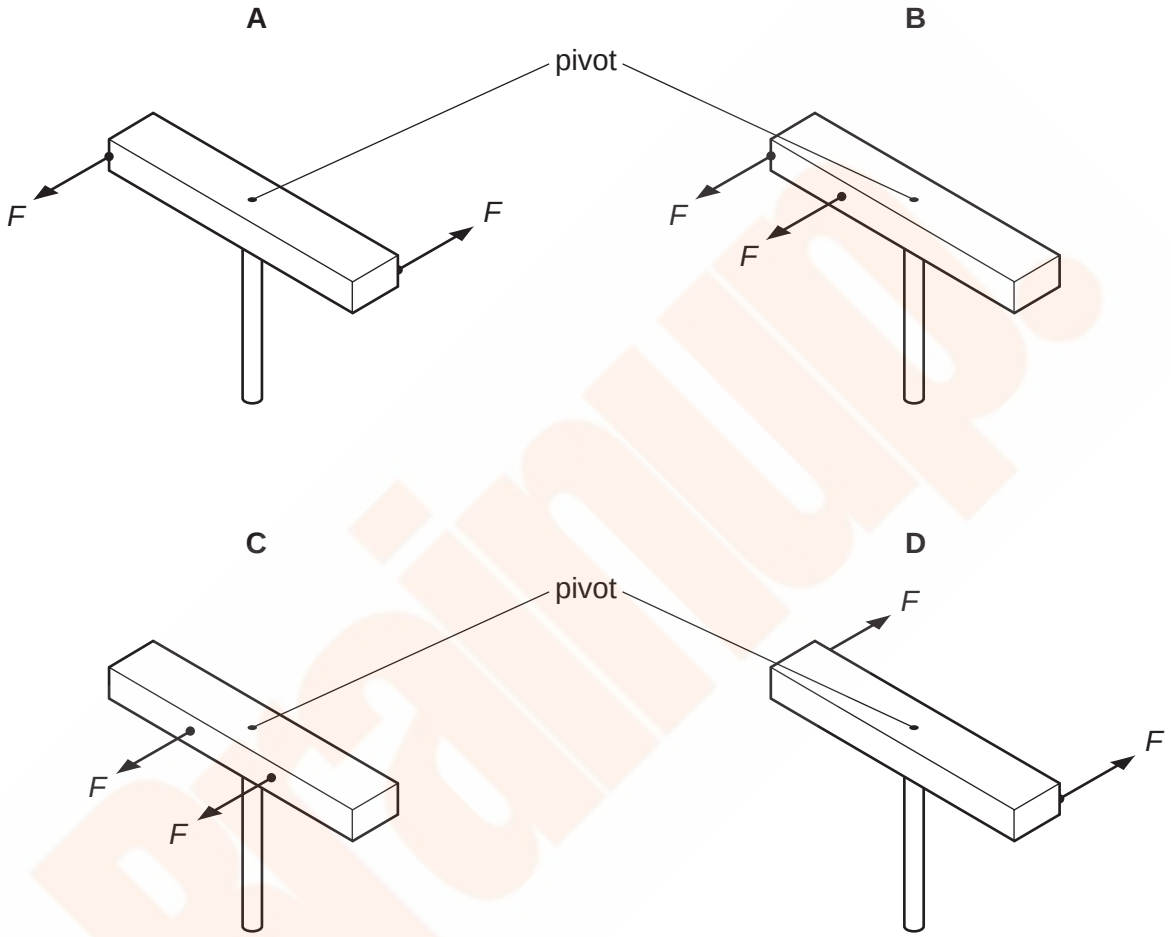


D

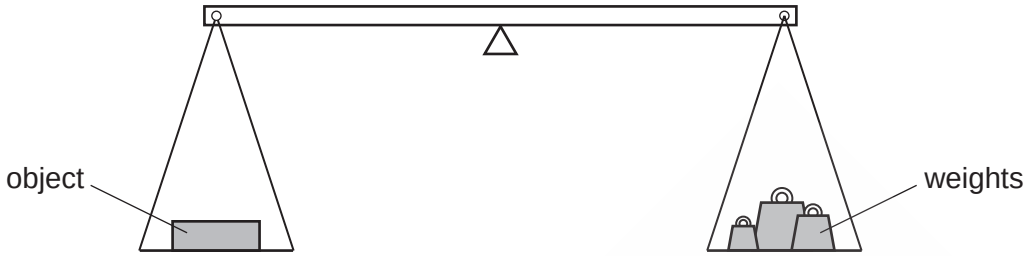


15 A wooden bar is pivoted at its centre so that it can rotate freely. Two equal forces *F* are applied to the bar.

In which diagram is the turning effect greatest?



16 The weight of an object is found using the balance shown in the diagram. The object is put in the left-hand pan and various weights are put in the right-hand pan.



These are the results.

weights in the right-hand pan	effect
0.1 N, 0.1 N, 0.05 N, 0.02 N	balance tips down slightly on the left-hand side
0.2 N, 0.1 N, 0.01 N	balance tips down slightly on the right-hand side

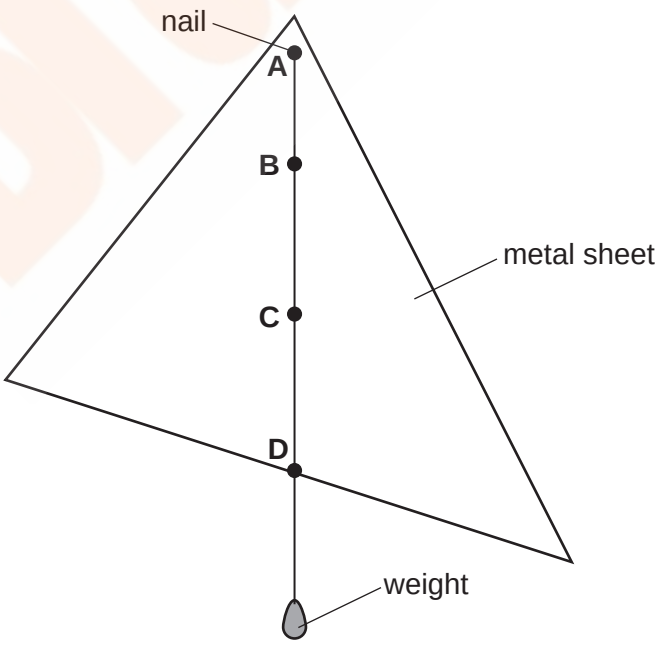
What is the best estimate of the weight of the object?

A 0.27 N **B** 0.29 N **C** 0.31 N **D** 0.58 N

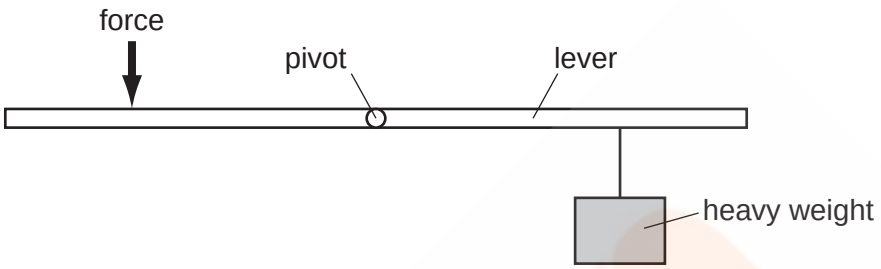
17 The diagram shows a uniform, flat metal sheet hanging freely from a nail at point **A**. A weight also hangs freely on a string tied to **A**.

One of the labelled points is at the centre of mass of the metal sheet.

Which point is at the centre of mass?



18 The diagram shows a force being applied to a lever to lift a heavy weight.



Which change would enable the heavy weight to be lifted with a smaller force?

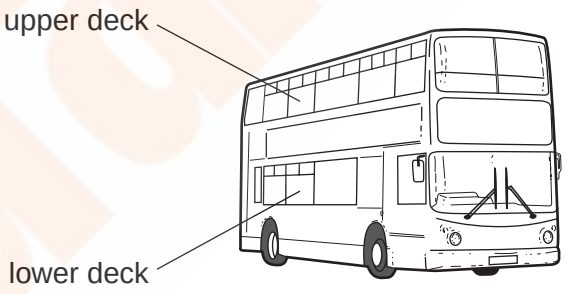
A Move the force to the right.

B Move the heavy weight to the right.

C Move the force to the left.

D Move the pivot to the left.

19 Passengers are **not** allowed to stand on the upper deck of double-decker buses.



Why is this?

A They would cause the bus to become less stable.

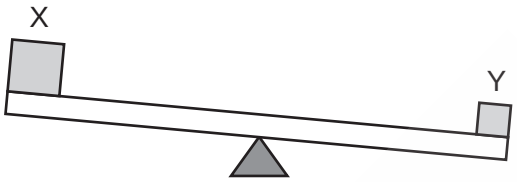
B They would cause the bus to slow down.

C They would increase the kinetic energy of the bus.

D They would lower the centre of mass of the bus.

20 Two objects X and Y are placed on a balance.

The balance tilts as shown.

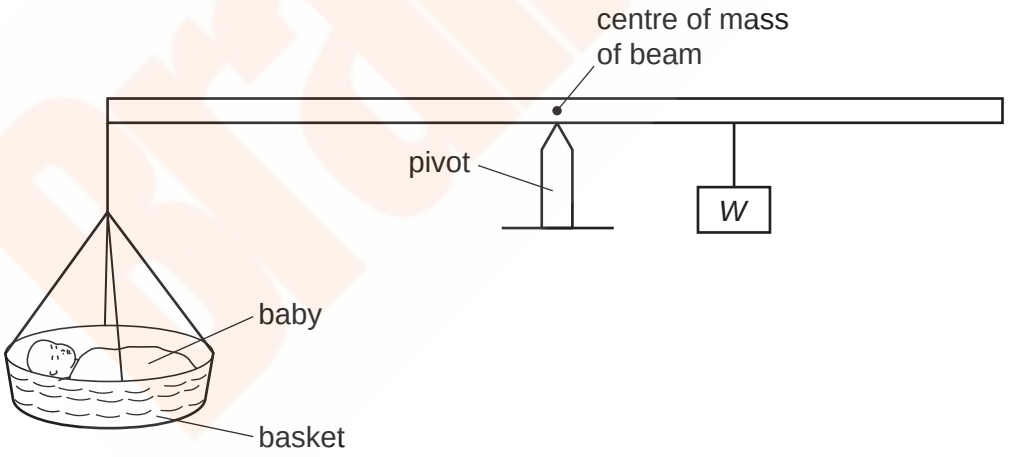


What does this show about the masses and weights of objects X and Y?

	masses	weights
A	X has less mass than Y	X has less weight than Y
B	X has less mass than Y	X has more weight than Y
C	X has the same mass as Y	X has less weight than Y
D	X has the same mass as Y	X has more weight than Y

21 The diagram shows a balance being used to find the weight of a baby. The weight of the basket can be ignored.

At equilibrium, the pivot is nearer to the weight *W* than to the baby.



What is the weight of the baby?

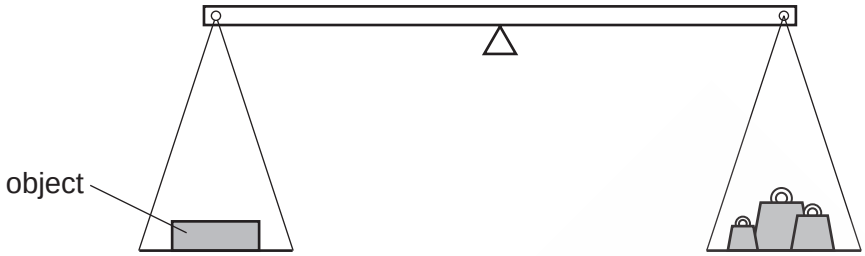
A less than *W*

B more than *W*

C *W*

D impossible to tell

22 The weight of an object is to be found using the balance shown in the diagram.



The object is put in the left-hand pan and various standard weights are put in the right-hand pan. These are the results.

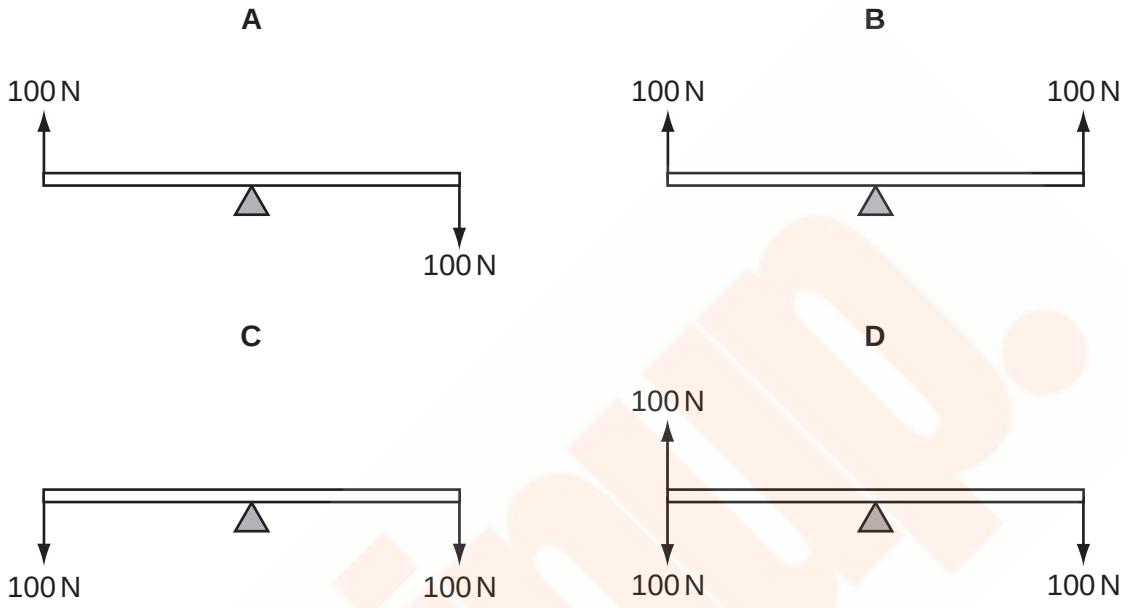
weights in the right-hand pan	effect
0.1 N, 0.1 N, 0.05 N, 0.02 N	balance tips down slightly on the left-hand side
0.2 N, 0.1 N, 0.01 N	balance tips down slightly on the right-hand side

What is the best estimate of the weight of the object?

A 0.27 N **B** 0.29 N **C** 0.31 N **D** 0.58 N

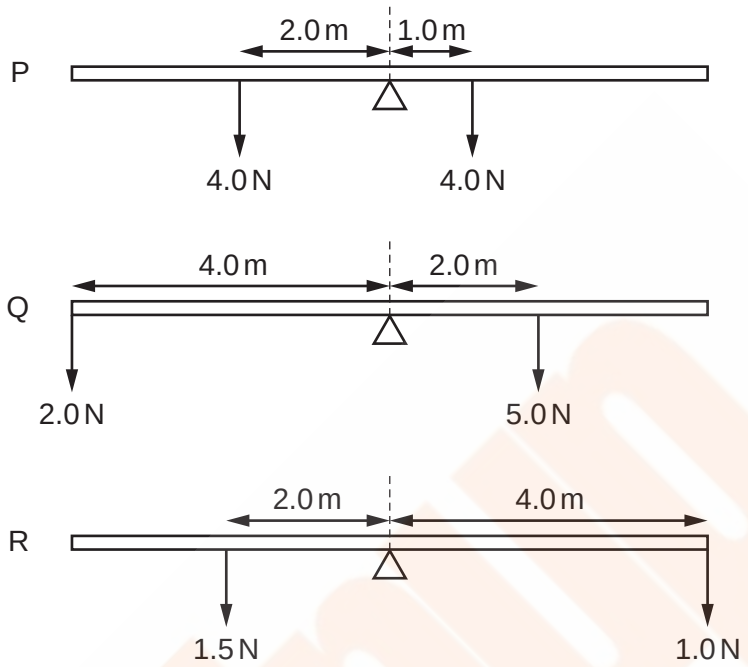
23 A uniform rod rests on a pivot at its centre. The rod is not attached to the pivot. Forces are then applied to the rod in four different ways, as shown. The weight of the rod can be ignored.

Which diagram shows the rod in equilibrium?



24 The diagrams show three uniform beams P, Q and R, each pivoted at its centre.

The two forces acting on each beam are also shown.



Which beams rotate clockwise?

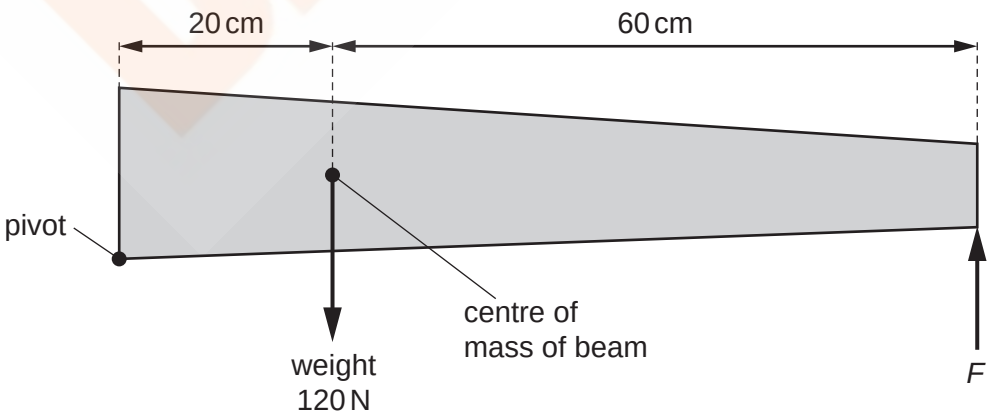
A P and Q only

B P and R only

C Q and R only

D P, Q and R

25 The diagram shows a non-uniform beam of weight 120 N, pivoted at one end. The beam is kept in equilibrium by force *F*.

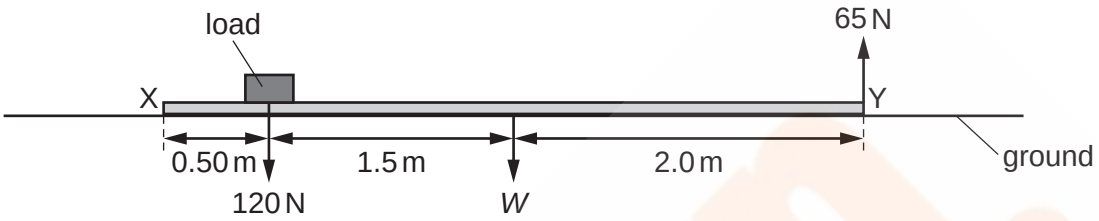


What is the value of force *F*?

A 30 N **B** 40 N **C** 360 N **D** 480 N

26 A long plank XY lies on the ground. A load of 120 N is placed on it, at a distance of 0.50 m from end X, as shown.

End Y is lifted off the ground. The upward force needed to do this is 65 N.

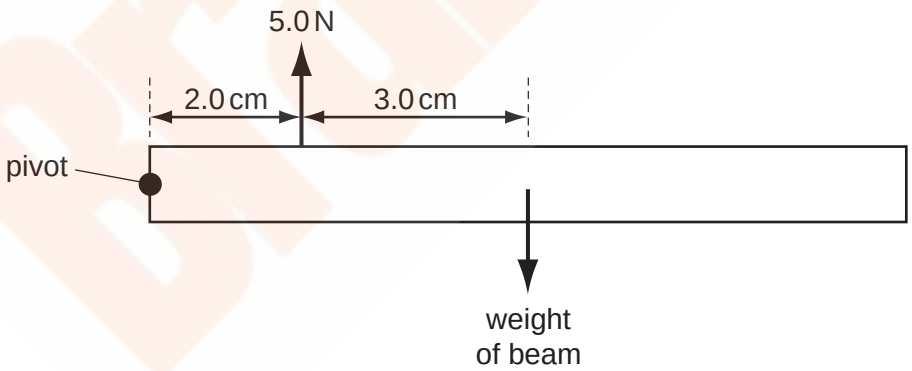


In the diagram, *W* is the weight of the plank, acting at its mid-point.

What is the value of *W*?

A 35 N **B** 47 N **C** 100 N **D** 133 N

27 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

1 An object has a mass of 50 kg.

The gravitational field strength on Earth is 10.0 N / kg.

The gravitational field strength on a distant planet is 4.0 N / kg.

What is the weight of the object on Earth, and what is its weight on the distant planet?

	on Earth	on the distant planet
A	5.0 kg	12.5 kg
B	5.0 N	12.5 N
C	500 kg	200 kg
D	500 N	200 N

2 An astronaut in an orbiting spacecraft experiences a force due to gravity. This force is less than when she is on the Earth's surface.

Compared with being on the Earth's surface, how do her mass and her weight change when she goes into orbit?

	mass in orbit	weight in orbit
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

3 A car travels 100 km. The journey takes two hours. The highest speed of the car is 80 km / h, and the lowest speed is 40 km / h.

What is the average speed for the journey?

A 40 km / h **B** 50 km / h **C** 60 km / h **D** 120 km / h

4 Weight is an example of which quantity?

A acceleration

B force

C mass

D pressure

5 The mass of an object is measured on Earth. The mass is 5.0 kg.

The object is taken to the Moon. The mass of the object is measured on the Moon.

What is the mass of the object on the Moon?

A 0 kg

B more than 0 kg, but less than 5.0 kg

C 5.0 kg

D more than 5.0 kg

6 Which statement about mass or weight is correct?

A Mass is a force.

B Mass is measured in newtons.

C Weight is a force.

D Weight is measured in kilograms.

7 What is the weight of an object?

A the force of gravity on the object

B the gravitational potential energy of the object

C the internal energy of the object

D the mass of the object

8 Which instrument is used to compare the masses of objects?

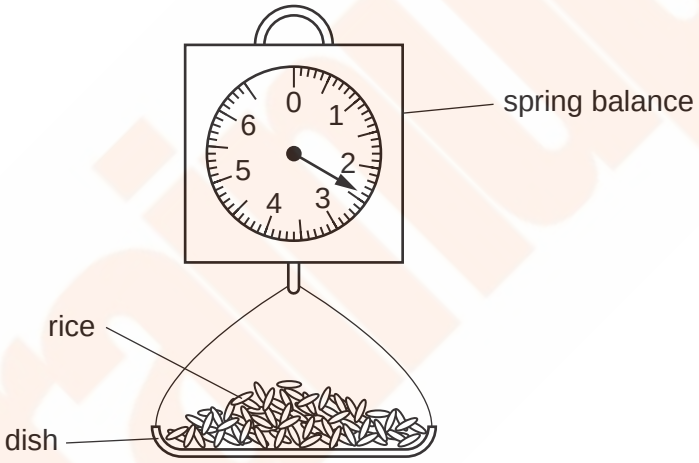
A a balance

B a barometer

C a manometer

D a measuring cylinder

9 A customer goes to a market and buys some rice. The stallholder pours rice into a dish that hangs from a spring balance. He records the reading on the spring balance.



The customer then buys some pasta and the stallholder notices that the reading on the spring balance, with just pasta in the dish, is the same as it was with just rice in the dish.

The rice and the pasta must have the same

A density.

B temperature.

C volume.

D weight.

10 The mass of an astronaut is 70 kg on the Moon.

What is the mass of the astronaut on the Earth?

A 7 kg **B** 70 kg **C** 80 kg **D** 700 kg

11 A 1 kg sample of aluminium is stored in a laboratory. In a different laboratory, in the same town, there is a 1 kg sample of iron.

Which quantity must these two samples **always** have in common?

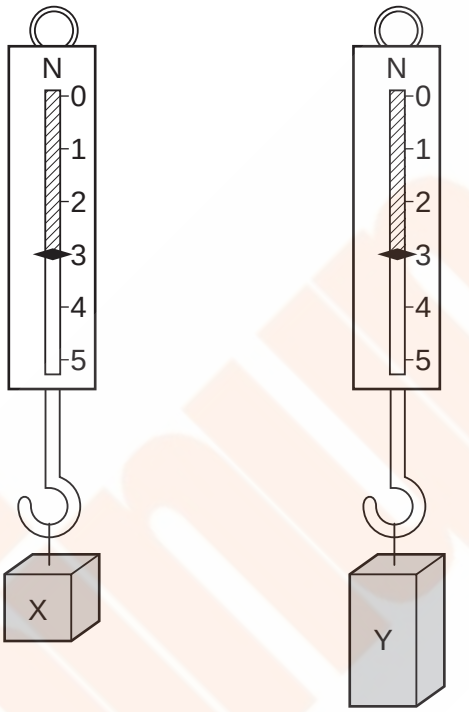
A the same density

B the same temperature

C the same volume

D the same weight

12 Two blocks of metal X and Y hang from spring balances, as shown in the diagrams.



What does the diagram show about X and Y?

A They have the same mass and the same volume but different weights.

B They have the same mass and the same weight but different volumes.

C They have the same mass, the same volume and the same weight.

D They have the same weight and the same volume but different masses.

13 A student stands with both feet on some scales in order to measure his weight.

The reading on the scales is 500 N. He lifts one foot off the scales and keeps it lifted.

What is the new reading on the scales?

A 0 **B** 250 N **C** 500 N **D** 1000 N

14 A child sits on a rubber ball and bounces up and down on the ground.

What stays the same when the ball hits the ground?

A the acceleration of the ball

B the mass of the ball

C the shape of the ball

D the velocity of the ball

15 Which is the unit for force and which is the unit for weight?

	force	weight
A	kg	kg
B	kg	N
C	N	kg
D	N	N

16 A cup contains hot liquid.

Some of the liquid evaporates.

What happens to the mass and to the weight of the liquid in the cup?

	mass	weight
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

17 Which quantity is measured in newtons?

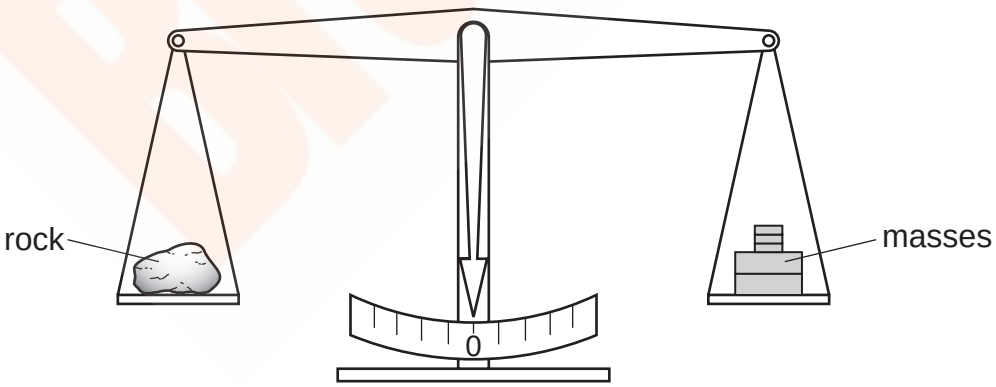
A density

B energy

C pressure

D weight

18 A geologist places a small rock on the left-hand pan of a balance. The two pans are level as shown when masses with a total weight of 23 N are placed on the right-hand pan.
Take the weight of 1.0 kg to be 10 N.



What is the mass of the small rock?

A 0.023 kg **B** 2.3 kg **C** 23 kg **D** 230 kg

19 Which statement about mass and weight is correct?

A Mass and weight are both forces.

B Neither mass nor weight is a force.

C Only mass is a force.

D Only weight is a force.

20 A cup contains hot liquid.

Some of the liquid evaporates.

What happens to the mass and what happens to the weight of the liquid in the cup?

	mass	weight
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

21 A concrete post is carried up a very high mountain. At the top of the mountain, the gravitational field is slightly weaker than at the bottom.

What is the effect of this weaker field on the mass and on the weight of the post at the top of the mountain?

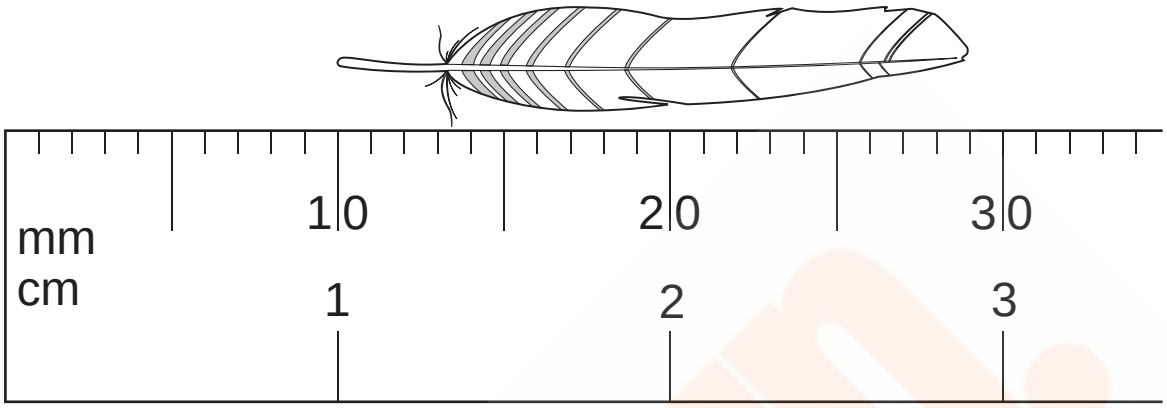
	mass	weight
A	is less	is less
B	is less	is unchanged
C	is unchanged	is less
D	is unchanged	is unchanged

22 An astronaut in an orbiting spacecraft experiences a force due to gravity. This force is less than when she is on the Earth's surface.

Compared with being on the Earth's surface, how do her mass and her weight change when she goes into orbit?

	mass in orbit	weight in orbit
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

1 The diagram shows an enlarged drawing of the end of a metre rule. It is being used to measure the length of a small feather.



What is the length of the feather?

A 19 mm **B** 29 mm **C** 19 cm **D** 29 cm

2 A student wishes to find the volume of a small, irregularly-shaped stone.

A ruler and a measuring cylinder containing some water are available.

Which apparatus is needed?

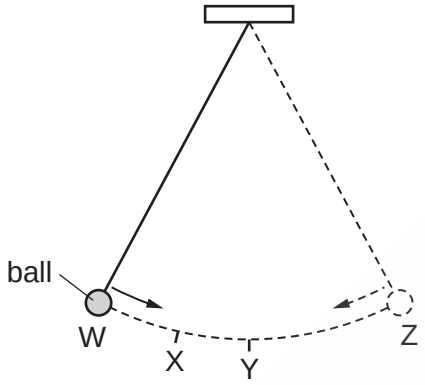
A neither the ruler nor the measuring cylinder

B the measuring cylinder only

C the ruler and the measuring cylinder

D the ruler only

3 The diagram shows a ball hanging on a string. The ball swings from point W to point Z and back to point W.



Which statement about the ball is correct?

A The kinetic energy of the ball is greatest at point W.

B The kinetic energy of the ball is greatest at point X.

C The kinetic energy of the ball is greatest at point Y.

D The kinetic energy of the ball is the same at all points of the swing.

4 A measuring cylinder is used to measure the volume of a quantity of water.

Which measuring technique would **not** improve the accuracy of the measurement?

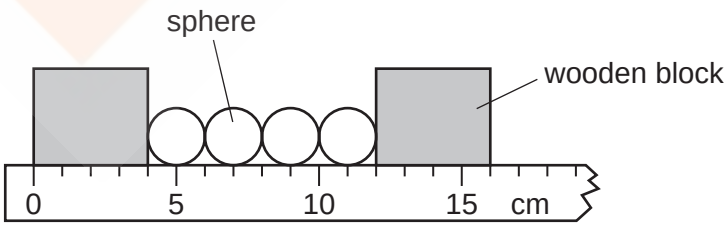
A making sure that the measuring cylinder is vertical

B making sure that the water surface is at eye level

C reading the top of the water meniscus

D using the smallest measuring cylinder available that will contain all the water

5 The diagram shows four identical spheres placed between two wooden blocks on a ruler.



What is the diameter of one sphere?

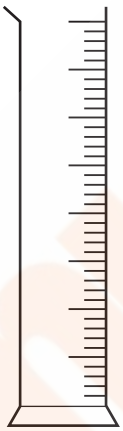
A 1.0 cm **B** 2.0 cm **C** 3.0 cm **D** 4.0 cm

6 A cook wants to prepare some food to be cooked by 1.15 p.m. He uses an oven with an automatic timer that can be set to switch on and off at certain times. The oven needs to be switched on for 2 hours 10 minutes.

At which time does the oven need to switch on?

A 11.05 a.m. **B** 11.25 a.m. **C** 3.05 p.m. **D** 3.25 p.m.

7 The diagram shows a measuring instrument.



Which quantity is this instrument used to measure?

A area

B density

C mass

D volume

8 Which option contains **only** apparatus that could be used to determine the volume of a small block of unknown material?

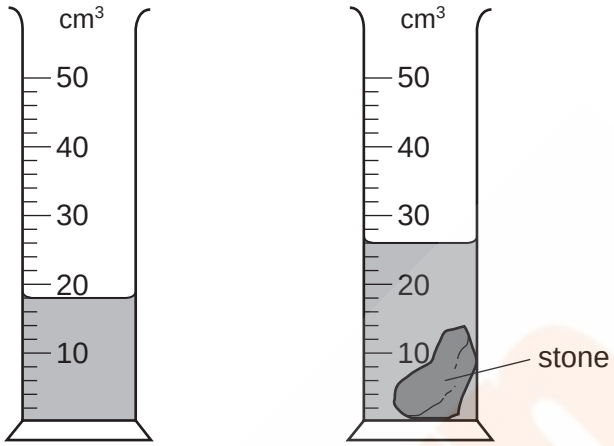
A measuring cylinder, metre rule

B measuring cylinder, stopwatch

C metre rule, balance

D metre rule, stopwatch

9 The diagram shows a measuring cylinder used to measure the volume of a small stone.



What is the volume of the stone?

A 8 cm^3 **B** 9 cm^3 **C** 14 cm^3 **D** 26 cm^3

10 A student uses a measuring cylinder to measure the volume of a quantity of water.

Which action would make her result **less** accurate?

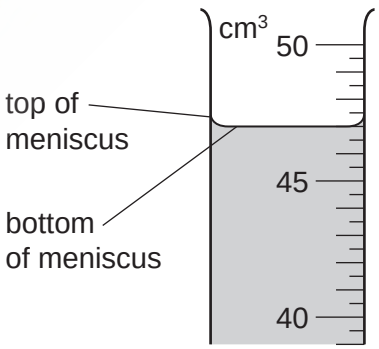
A making sure her eye is level with the water surface

B making sure the cylinder is vertical

C reading the bottom of the meniscus

D using the largest measuring cylinder possible

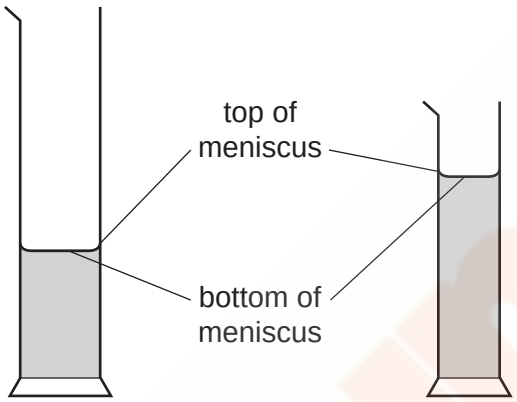
11 A student uses a measuring cylinder to measure the volume of some water. The diagram shows part of the measuring cylinder. The top and bottom of the meniscus are labelled.



What is the volume of the water?

A 47.0 cm^3 **B** 47.5 cm^3 **C** 49.0 cm^3 **D** 49.5 cm^3

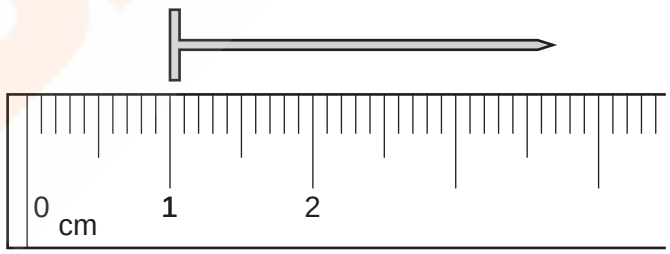
12 A student wishes to measure accurately the volume of approximately 40 cm^3 of water. She has two measuring cylinders, a larger one that can hold 100 cm^3, and a smaller one that can hold 50 cm^3. The water forms a meniscus where it touches the glass.



Which cylinder should the student use and which water level should she use to ensure an accurate result?

	cylinder	water level
A	larger one	bottom of meniscus
B	larger one	top of meniscus
C	smaller one	bottom of meniscus
D	smaller one	top of meniscus

13 The diagram shows part of a ruler. The ruler is used to find the length of a nail.



What is the length of the nail?

A 2.2 cm **B** 2.7 cm **C** 3.2 cm **D** 3.7 cm

14 Which instrument is used to compare the masses of objects?

A a balance

B a barometer

C a manometer

D a measuring cylinder

15 Diagram 1 shows a measuring cylinder containing water.

Five identical steel balls are now lowered into the measuring cylinder. Diagram 2 shows the new water level in the cylinder.

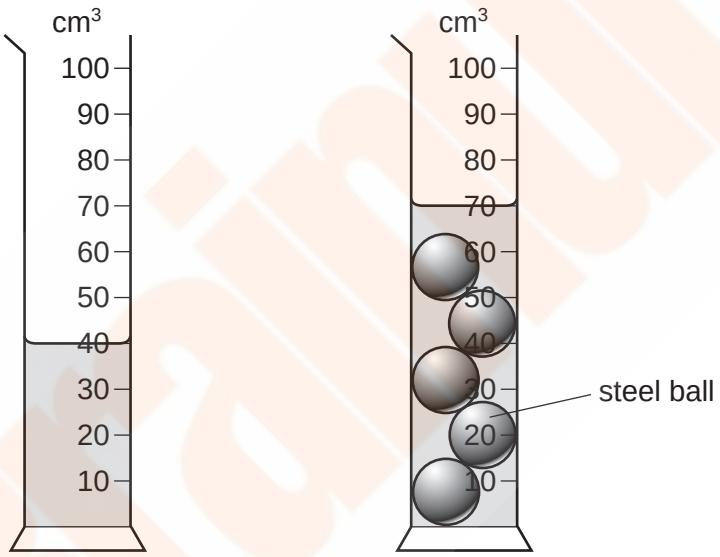
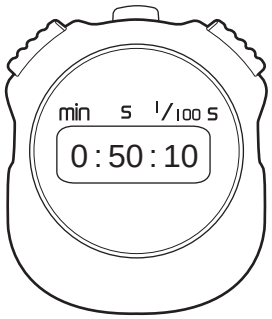


diagram 1 diagram 2

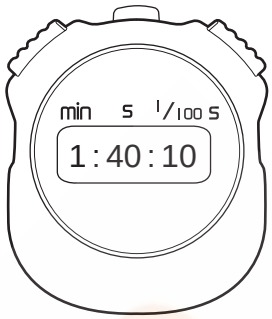
What is the volume of each steel ball?

A 6 cm^3 **B** 14 cm^3 **C** 30 cm^3 **D** 70 cm^3

16 A stopwatch is used to time a runner in a race. The diagrams show the stopwatch at the start and at the end of a lap of the race.



start of lap



end of lap

How long did the runner take to finish the lap of the race?

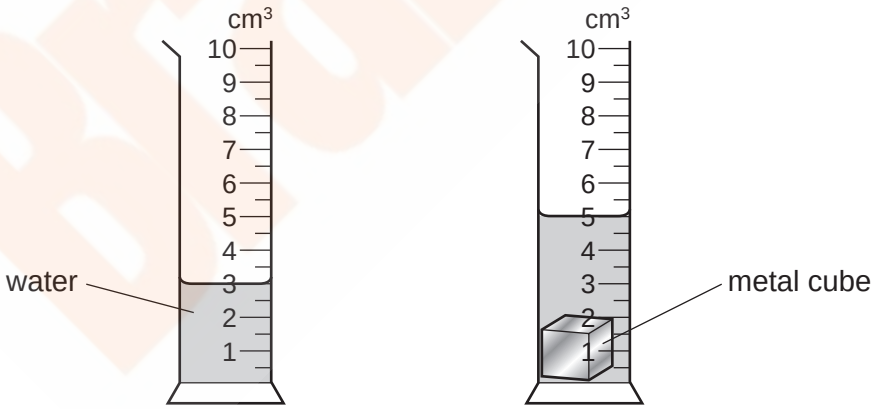
A 50.00 seconds

B 50.10 seconds

C 90.00 seconds

D 100.10 seconds

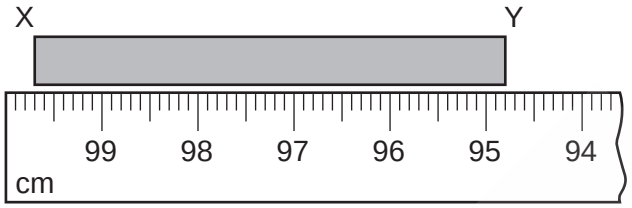
17 The diagrams show the readings on a measuring cylinder before and after a small metal cube is added.



How many more identical cubes can be added to the cylinder, without causing the water to overflow? Do not include the cube already in the cylinder.

A 1 **B** 2 **C** 3 **D** 4

18 A student measures the length of a rod XY by holding it next to a metre rule.



The student writes down the length as 94.8 cm.

Which statement is correct?

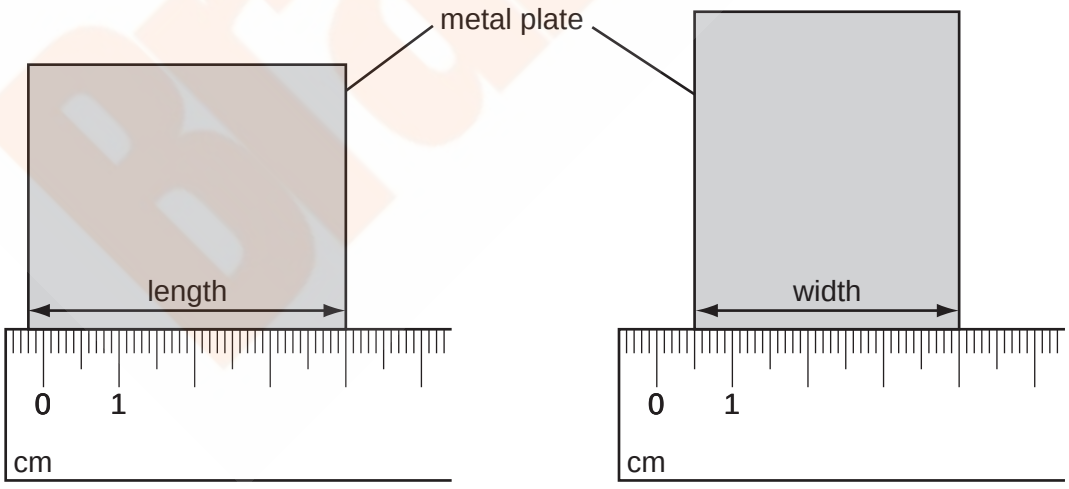
A The value is correct.

B The value is incorrect because it should be 95.2 cm.

C The value is incorrect because it should be in millimetres.

D The value is incorrect because the student should subtract the reading for end Y from the reading for end X.

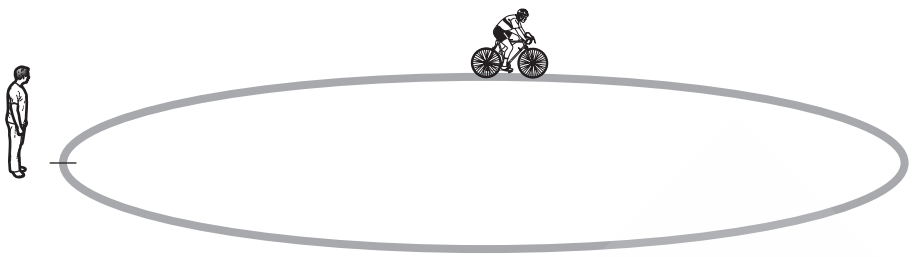
19 A student uses a ruler to measure the length and the width of a small rectangular metal plate.



What is the area of the plate?

A 14.0 cm^2 **B** 14.7 cm^2 **C** 16.0 cm^2 **D** 16.8 cm^2

20 A cyclist rides round a track three times.



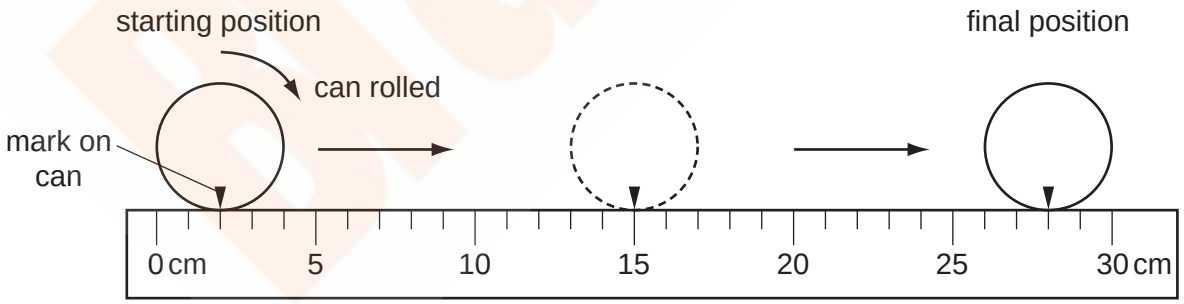
Her friend uses a stopwatch to record the time at the start of the ride, after one circuit, and at the end of the three circuits. The readings from the stopwatch are shown.

at the start | after one circuit | at the end of three circuits

What is the average time for one circuit of the track?

A 174 s **B** 180 s **C** 198 s **D** 200 s

21 A cylindrical can is rolled along the ruler shown in the diagram.

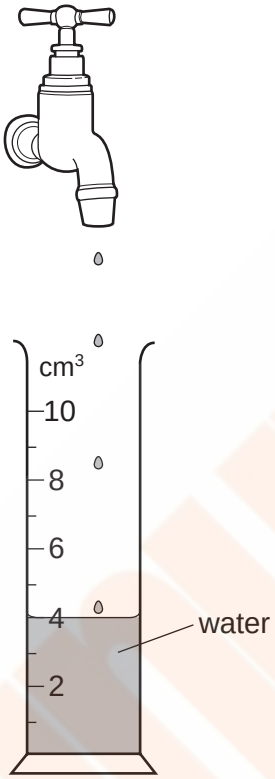


The can rolls over twice.

What is the circumference (distance all round) of the can?

A 13 cm **B** 14 cm **C** 26 cm **D** 28 cm

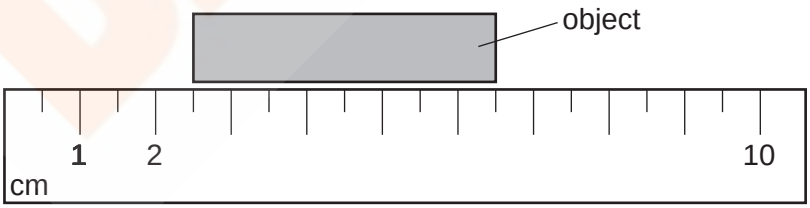
22 Drops of water are dripping steadily from a tap (faucet). The diagram shows a measuring cylinder which has collected 120 drops of water.



How many drops in total will have been collected when the measuring cylinder reads 10 cm^3?

A 48 **B** 60 **C** 180 **D** 300

23 A ruler is used to measure the length of an object.



What is the length of the object?

A 3.0 cm **B** 4.0 cm **C** 5.0 cm **D** 6.5 cm

24 The diameter of a copper wire is thought to be approximately 0.3 mm.

Which instrument should be used to obtain a more accurate measurement of the diameter of the wire?

A measuring tape

B metre rule

C micrometer

D ruler

25 Which measurement can be made using a micrometer screw gauge?

A the air pressure of a tyre

B the diameter of a wire

C the turning effect of a spanner

D the wavelength of microwaves

1 An experiment is carried out to measure the extension of a rubber band for different loads.

The results are shown below.

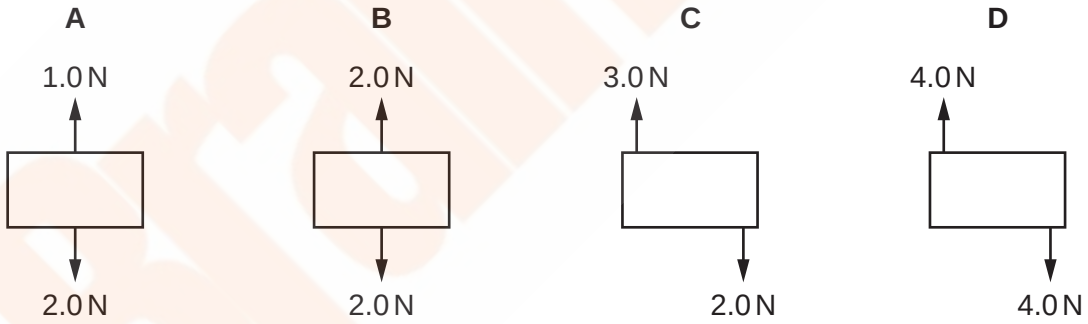
load / N	0	1.0	2.0	3.0
length / cm	15.2	16.2		18.6
extension / cm	0	1.0	2.1	3.4

Which figure is missing from the table?

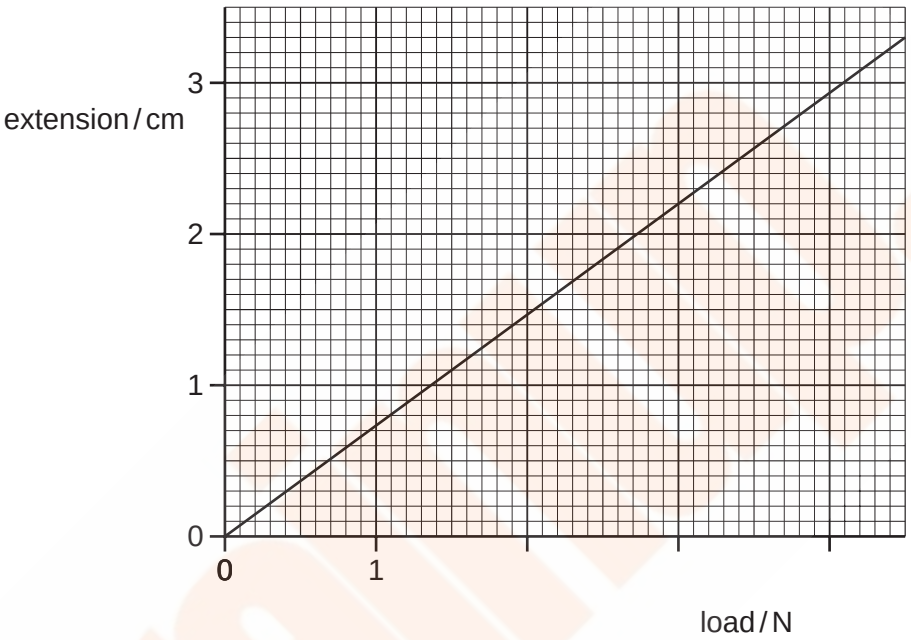
A 17.2 **B** 17.3 **C** 17.4 **D** 17.6

2 Four objects are each acted on by only two forces, as shown.

Which object is in equilibrium?



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

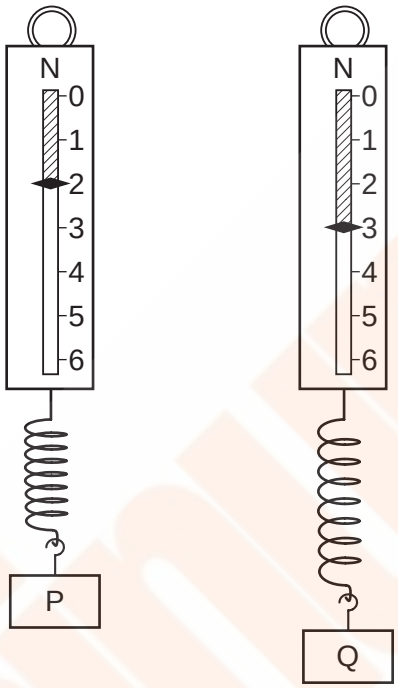


When an object is hung from the spring, the length of the spring is 19.2 cm.

What is the weight of the object?

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

4 Two metal blocks P and Q have identical dimensions. They hang on identical spring balances.



What can be deduced about P and Q?

A They have different volumes and different weights.

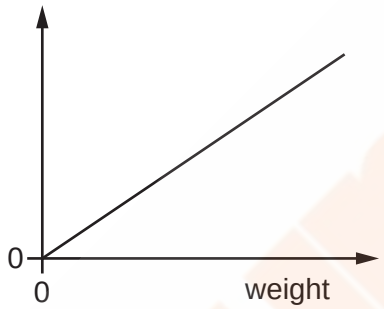
B They have different volumes, but equal masses.

C They have equal volumes and equal weights.

D They have equal volumes, but different masses.

5 A student adds weights to an elastic cord. He measures the length of the cord for each weight.

He then plots a graph from the results, as shown.



What has he plotted on the vertical axis?

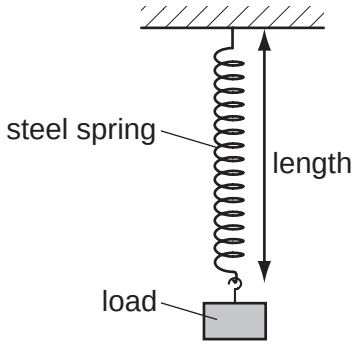
A measured length

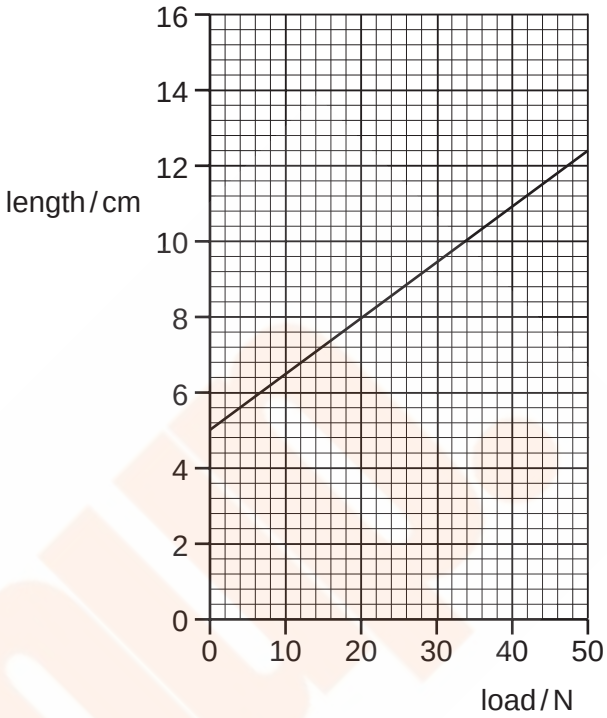
B original length

C (measured length + original length)

D (measured length – original length)

6 The diagrams show a steel spring and a graph of its length against the load applied to it.

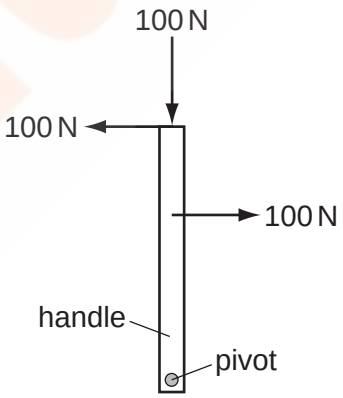




What is the extension of the spring when a load of 20 N is applied to it?

A 3.0 cm **B** 4.5 cm **C** 5.0 cm **D** 8.0 cm

7 The diagram shows a handle with three forces, each 100 N, applied to it. The handle is free to move.



What is the effect of the forces on the handle?

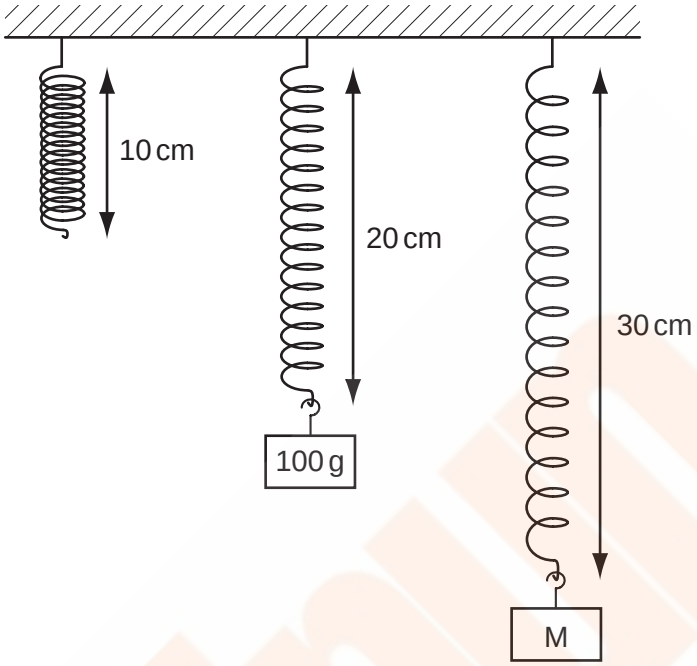
A The handle will move downwards.

B The handle will not move.

C The handle will turn anticlockwise (to the left).

D The handle will turn clockwise (to the right).

8 Objects with different masses are hung on a spring. The diagram shows how much the spring stretches.



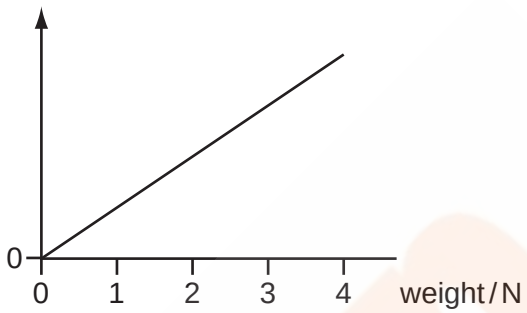
The extension of the spring is directly proportional to the mass hung on it.

What is the mass of object M?

A 110 g **B** 150 g **C** 200 g **D** 300 g

9 A student adds weights to an elastic cord. He measures the length of the cord for each weight.

He then plots a graph from the results, as shown.



Which length has he plotted on the vertical axis?

A measured length

B original length

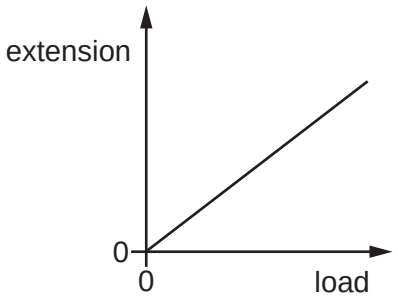
C (measured length – original length)

D (measured length + original length)

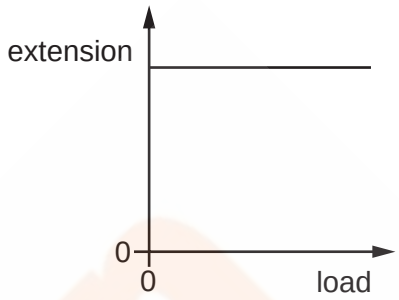
10 A spring obeys Hooke's law.

Which graph is obtained by plotting the extension of the spring against the load applied?

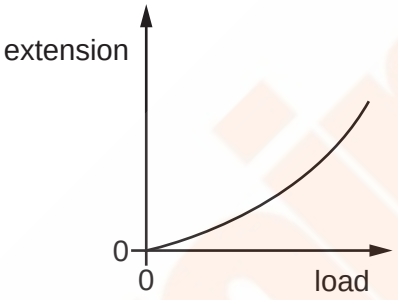
A



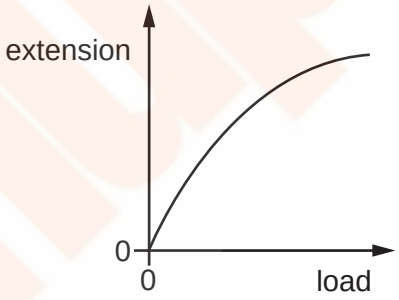
B



C



D



11 An experiment is carried out to measure the extension of a rubber band for different loads.

The results are shown below.

load / N	0	1.0	2.0	3.0
length / cm	15.2	16.2		18.6
extension / cm	0	1.0	2.1	3.4

Which figure is missing from the table?

A 17.2 **B** 17.3 **C** 17.4 **D** 17.6

1 Fig. 3.1 shows an oil tank that has a rectangular base of dimensions 2.4 m by 1.5 m.

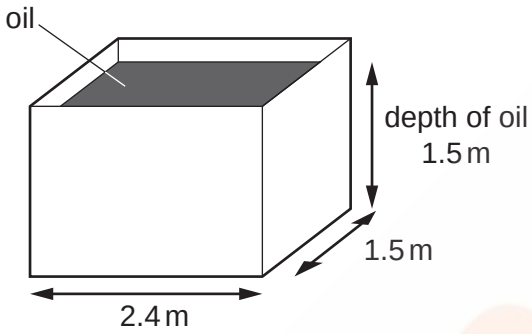


Fig. 3.1

The tank is filled with oil of density 850 kg / m^3 to a depth of 1.5 m.

(a) Calculate

(i) the pressure exerted by the oil on the base of the tank,

pressure = ... [2]

(ii) the force exerted by the oil on the base of the tank.

force = ... [2]

(b) The force calculated in **(a)(ii)** is the weight of the oil.

Calculate the mass of oil in the tank.

mass = ... [1]

(c) When he is checking the level of oil in the tank, a man drops a brass key into the oil and it sinks to the bottom of the oil.

(i) State what this shows about the density of brass.

..... [1]

(ii) Explain how attaching the key to a piece of wood could prevent the key from sinking.

.....

.....

..... [1]

[Total: 7]

2 A student wishes to find the volume of a piece of wood of irregular shape. Her experiment requires the use of a small brass object of mass 200 g.

(a) Calculate the volume of the brass object. The density of brass is 8.4 g / cm^3.

volume = ...[2]

(b) To find the volume of the piece of wood, the student has a measuring cylinder, a supply of water and the brass object in **(a)**. The piece of wood and the brass object are small enough to be placed in the measuring cylinder.

(i) The piece of wood does not sink in water.

Suggest why.

.....[1]

(ii) Describe what the student does to find the volume of the piece of wood, stating the measurements that she makes and any calculations required.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 7]

3 A student has 500 identical, rectangular sheets of paper. The mass of 1.0 m^2 of the paper is 0.080 kg.

(a) Using a metre rule, she measures the length of one sheet of paper and its width. The length is 0.300 m and the width is 0.210 m.

(i) Calculate the mass of one sheet of paper.

mass = ...[1]

(ii) The student makes a single pile of the 500 sheets of paper.

With a metre rule, she measures the height of the pile. The height of the pile is 0.048 m.

Calculate the density of the paper.

density = ...[3]

(b) A second student has only 5 sheets of the same type of paper.

Suggest how this student determines the density of the paper to a similar accuracy. Additional apparatus may be used.

.....

.....

.....

.....[2]

[Total: 6]

4 A student has a large number of coins of different diameters, all made of the same metal. She wishes to find the density of the metal by a method involving placing the coins in water.

(a) State the formula needed to calculate the density.

..... [1]

(b) Describe how the measurements of the required quantities are carried out.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) State **one** precaution taken when carrying out the measurements in **(b)** to ensure that the result is as accurate as possible.

.....

..... [1]

[Total: 7]

5 A student wishes to determine the density of a small, irregularly shaped stone.

(a) With the aid of a labelled diagram, describe an experiment to determine the volume of the stone.

.....

.....

.....

.....

..... [4]

(b) **(i)** State the other quantity, apart from the volume, that must be measured in order to determine the density.

..... [1]

(ii) State the formula that is used to calculate the density.

.....

..... [1]

(c) The student now wishes to determine the volume of a small, irregularly shaped piece of wood that floats in water. He notices that a small lead weight tied to the wood makes it sink in water.

Describe how the student can adapt the experiment in **(a)** to determine the volume of the wood. You may draw a diagram.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 8]

6 **(a)** Define *density*.

.....

.....[1]

(b) The density of aluminium is $2.70\,g/cm^3$. The thickness of a rectangular sheet of aluminium foil varies, but is much less than 1 mm.

A student wishes to find the average thickness. She obtains the following measurements.

mass of sheet = 60.7 g
length of sheet = 50.0 cm
width of sheet = 30.0 cm

Calculate the student's values for

(i) the volume of the sheet,

volume = ...[2]

(ii) the average thickness of the sheet.

thickness = ...[2]

(c) Another student, provided with a means of cutting the sheet, decides to find its average thickness using a single measuring instrument. Assume the surfaces of the sheet are perfectly smooth.

(i) Name a measuring instrument she could use.

.....[1]

(ii) Describe the procedure she should follow to obtain an accurate value of the average thickness of the sheet.

Details of how to read the instrument are not required.

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

7 Fig. 1.1 shows a side view of a large tank in a marine visitor attraction.

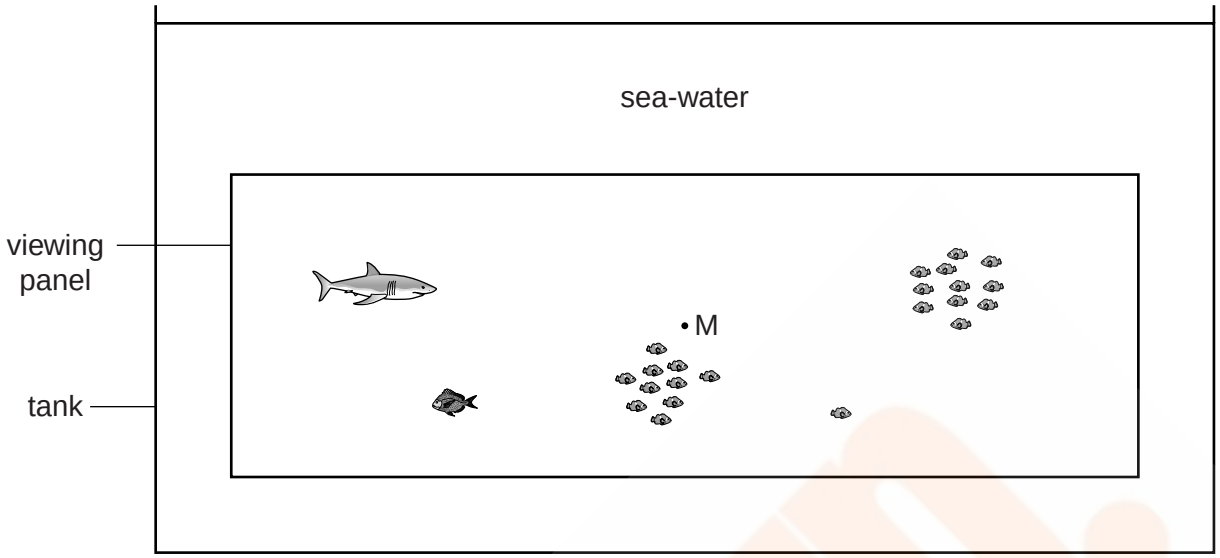


Fig. 1.1 (not to scale)

The tank is 51 m long and 20 m wide. The sea-water in the tank is 11 m deep and has a density of 1030 kg / m^3.

(a) Calculate the mass of water in the tank.

mass = ... [3]

(b) The pressure at point M, halfway down the large viewing panel, is 60 kPa more than atmospheric pressure.

Calculate the depth of M below the surface of the water.

depth = ... [2]

(c) The viewing panel is 32.8 m wide and 8.3 m high.

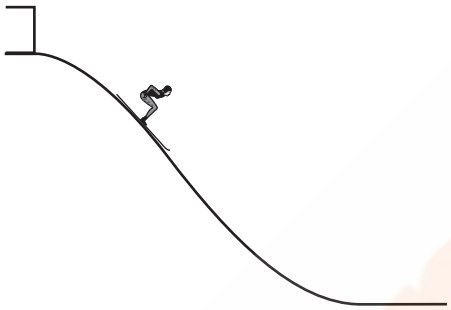
Calculate the outward force of the water on the panel. Assume that the pressure at M is the average pressure on the whole panel.

force = ... [2]

[Total: 7]

1 A skier walks from the bottom of a ski slope to the top and gains 10 000 J of gravitational potential energy.

She skis down the slope. At the bottom of the slope, her kinetic energy is 2000 J.



How much energy is dissipated in overcoming friction and air resistance as the skier moves down the slope?

A 2000 J **B** 8000 J **C** 10 000 J **D** 12 000 J

2 A coal-fired power station generates electricity. Coal is burnt and the energy released is used to boil water. The steam from the water makes the generator move and this produces electricity.

Which words are used to describe the energy stored in the coal and the energy of the moving generator?

	coal	generator
A	chemical	hydroelectric
B	chemical	kinetic
C	geothermal	hydroelectric
D	geothermal	kinetic

3 Four different children run up the same set of stairs.

For which child is the useful power to climb the stairs the greatest?

	mass of child / kg	time taken / s
A	40	15
B	50	25
C	60	25
D	70	15

4 Which energy source is one that is used to boil water to make steam in power stations?

A energy from tides

B energy from waves

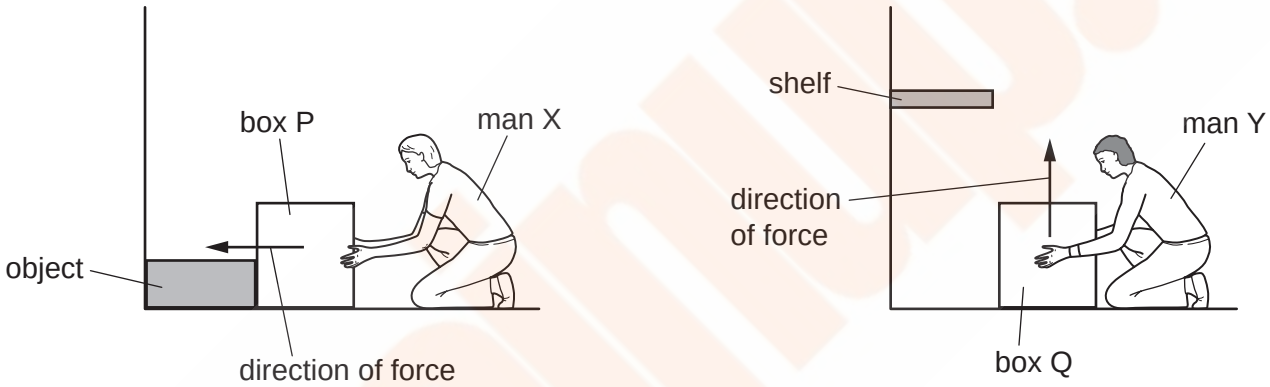
C hydroelectric energy

D nuclear energy

5 In a factory, two men X and Y try to move identical heavy boxes P and Q.

Man X tries to push box P along the floor. The box does not move because an object is in the way.

Man Y lifts box Q from the floor onto a shelf.



Which man does the most work on the box, and which box gains the most energy?

	man doing most work	box gaining most energy
A	X	P
B	X	Q
C	Y	P
D	Y	Q

6 Which energy source is renewable and reliably available at all times?

A coal

B geothermal

C nuclear

D wind

7 Two workers are stacking cans on to a shelf in a shop. The workers lift the same number of identical cans on to the same shelf from the same level.

Worker P takes 3.0 minutes to lift the cans. Worker Q takes 4.0 minutes to lift the cans.

Which statement about the workers is correct?

A Worker P develops less useful power than worker Q.

B Worker P develops more useful power than worker Q.

C Worker P does less useful work than worker Q.

D Worker P does more useful work than worker Q.

8 Which quantities are measured in the same unit?

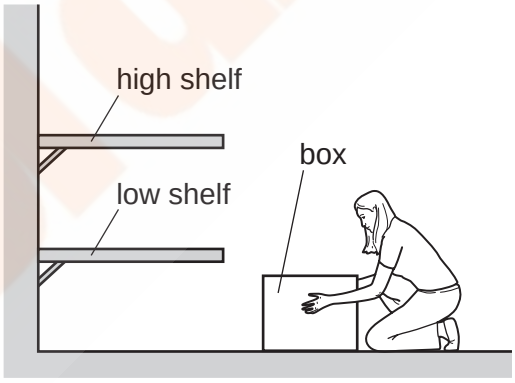
A energy, power and work

B energy and power, but not work

C energy and work, but not power

D power and work, but not energy

9 A person in a factory has to lift a box on to a shelf.



Which action involves the person doing the **least** amount of work?

A lifting the box quickly to the high shelf

B lifting the box slowly to the high shelf

C lifting the box to the low shelf first then lifting it to the high shelf

D lifting the box to the low shelf instead of to the high shelf

10 Which is a non-renewable energy resource?

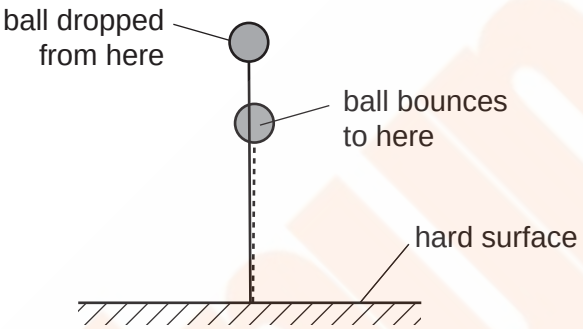
A coal

B solar

C tides

D wind

11 A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started, and so has not regained all of its original gravitational potential energy.



Which statement accounts for the loss of gravitational potential energy?

A Energy was destroyed as the ball hit the ground.

B Energy was destroyed as the ball travelled through the air.

C The chemical energy and elastic energy of the ball have increased.

D The internal (heat) energy of the ball and its surroundings has increased.

12 Which energy resource is used to boil water to generate electricity?

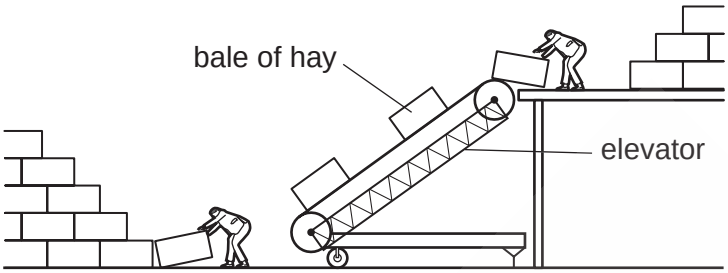
A hydroelectric

B nuclear fission

C tides

D waves

13 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.



As sunset approaches, they increase the speed of the elevator so that more bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the elevator?

	work done in lifting each bale	useful output power of the elevator
A	increases	decreases
B	increases	increases
C	no change	decreases
D	no change	increases

14 A student measures the length of a spring. She then hangs different weights from the spring. She measures the length of the spring for each different 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 when the weight hung from it is 3.0 N?

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

15 Which energy resource is used to generate electricity without using any moving parts?

A geothermal

B hydroelectric

C nuclear

D solar

16 Which source of energy involves the splitting of heavy atoms?

A chemical energy

B geothermal energy

C hydroelectric energy

D nuclear energy

17 A cyclist travels down a hill from rest at point X, without pedalling.

The cyclist applies his brakes and the cycle stops at point Y.

Which energy changes have taken place between X and Y?

A gravitational potential → kinetic → thermal (heat)

B gravitational potential → thermal (heat) → kinetic

C kinetic → gravitational potential → thermal (heat)

D kinetic → thermal (heat) → gravitational potential

18 To calculate the power produced by a force, the size of the force must be known.

What else needs to be known to calculate the power?

	the distance the force moves the object	the time for which the force acts on the object
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = needed

✗ = not needed

19 Which form of energy is used to generate electrical energy in a tidal power station?

A chemical energy

B gravitational energy

C internal energy (thermal energy)

D nuclear energy

20 Four different model steam engines each lift a 1.0 kg object from the **same** laboratory floor to the **same** laboratory bench. Each engine takes a different time to lift the object.

How does the most powerful engine compare with the other engines?

	speed of lifting object onto bench	useful work done
A	faster	more than other engines
B	faster	same as other engines
C	slower	less than other engines
D	slower	same as other engines

21 What needs to be known to calculate the work done by a force acting on an object?

	the size of the force	the distance the force moves the object	the time for which the force acts
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✓	✗	✗

key

✓ = needed

✗ = not needed

22 Electrical energy may be obtained from nuclear fission.

In which order is the energy transferred in this process?

A nuclear fuel → generator → reactor and boiler → turbines

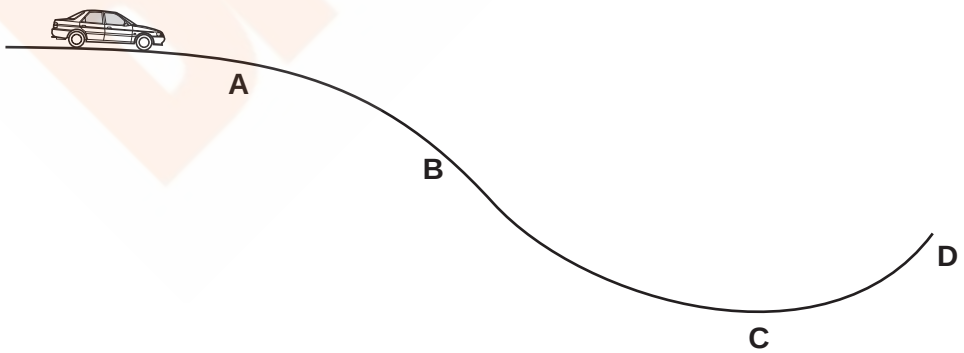
B nuclear fuel → generator → turbines → reactor and boiler

C nuclear fuel → reactor and boiler → generator → turbines

D nuclear fuel → reactor and boiler → turbines → generator

23 A car is stationary at the top of a hill with the engine switched off. The brakes are released and the car rolls down the hill.

At which labelled point does the car have the greatest kinetic energy? Ignore friction.



24 Which row gives the energy change in a battery and the energy change in a solar cell?

	battery	solar cell
A	chemical to electrical	electrical to light
B	chemical to electrical	light to electrical
C	electrical to chemical	electrical to light
D	electrical to chemical	light to electrical

25 A helicopter takes off from the ground and rises vertically. It then hovers at a constant height above the ground.

Which sequence of energy changes takes place during the gain in height?

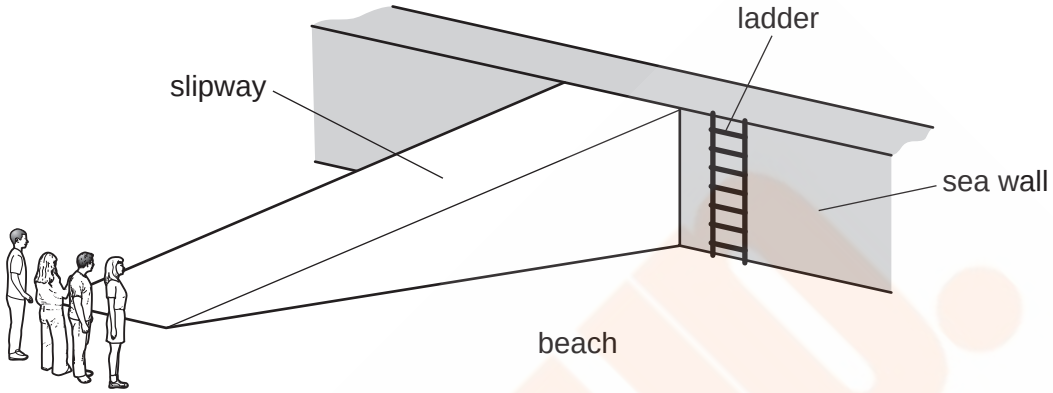
A chemical → gravitational potential → kinetic

B chemical → kinetic → gravitational potential

C gravitational potential → chemical → kinetic

D kinetic → chemical → gravitational potential

26 Four people of equal weight on a beach use different routes to get to the top of a sea wall.



Which person produces the greatest average power?

person		time taken / s
A	runs across the beach, then climbs the ladder	8
B	walks across the beach, then climbs the ladder	16
C	runs up the slipway	5
D	walks up the slipway	10

27 Which energy transfer takes place when a matchstick burns?

A chemical to thermal

B chemical to nuclear

C nuclear to chemical

D thermal to chemical

28 Four cars are driven along a road.

The table shows the work done by the engine in each car and the time taken by each car.

Which engine produces the most power?

	work done by engine / J	time taken / s
A	50 000	20
B	50 000	40
C	100 000	20
D	100 000	40

29 In a hydroelectric power station, one form of energy is stored in a lake or reservoir. This energy is then transferred in stages to another useful form, which is the output.

Which row gives the name of the stored energy and the name of the output energy?

	stored energy	output energy
A	electrical	thermal (heat)
B	electrical	kinetic
C	gravitational	electrical
D	kinetic	electrical

30 A certain machine is very efficient.

What does this mean?

A It produces a large amount of power.

B It uses very little energy.

C It wastes very little energy.

D It works very quickly.

31 The list contains three energy resources P, Q and R.

P geothermal energy from hot rocks

Q nuclear fission in reactors

R sunlight on solar panels

Which of these resources are renewable?

A P and Q only

B P and R only

C Q and R only

D P, Q and R

32 Which movement will require the greatest amount of work to be done?

A a force of 10 N moving an object a distance of 3.0 m

B a force of 10 N moving an object a distance of 5.0 m

C a force of 15 N moving an object a distance of 3.0 m

D a force of 15 N moving an object a distance of 5.0 m

33 When a bicycle lamp is switched on, what is the useful energy change **within the battery**?

A chemical energy to electrical energy

B electrical energy to chemical energy

C electrical energy to light energy

D light energy to chemical energy

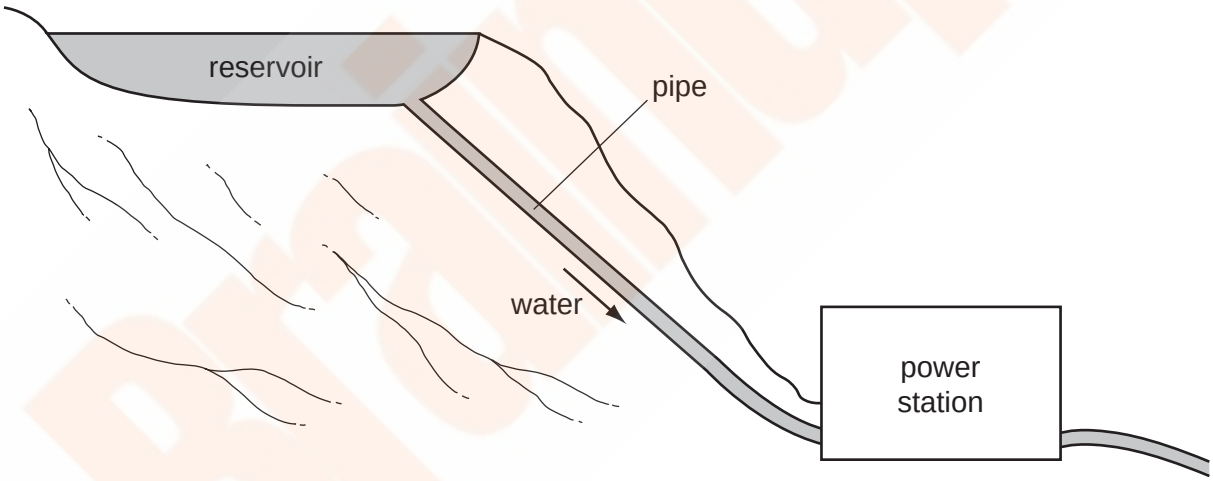
34 A student does some work by pulling a suitcase along a corridor.

She now pulls a second suitcase along the corridor.

Which row indicates that the student is now doing twice as much work?

	the force used to pull suitcase	the distance the suitcase is pulled
A	is doubled	is doubled
B	is doubled	is halved
C	stays the same	is doubled
D	stays the same	is halved

35 The diagram shows a hydroelectric system.



What are the main energy changes taking place?

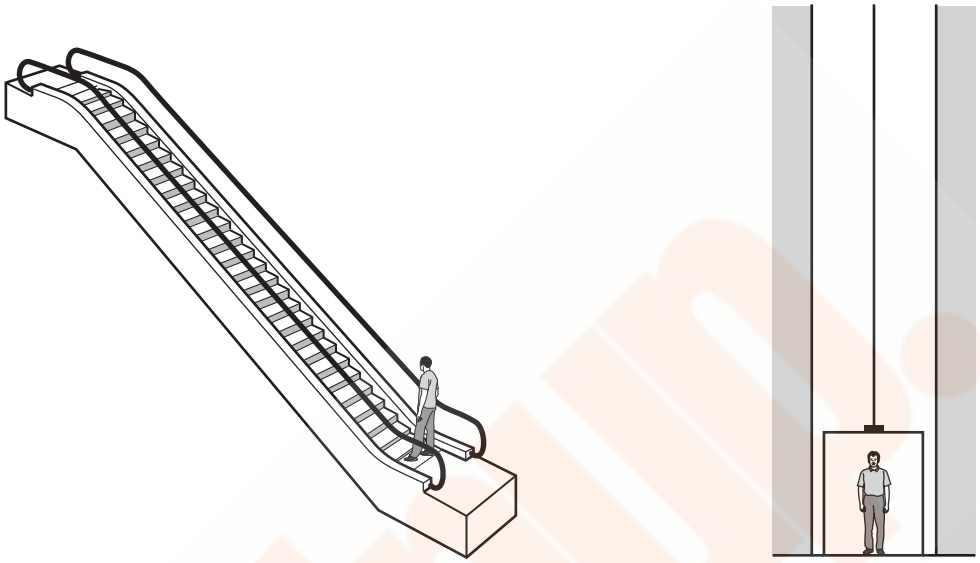
A chemical energy → kinetic energy → electrical energy

B electrical energy → gravitational energy → kinetic energy

C gravitational energy → kinetic energy → electrical energy

D kinetic energy → electrical energy → gravitational energy

36 An escalator (moving stairs) and a lift (elevator) are both used to carry passengers from the same underground railway platform up to street level.



escalator lift

The escalator takes 20 seconds to carry a man to street level. The useful work done is *W.* The useful power developed is *P.* The lift takes 30 seconds to carry the same man to street level.

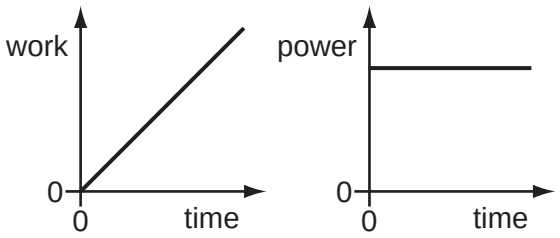
How much useful work is done by the lift, and how much useful power is developed by the lift?

	useful work done by lift	useful power developed by lift
A	more than *W*	less than *P*
B	more than *W*	*P*
C	*W*	less than *P*
D	*W*	*P*

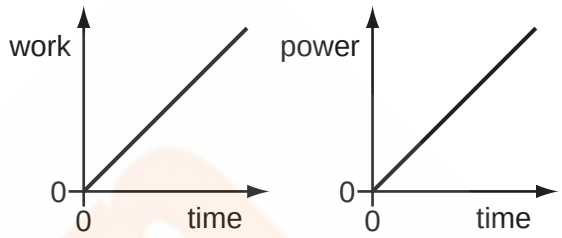
37 A car moves along a level road at constant speed. Work is done by the engine and power is developed by the engine.

Which pair of graphs shows how the work done and the power developed vary with time?

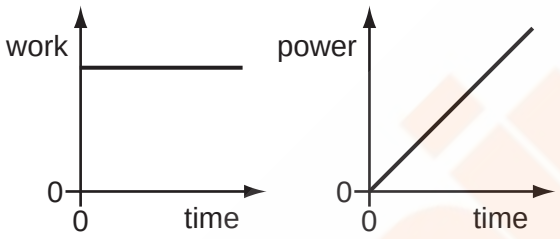
A



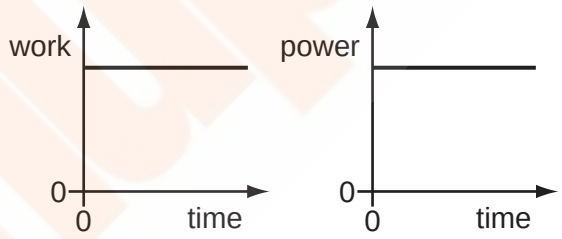
B



C



D

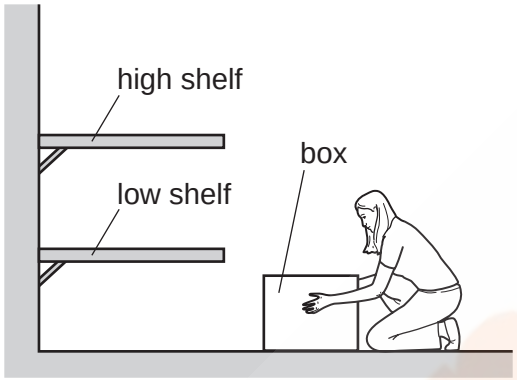


38 Some energy sources are reliably available at all times, and some are not.

Which row shows three sources all in their correct columns?

	available at all times	not available at all times
A	geothermal	nuclear fission, solar
B	geothermal, nuclear fission	solar
C	solar, nuclear fission	geothermal
D	solar	nuclear fission, geothermal

39 A woman in a factory has to lift a box on to a shelf.



Which action involves the woman in doing the **least** amount of work?

A lifting the box quickly to the high shelf

B lifting the box slowly to the high shelf

C lifting the box to the low shelf first then lifting it to the high shelf

D lifting the box to the low shelf instead of to the high shelf

40 An aeroplane is landing. As it descends towards the runway, its speed reduces.

What are the energy changes that take place during the descent?

A kinetic + gravitational → thermal (heat)

B kinetic → gravitational + thermal (heat)

C kinetic + thermal (heat) → gravitational

D thermal (heat) → kinetic + gravitational

41 Energy from uranium is transferred to electrical energy in a nuclear power station.

What is the correct order of the stages of this process?

A boiler → generator → reactor → turbine

B generator → boiler → turbine → reactor

C reactor → boiler → turbine → generator

D reactor → turbine → boiler → generator

42 In which pair of energy sources are both sources renewable?

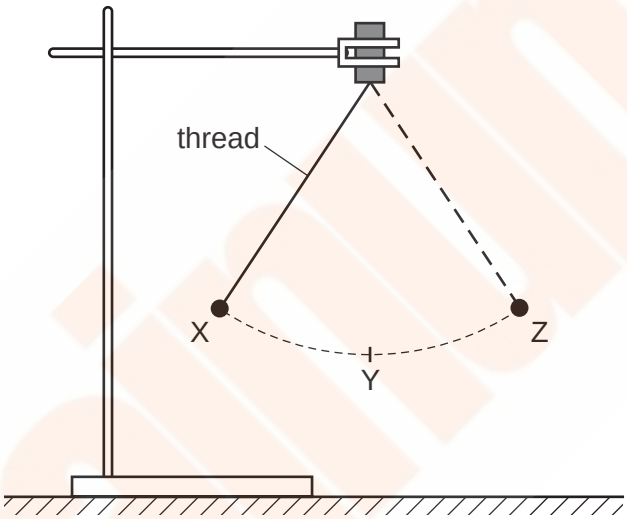
A oil and coal

B oil and tidal

C tidal and geothermal

D tidal and nuclear fission

43 An object on a thread is swinging between X and Z, as shown in the diagram. It is momentarily at rest at X and at Z.



An incomplete word equation about the energy of the object is shown below.

gravitational potential energy at X = kinetic energy at Y + ……. energy at Y + energy losses

Which form of energy is needed to complete the word equation?

A chemical

B gravitational potential

C internal

D strain

44 Electricity can be obtained from different energy resources.

Which energy resource is used to obtain electricity without producing heat to boil water?

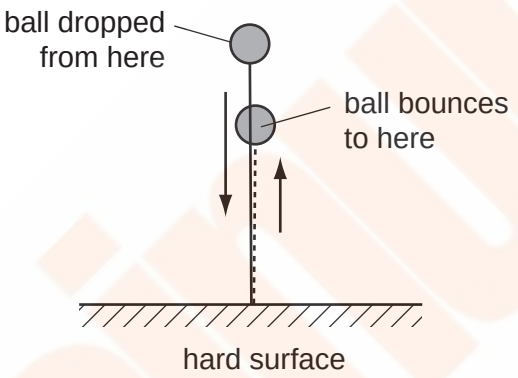
A coal

B gas

C hydroelectric

D nuclear

45 A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started, so it has less gravitational potential energy than when it started.



What happens to the 'lost' energy?

A It is converted into chemical and strain energy.

B It is converted into internal (heat) energy and sound.

C It is destroyed as the ball rises upwards after hitting the ground.

D It is destroyed when the ball hits the ground.

46 Which row gives an example of the stated form of energy?

	form of energy	example
A	gravitational	the energy due to the movement of a train along a level track
B	internal	the energy due to the flow of cathode rays in a cathode-ray tube
C	kinetic	the energy due to the position of a swimmer standing on a high diving board
D	strain	the energy due to the compression of springs in a car seat

47 Which energy resource is used to generate electricity by first boiling water?

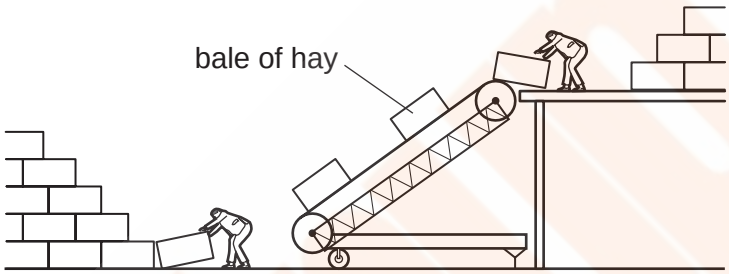
A hydroelectric

B nuclear fission

C tides

D waves

48 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.

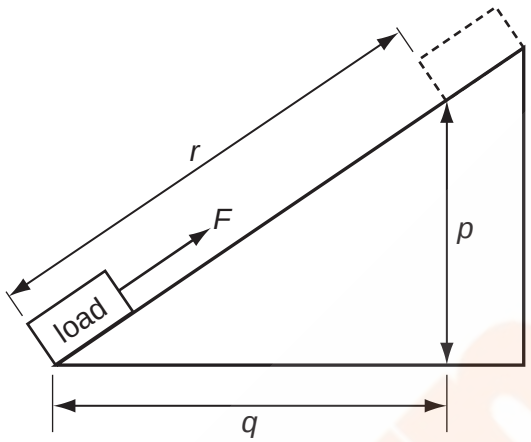


As sunset approaches, they increase the speed of the motor so that more bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the motor?

	work done in lifting each bale	useful output power of the motor
A	increases	decreases
B	increases	increases
C	no change	decreases
D	no change	increases

49 A force *F* moves a load from the bottom of a slope to the top.



The work done by the force depends on the size of the force, and on a distance.

What is this distance?

A *p** **B** *q** **C** *r** **D** *p* + *q*

50 Energy is released in some nuclear reactions.

Which nuclear reaction takes place in a nuclear power station, and which nuclear reaction takes place in the Sun?

	nuclear power station	the Sun
A	fission	fission
B	fission	fusion
C	fusion	fission
D	fusion	fusion

51 A lorry of mass 4000 kg is travelling at a speed of 4.0 m/s.

A car has a mass of 1000 kg. The kinetic energy of the car is equal to the kinetic energy of the lorry.

What is the speed of the car?

A 2.0 m/s **B** 4.0 m/s **C** 8.0 m/s **D** 16.0 m/s

52 A force acts on an object and causes the object to move a certain distance, in the same direction as the force.

Which row represents a situation in which the largest amount of work is done on the object by the force?

	force/N	distance moved/m
A	2.0	40.0
B	10.0	2.0
C	20.0	6.0
D	100.0	1.0

53 A stone of mass m is held at rest in water. The stone is released and falls vertically a distance h. The stone reaches a speed v.

Some of the original energy of the stone is transferred to the water. As it falls, resistive forces cause the temperature of the water and stone to increase.

Which expression gives the work done against the resistive forces?

A $\frac{1}{2}mv^2$

B $mgh - \frac{1}{2}mv^2$

C mgh

D $mgh + \frac{1}{2}mv^2$

54 Which energy resource does **not** derive its energy from the Sun?

A geothermal

B hydroelectric

C oil

D waves

55 Some processes are more efficient than others.

Which expression gives the efficiency of a process?

A $\frac{\text{total energy output}}{\text{total energy input}} \times 100\%$

B $\frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$

C $\frac{\text{wasted energy output}}{\text{total energy input}} \times 100\%$

D $\frac{\text{wasted energy output}}{\text{useful energy output}} \times 100\%$

56 Which energy resource does **not** derive its energy from the Sun?

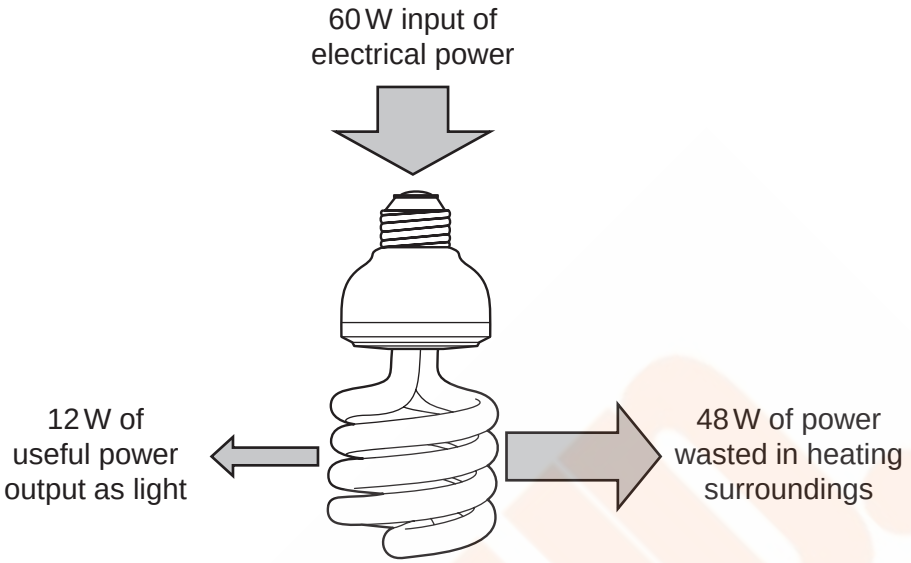
A hydroelectric

B nuclear fission

C waves

D wind

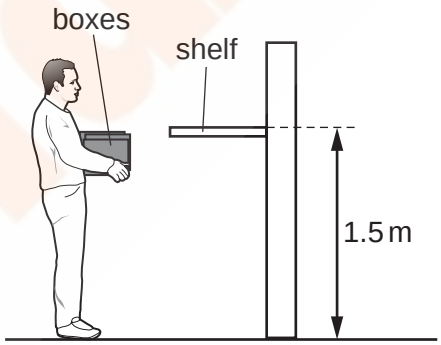
57 The diagram shows the energy used by a modern lamp.



Which expression gives the efficiency of the lamp?

A $\frac{12}{60} \times 100\%$ **B** $\frac{12}{48} \times 100\%$ **C** $\frac{48}{60} \times 100\%$ **D** $\frac{48}{12} \times 100\%$

58 Three boxes each weigh 100 N. A man lifts all the boxes together from the ground on to a shelf that is 1.5 m above the ground. The man takes 2.0 s to do this.



How much useful power does the man produce to lift the boxes?

A 75 W **B** 225 W **C** 300 W **D** 900 W

59 The table gives four energy sources and states whether the energy of the source is derived from the Sun.

Which row is correct?

	source of energy	derived from the Sun
A	geothermal	yes
B	oil	no
C	water held behind a dam	yes
D	wind	no

60 A weight-lifter raises a 2000 N weight through a vertical height of 2.0 m in 0.80 s.

What useful power does he develop in doing this?

A 800 W **B** 3200 W **C** 4000 W **D** 5000 W

61 A wind turbine generates 54 kW of useful power from an input of 180 kW of wind power.

Which calculation gives the percentage efficiency of the turbine?

A $\frac{54000}{180000 \times 100}$ %

B $\frac{180000}{54000 \times 100}$ %

C $\frac{54000 \times 100}{180000}$ %

D $\frac{180000 \times 100}{54000}$ %

62 A car has a mass of 1000 kg and a momentum of 12 000 kg m / s.

What is its kinetic energy?

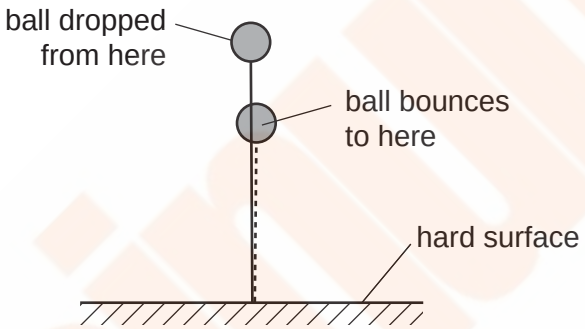
A 6 kJ

B 12 kJ

C 72 kJ

D 144 kJ

63 A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started, and so has not regained all of its original gravitational potential energy.



Which statement accounts for the loss of gravitational potential energy?

A Energy was destroyed as the ball hit the ground.

B Energy was destroyed as the ball travelled through the air.

C The chemical energy and elastic energy of the ball have increased.

D The internal (heat) energy of the ball and its surroundings has increased.

64 The Sun is the original source of energy for many of our energy resources.

Which energy resource **does not** originate from the Sun?

A geothermal

B hydroelectric

C waves

D wind

1 **(a)** **(i)** On Fig. 3.1, draw a graph of extension against load for a spring which obeys Hooke's law. [1]

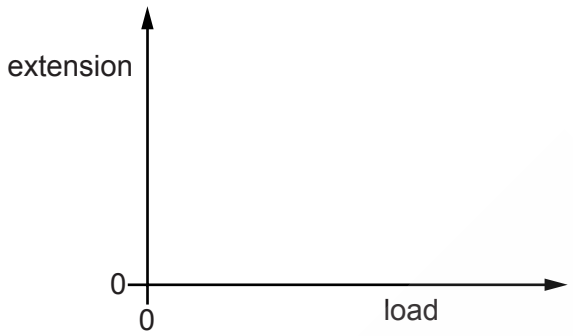


Fig. 3.1

(ii) State the word used to describe the energy stored in a spring that has been stretched or compressed.

.....[1]

(b) Fig. 3.2 shows a model train, travelling at speed *v,* approaching a buffer.

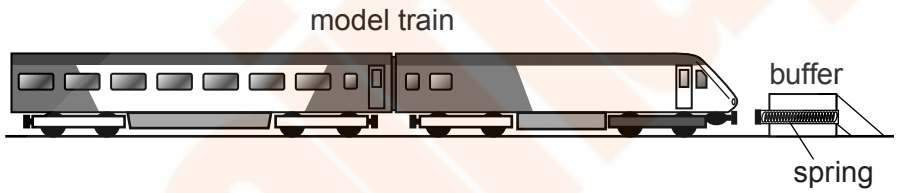


Fig. 3.2

The train, of mass 2.5 kg, is stopped by compressing a spring in the buffer. After the train has stopped, the energy stored in the spring is 0.48 J.

Calculate the initial speed *v* of the train.

v = ...[4]

[Total: 6]

2 Fig. 2.1 shows a conveyor belt transporting a package to a raised platform. The belt is driven by a motor.

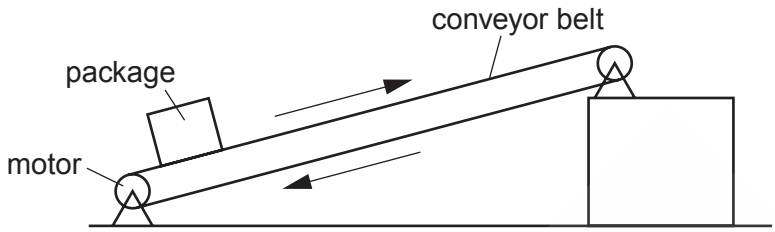


Fig. 2.1

(a) The mass of the package is 36 kg.

Calculate the increase in the gravitational potential energy (g.p.e.) of the package when it is raised through a vertical height of 2.4 m.

increase in g.p.e. = ... [2]

(b) The package is raised through the vertical height of 2.4 m in 4.4 s.

Calculate the power needed to raise the package.

power = ... [2]

(c) The electrical power supplied to the motor is much greater than the answer to **(b)**.

Explain how the principle of conservation of energy applies to this system.

.....

.....

..... [2]

(d) Assume that the power available to raise packages is constant. A package of mass greater than 36 kg is raised through the same height.

Suggest and explain the effect of this increase in mass on the operation of the conveyer belt.

.....

.....

.....

.....

..... [3]

[Total: 9]

3 An athlete of mass 64 kg is bouncing up and down on a trampoline.

At one moment, the athlete is stationary on the stretched surface of the trampoline. Fig. 3.1 shows the athlete at this moment.

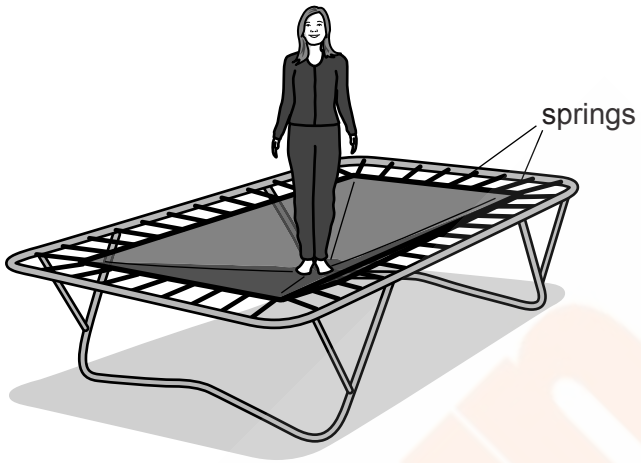


Fig. 3.1

(a) State the form of energy stored due to the stretching of the surface of the trampoline.

.....[1]

(b) The stretched surface of the trampoline begins to contract. The athlete is pushed vertically upwards and she accelerates. At time *t*, when her upwards velocity is 6.0 m/s, she loses contact with the surface.

(i) Calculate her kinetic energy at time *t*.

kinetic energy = ...[2]

(ii) Calculate the maximum possible distance she can travel upwards after time *t*.

maximum distance = ...[3]

(iii) In practice, she travels upwards through a slightly smaller distance than the distance calculated in **(ii)**.

Suggest why this is so.

.....

.....[1]

(c) The trampoline springs are tested. An extension-load graph is plotted for one spring. Fig. 3.2 is the graph.

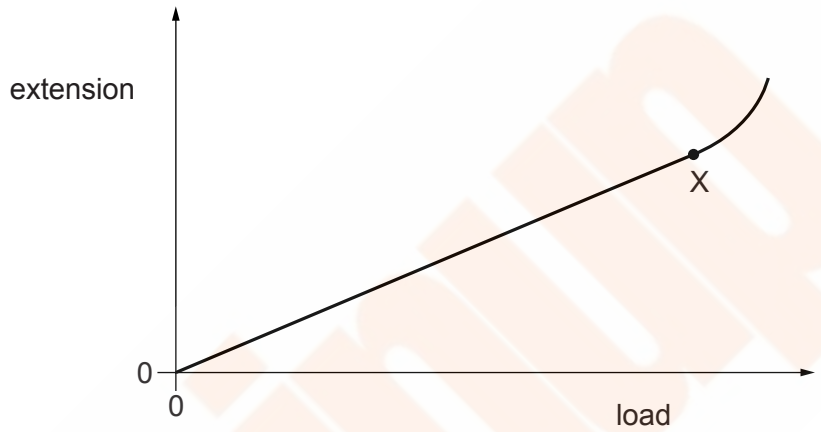


Fig. 3.2

(i) State the name of the point X.

.....[1]

(ii) State the name of the law that the spring obeys between the origin of the graph and point X.

.....[1]

[Total: 9]

4 An electric train is initially at rest at a railway station. The motor causes a constant force of 360 000 N to act on the train and the train begins to move.

(a) State the form of energy gained by the train as it begins to move.

.....[1]

(b) The train travels a distance of 4.0 km along a straight, horizontal track.

(i) Calculate the work done on the train during this part of the journey.

work done = ...[2]

(ii) The mass of the train is 450 000 kg.

Calculate the maximum possible speed of the train at the end of the first 4.0 km of the journey.

maximum possible speed = ...[3]

(iii) In practice, the speed of the train is much less than the value calculated in **(ii)**.

Suggest **one** reason why this is the case.

.....

.....[1]

(c) After travelling 4.0 km, the train reaches its maximum speed. It continues at this constant speed on the next section of the track where the track follows a curve which is part of a circle.

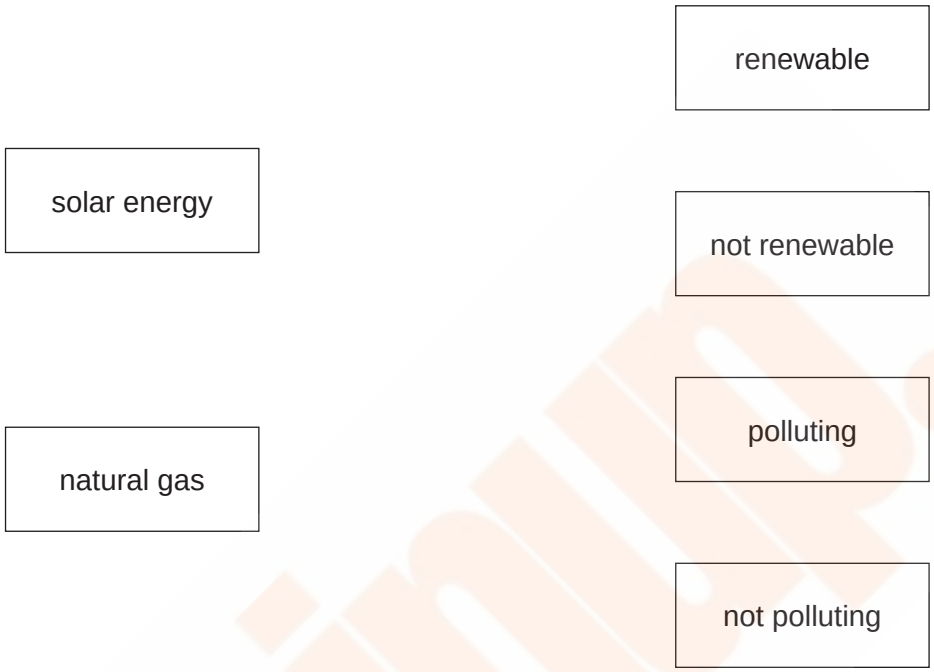
State the direction of the resultant force on the train as it follows the curved path.

.....[1]

[Total: 8]

5 **(a)** The boxes on the left contain the names of some sources of energy. The boxes on the right contain properties of some sources of energy.

Draw **two** straight lines **from each box** on the left to the two boxes on the right which describe that source of energy.



[2]

(b) Coal-fired power stations are polluting.

State an advantage of using coal as a source of energy.

.....

.....[1]

(c) A coal-fired power station generates electricity at night when it is not needed.

Some of this energy is stored by pumping water up to a mountain lake. When there is high demand for electricity, the water is allowed to flow back through turbines to generate electricity.

On one occasion, 2.05×10^8 kg of water is pumped up through a vertical height of 500 m.

(i) Calculate the weight of the water.

weight = ...[1]

(ii) Calculate the gravitational potential energy gained by the water.

energy gained = ...[2]

(iii) The electrical energy used to pump the water up to the mountain lake is 1.2×10^{12} J. Only 6.2×10^{11} J of electrical energy is generated when the water is released.

Calculate the efficiency of this energy storage scheme.

efficiency = ...[2]

[Total: 8]

6 Fig. 3.1 shows a skier taking part in a downhill race.

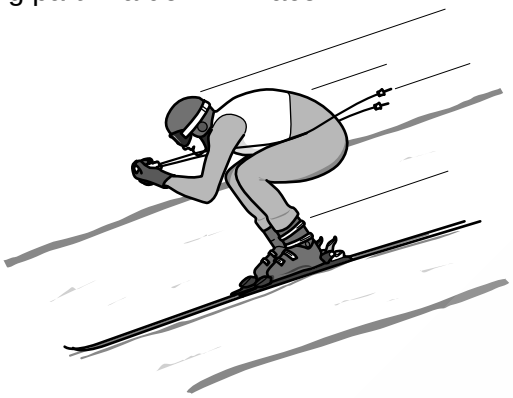


Fig. 3.1

(a) The mass of the skier, including his equipment, is 75 kg. In the ski race, the total vertical change in height is 880 m.

Calculate the decrease in the gravitational potential energy (g.p.e.) of the skier.

decrease in g.p.e. = ...[2]

(b) The skier starts from rest. The total distance travelled by the skier during the descent is 2800 m. The average resistive force on the skier is 220 N.

Calculate

(i) the work done against the resistive force,

work done = ...[2]

(ii) the kinetic energy of the skier as he crosses the finishing line at the end of the race.

kinetic energy = ...[2]

(c) Suggest why the skier bends his body as shown in Fig. 3.1.

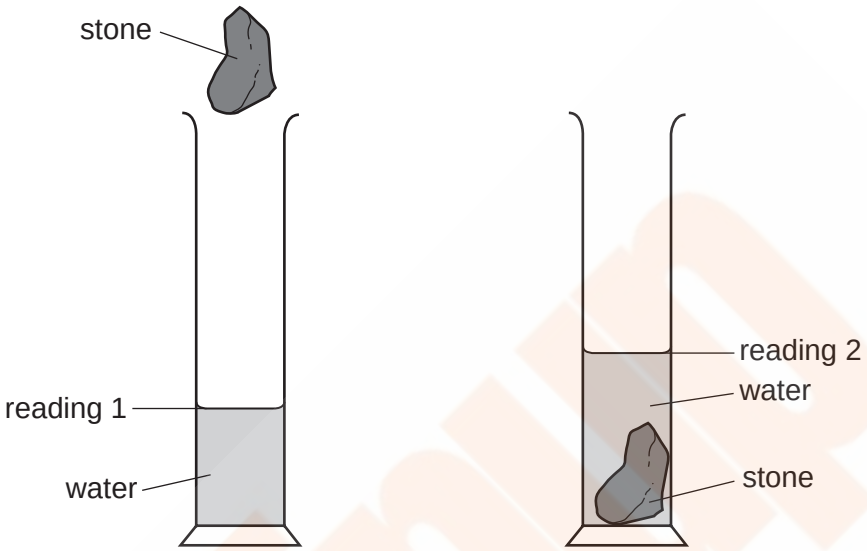
.....[1]

[Total: 7]

1 A student wishes to determine the density of an irregularly-shaped stone.

First he finds the mass of the stone. Next he lowers the stone into a measuring cylinder containing water.

The diagrams show the measuring cylinder before and after the stone is lowered into it.



How should the student calculate the density of the stone?

A mass of stone × reading 2

B mass of stone × (reading 2 – reading 1)

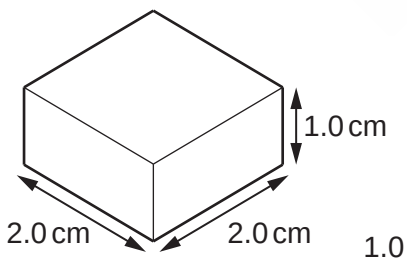
C mass of stone ÷ reading 2

D mass of stone ÷ (reading 2 – reading 1)

2 The diagrams show the dimensions and masses of four regular solid objects. The objects are made from different metals.

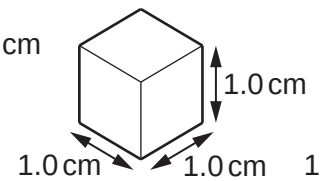
Which metal has the greatest density?

A



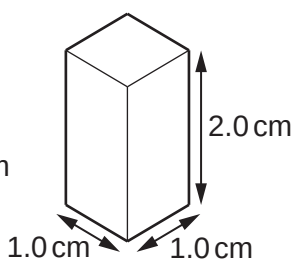
mass = 20 g

B



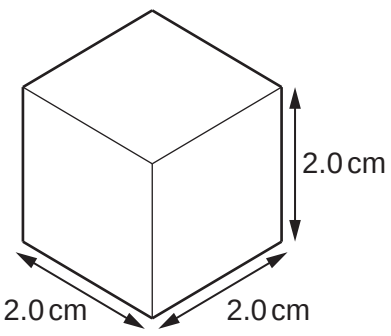
mass = 6.0 g

C



mass = 14 g

D



mass = 32 g

3 Diagram 1 shows a measuring cylinder containing water.

Diagram 2 shows the same measuring cylinder and water after 10 identical solid glass spheres have been added.

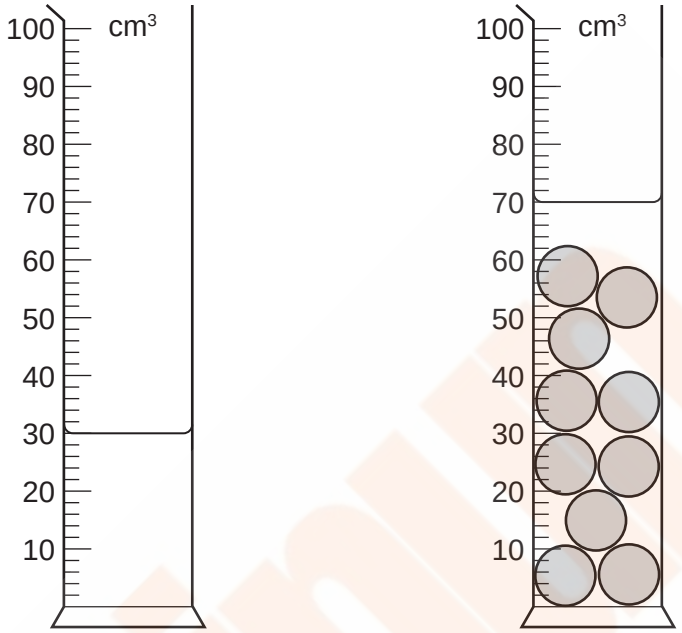


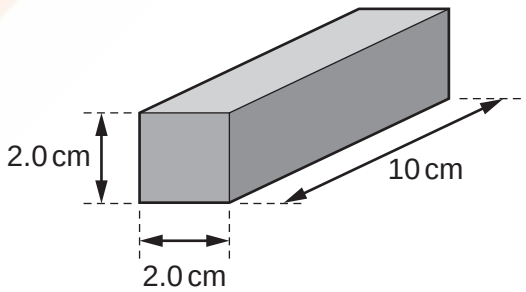
diagram 1 diagram 2

The mass of one of the spheres is 10 g.

What is the density of the glass from which the spheres are made?

A $0.25\,g/cm^3$ **B** $0.40\,g/cm^3$ **C** $2.5\,g/cm^3$ **D** $4.0\,g/cm^3$

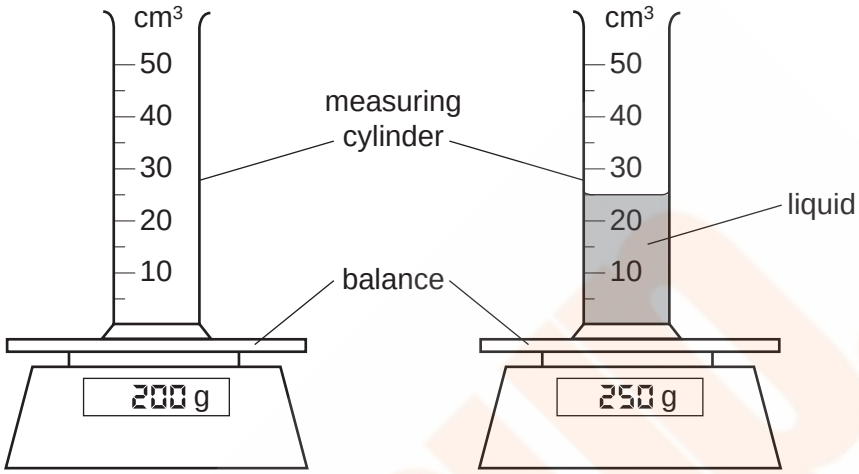
4 The diagram shows a cuboid block made from a metal of density $2.5\,g/cm^3$.



What is the mass of the block?

A 8.0 g **B** 16 g **C** 50 g **D** 100 g

5 The diagram shows an experiment to find the density of a liquid.



What is the density of the liquid?

A $0.5\,g/cm^3$ **B** $2.0\,g/cm^3$ **C** $8.0\,g/cm^3$ **D** $10.0\,g/cm^3$

6 Diagram 1 shows a piece of foam rubber that contains many pockets of air. Diagram 2 shows the same piece of foam rubber after it has been compressed so that its volume decreases.

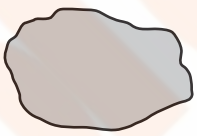


diagram 1
(before compression)

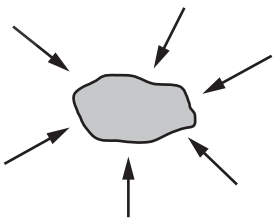
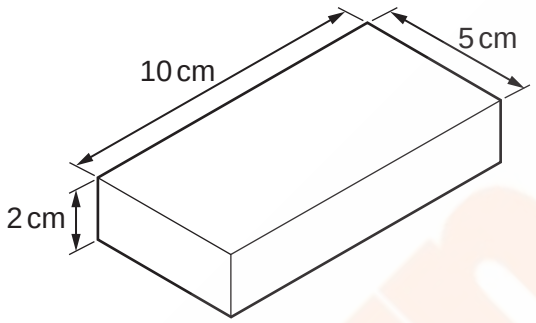


diagram 2
(after compression)

What happens to the mass and to the weight of the foam rubber when it is compressed?

	mass	weight
A	increases	increases
B	increases	no change
C	no change	increases
D	no change	no change

7 A metal block has the dimensions shown. Its mass is 1000 g.



What is the density of the metal?

A $\left(\frac{5 \times 10}{1000 \times 2}\right) \text{g/cm}^3$

B $\left(\frac{2 \times 5 \times 10}{1000}\right) \text{g/cm}^3$

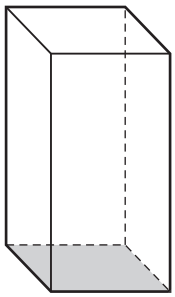
C $\left(\frac{1000 \times 2}{5 \times 10}\right) \text{g/cm}^3$

D $\left(\frac{1000}{2 \times 5 \times 10}\right) \text{g/cm}^3$

8 Which substance in the table has the lowest density?

	substance	mass / g	volume / cm^3
A	nylon	1.14	1.0
B	cotton	1.55	1.0
C	olive oil	1.8	2.0
D	water	2.0	2.0

9 A student wishes to determine the density of the solid block shown.



Which quantities must be known?

A the area of the shaded face and the volume of the block

B the area of the shaded face and the weight of the block

C the mass of the block and the height of the block

D the mass of the block and the volume of the block

10 Two cylinders are made of the same metal. Both cylinders have the same cross-sectional area but one is longer than the other.

cylinder 1 cylinder 2

Which quantity is the same for both cylinders?

A density

B mass

C resistance

D volume

11 The mass of a piece of metal is 1200 g.

A measuring cylinder contains 150 cm^3 of water.

The piece of metal is put into the measuring cylinder. The water level rises to 250 cm^3 and covers the metal.

What is the density of the metal?

A 3.0 g/cm^3 **B** 4.8 g/cm^3 **C** 8.0 g/cm^3 **D** 12.0 g/cm^3

12 A person measures the length, width, height and mass of a metal block with rectangular sides.

Which of these measurements must be used in order to calculate the density of the metal?

A mass only

B height and mass only

C length, width and height only

D length, width, height and mass

13 A liquid has a volume of 100 cm^3 and a mass of 85 g.

The density of water is 1.0 g/cm^3.

How does the density of the liquid compare with the density of water?

A Its density is higher than that of water.

B Its density is lower than that of water.

C Its density is the same as that of water.

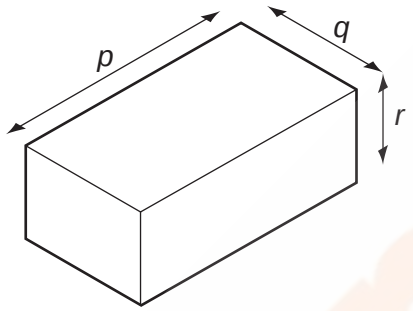
D It is impossible to say with only this data.

14 The table gives the volumes and masses of four objects.

Which object has the greatest density?

	mass / g	volum / cm^3
A	5.4	1
B	13	3
C	15	6
D	18	5

15 The diagram shows the dimensions of a rectangular block of metal of mass m.



Which expression is used to calculate the density of the metal?

A $m \times p \times q$

B $m \times p \times q \times r$

C $\dfrac{m}{(p \times q)}$

D $\dfrac{m}{(p \times q \times r)}$

16 Diagram 1 shows an empty measuring cylinder on a balance.

Diagram 2 shows the same measuring cylinder on the balance, but it now contains a liquid.

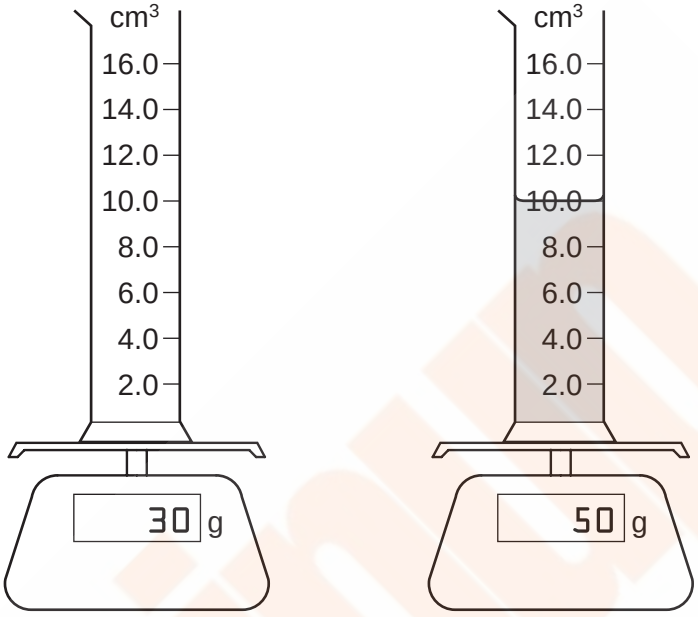
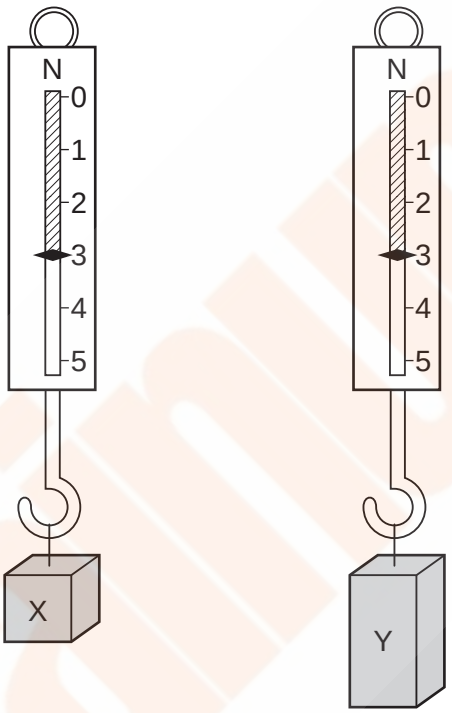


diagram 1 diagram 2

What is the density of the liquid?

A $0.2\,g/cm^3$ **B** $0.5\,g/cm^3$ **C** $2.0\,g/cm^3$ **D** $5.0\,g/cm^3$

17 Two blocks of metal X and Y hang from spring balances, as shown in the diagrams.



What does the diagram show about X and Y?

A They have the same mass and the same volume but different weights.

B They have the same mass and the same weight but different volumes.

C They have the same mass, the same volume and the same weight.

D They have the same weight and the same volume but different masses.

18 A measuring cylinder has a mass of 120 g when empty.

When it contains 50 cm^3 of a liquid, the total mass of the measuring cylinder and the liquid is 160 g.

What is the density of the liquid?

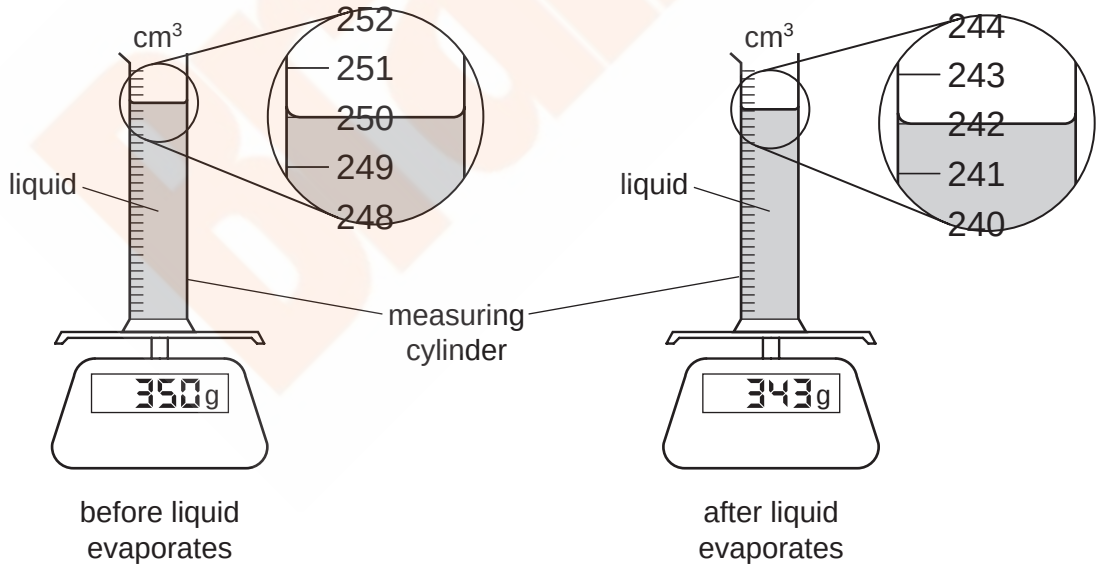
A $\frac{40}{50}$ g/cm^3

B $\frac{50}{40}$ g/cm^3

C $\frac{120}{50}$ g/cm^3

D $\frac{160}{50}$ g/cm^3

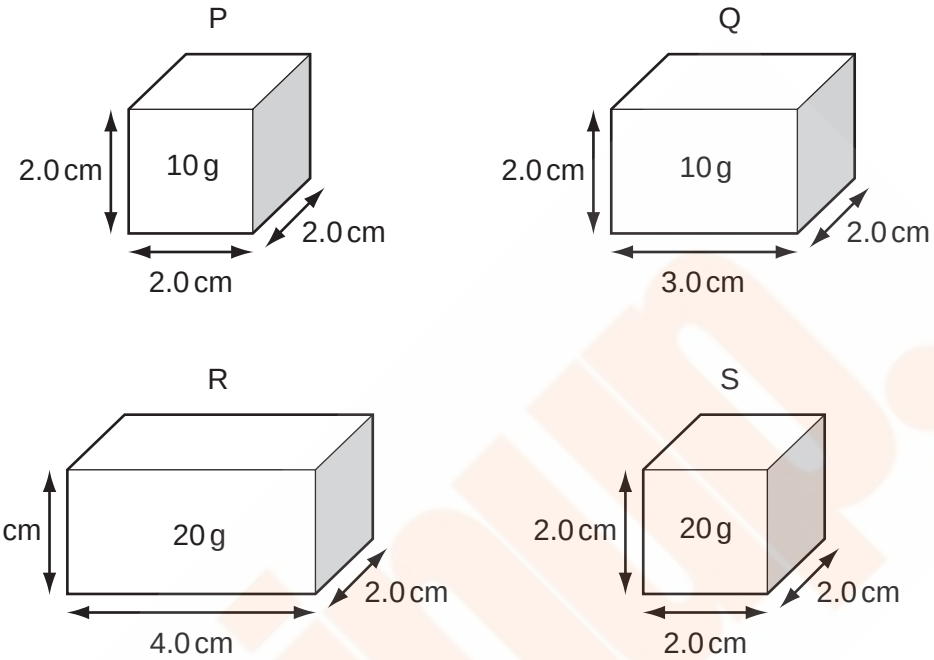
19 A measuring cylinder containing liquid is placed on a top-pan balance. The apparatus is left overnight and some of the liquid evaporates. The diagrams show the readings.



What is the density of the liquid?

A 0.875 g/cm^3 **B** 1.14 g/cm^3 **C** 1.40 g/cm^3 **D** 1.42 g/cm^3

20 Four rectangular blocks, P, Q, R and S are shown. Each block is labelled with its size and its mass.

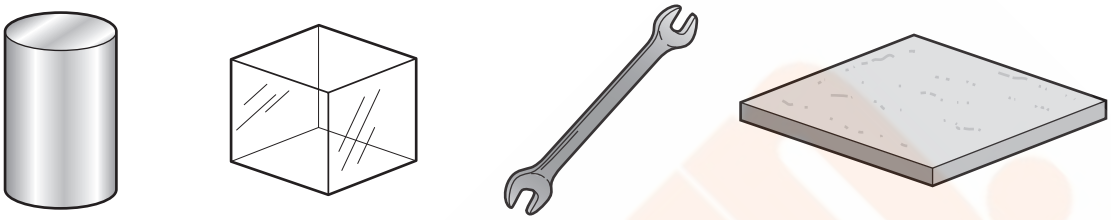


Which two blocks have the same density?

A P and Q **B** P and R **C** Q and R **D** R and S

21 A student is given four different objects and a metre rule.
Each object has a known mass. She is asked to determine the densities of the materials from which the four objects are made.

The objects are a copper cylinder, a glass cube, a steel spanner and a stone tile.



copper glass steel stone

Using only the metre rule, she is able to find the densities of only three of the four materials.

Which three materials are these?

A copper, glass and steel

B copper, glass and stone

C copper, steel and stone

D glass, steel and stone

22 A stone has a volume of $0.50\,cm^3$ and a mass of $2.0\,g$.

What is the density of the stone?

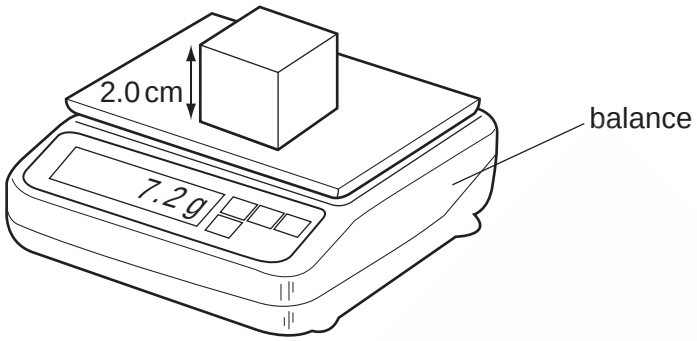
A $0.25\,g/cm^3$

B $1.5\,g/cm^3$

C $2.5\,g/cm^3$

D $4.0\,g/cm^3$

23 A cube of side 2.0 cm is placed on a balance.



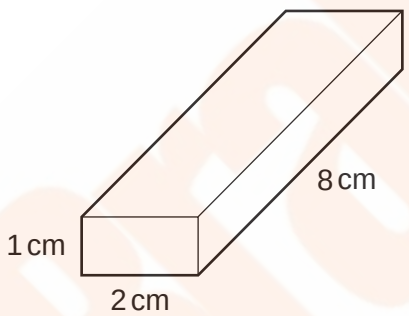
What is the density of the cube?

A $0.90\,g/cm^3$ **B** $1.2\,g/cm^3$ **C** $1.8\,g/cm^3$ **D** $3.6\,g/cm^3$

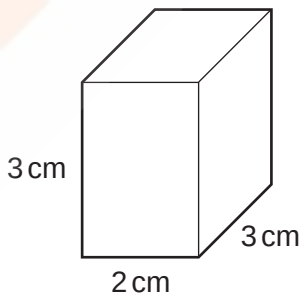
24 The diagrams show four blocks with the same mass.

Which block is made from the least dense material?

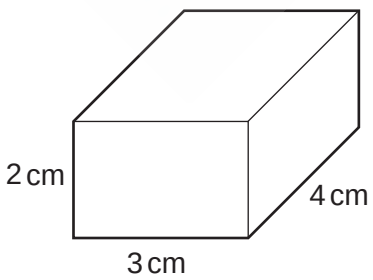
A



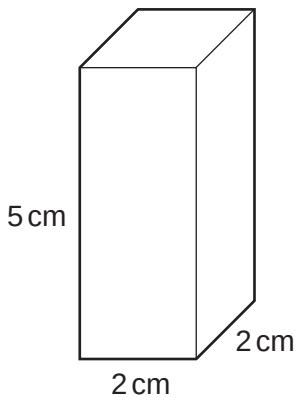
B



C



D



25 A student is told to measure the density of a liquid and also of a large cube of metal.

Which pieces of equipment are sufficient to be able to take the measurements needed?

A balance, measuring cylinder and ruler

B balance and thermometer

C measuring cylinder and ruler

D measuring cylinder, ruler and thermometer

1 **(a)** State the factors which completely describe a vector quantity.

.....

..... [1]

(b) An aeroplane is flying towards the east in still air at 92 m/s. A wind starts to blow at 24 m/s towards the north.

Draw a vector diagram to find the resultant velocity of the aeroplane. Use a scale of 1.0 cm = 10 m/s.

resultant speed = ...

angle between resultant and easterly direction = ...
[5]

[Total: 6]

2 **(a)** A stationary body is acted upon by a number of forces. State the two conditions which must apply for the body to remain at rest.

1. .....

2. .....

[2]

(b) Fig. 3.1 shows a device used for compressing crushed material.

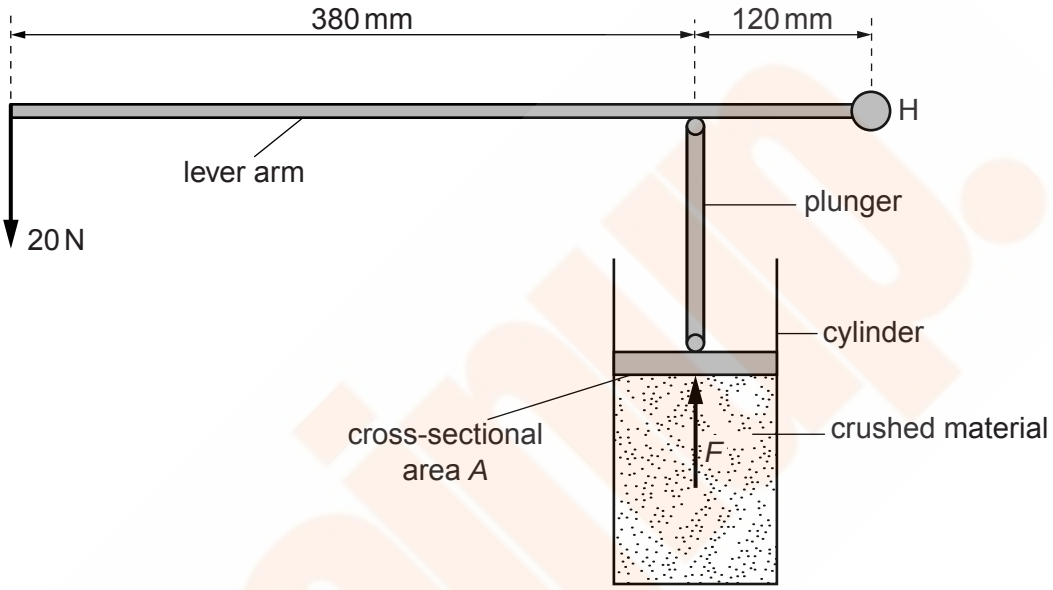


Fig. 3.1

The lever arm rotates about the hinge H at its right-hand end. A force of 20 N acts downwards on the left-hand end of the lever arm. The force *F* of the crushed material on the plunger acts upwards. Ignore the weight of the lever arm.

(i) Use the clockwise and anticlockwise moments about H to calculate the upward force *F* which the crushed material exerts on the plunger. The distances are shown on Fig. 3.1.

force *F* = ... [3]

(ii) The cross-sectional area A of the plunger in contact with the crushed material is $0.0036\,m^2$. Calculate the pressure exerted on the crushed material by the plunger.

pressure = ... [2]

[Total: 7]

3 Fig. 2.1 is a head-on view of an airliner flying at constant speed in a circular horizontal path. The centre of the circle is to the left of the diagram.

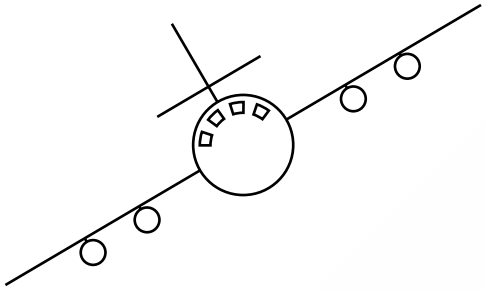


Fig. 2.1

(a) On Fig. 2.1, draw the resultant force acting on the airliner. Explain your answer.

.....

.....

..... [3]

(b) The weight of the airliner is 1.20×10^6 N and there is an aerodynamic lift force of 1.39×10^6 N acting at 30° to the left of the vertical.

By drawing a scale vector diagram, or otherwise, show that the resultant of these two forces is in the same direction as the resultant force you drew in **(a)**.

(c) The speed is constant as the airliner flies in this circular path.

State and explain what is happening to the velocity.

.....

.....

.....

..... [2]

[Total: 8]

4 Fig. 3.1 shows an aeroplane of mass 3.4×10^5 kg accelerating uniformly from rest along a runway.

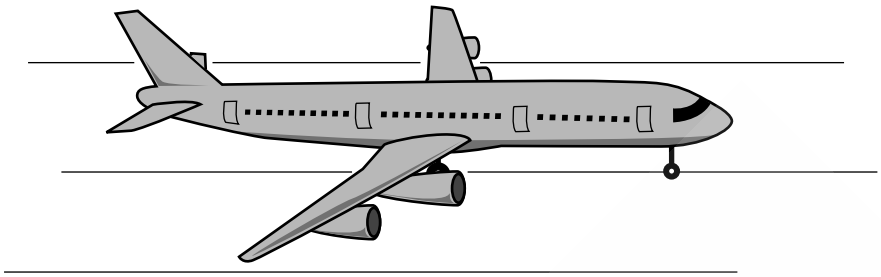


Fig. 3.1

After 26 s it reaches a speed of 65 m / s.

(a) Calculate

(i) the acceleration of the aeroplane,

acceleration = ... [2]

(ii) the resultant force on the aeroplane.

force = ... [2]

(b) Just after taking off, the aeroplane continues to accelerate as it gains height.

(i) State **two** forms of energy that increase during this time.

1. .....

2. ..... [2]

(ii) State **one** form of energy that decreases during this time.

..... [1]

(iii) State why the total energy of the aeroplane decreases during this time.

.....

..... [1]

(c) When the aeroplane reaches its maximum height, it starts to follow a curved path at a constant speed.

State the direction of the resultant force on the aeroplane.

..... [1]

[Total: 9]

5 **(a)** Complete the following statement:

The moment of a force about a point is .....

multiplied by .....[1]

(b) Fig. 3.1 shows a uniform iron bar B of weight 30 N and length 1.40 m. The bar is being used to lift one edge of a concrete slab S. A stone, placed 0.20 m from one end of B, acts as a pivot. A force of 40 N pushing down at the other end of B is just enough to lift the slab and hold it as shown.

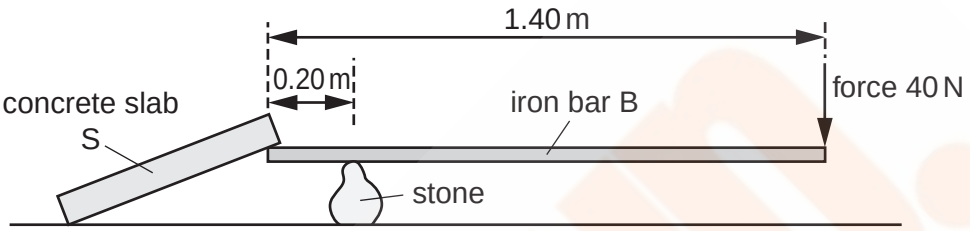


Fig. 3.1

(i) On Fig. 3.1, draw an arrow to show the weight of bar B acting from its centre of mass. [1]

(ii) State the distance *d* of the centre of mass of bar B from the pivot.

d = ...[1]

(iii) Calculate the total clockwise moment, about the pivot, of the forces acting on bar B.

total clockwise moment = ...[3]

(iv) Calculate the downward force which the slab S exerts on the end of bar B.

force = ...[2]

(v) Suggest a change to the arrangement in Fig. 3.1 that would reduce the force required to lift the slab.

.....

.....[1]

[Total: 9]

1 **(a)** **(i)** On Fig. 3.1, draw a graph of extension against load for a spring which obeys Hooke's law. [1]

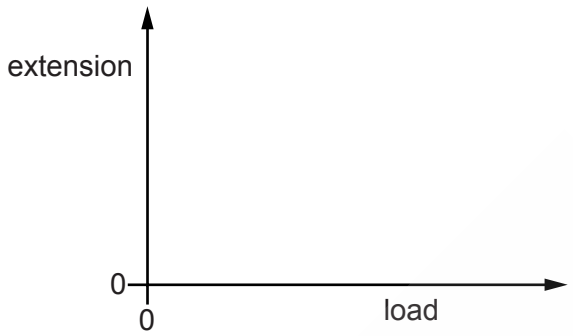


Fig. 3.1

(ii) State the word used to describe the energy stored in a spring that has been stretched or compressed.

.....[1]

(b) Fig. 3.2 shows a model train, travelling at speed *v,* approaching a buffer.

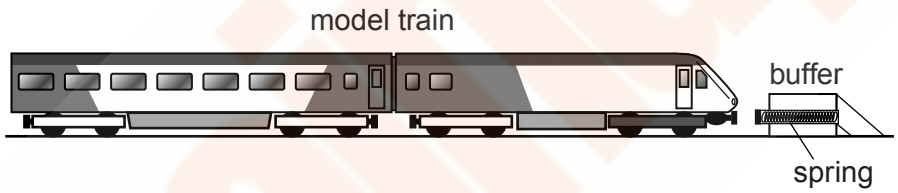


Fig. 3.2

The train, of mass 2.5 kg, is stopped by compressing a spring in the buffer. After the train has stopped, the energy stored in the spring is 0.48 J.

Calculate the initial speed *v* of the train.

v = ...[4]

[Total: 6]

2 Fig. 2.1 shows a conveyor belt transporting a package to a raised platform. The belt is driven by a motor.

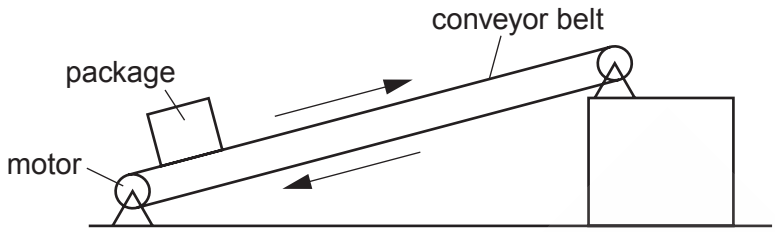


Fig. 2.1

(a) The mass of the package is 36 kg.

Calculate the increase in the gravitational potential energy (g.p.e.) of the package when it is raised through a vertical height of 2.4 m.

increase in g.p.e. = ... [2]

(b) The package is raised through the vertical height of 2.4 m in 4.4 s.

Calculate the power needed to raise the package.

power = ... [2]

(c) The electrical power supplied to the motor is much greater than the answer to **(b)**.

Explain how the principle of conservation of energy applies to this system.

.....

.....

..... [2]

(d) Assume that the power available to raise packages is constant. A package of mass greater than 36 kg is raised through the same height.

Suggest and explain the effect of this increase in mass on the operation of the conveyer belt.

.....

.....

.....

.....

..... [3]

[Total: 9]

3 An athlete of mass 64 kg is bouncing up and down on a trampoline.

At one moment, the athlete is stationary on the stretched surface of the trampoline. Fig. 3.1 shows the athlete at this moment.

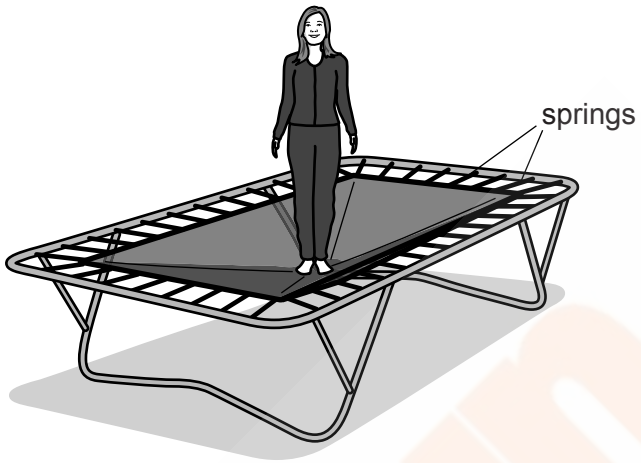


Fig. 3.1

(a) State the form of energy stored due to the stretching of the surface of the trampoline.

.....[1]

(b) The stretched surface of the trampoline begins to contract. The athlete is pushed vertically upwards and she accelerates. At time *t*, when her upwards velocity is 6.0 m/s, she loses contact with the surface.

(i) Calculate her kinetic energy at time *t*.

kinetic energy = ...[2]

(ii) Calculate the maximum possible distance she can travel upwards after time *t*.

maximum distance = ...[3]

(iii) In practice, she travels upwards through a slightly smaller distance than the distance calculated in **(ii)**.

Suggest why this is so.

.....

.....[1]

(c) The trampoline springs are tested. An extension-load graph is plotted for one spring. Fig. 3.2 is the graph.

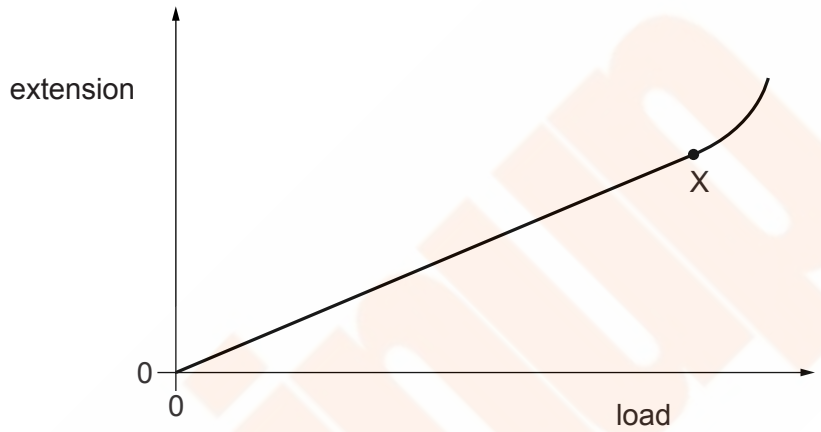


Fig. 3.2

(i) State the name of the point X.

.....[1]

(ii) State the name of the law that the spring obeys between the origin of the graph and point X.

.....[1]

[Total: 9]

4 An electric train is initially at rest at a railway station. The motor causes a constant force of 360 000 N to act on the train and the train begins to move.

(a) State the form of energy gained by the train as it begins to move.

.....[1]

(b) The train travels a distance of 4.0 km along a straight, horizontal track.

(i) Calculate the work done on the train during this part of the journey.

work done = ...[2]

(ii) The mass of the train is 450 000 kg.

Calculate the maximum possible speed of the train at the end of the first 4.0 km of the journey.

maximum possible speed = ...[3]

(iii) In practice, the speed of the train is much less than the value calculated in **(ii)**.

Suggest **one** reason why this is the case.

.....

.....[1]

(c) After travelling 4.0 km, the train reaches its maximum speed. It continues at this constant speed on the next section of the track where the track follows a curve which is part of a circle.

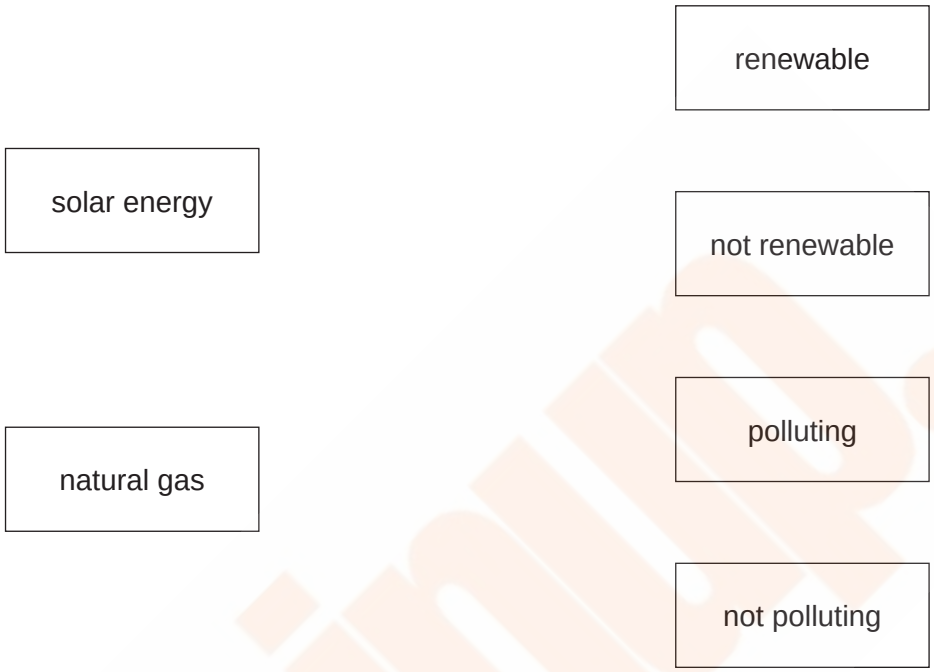
State the direction of the resultant force on the train as it follows the curved path.

.....[1]

[Total: 8]

5 **(a)** The boxes on the left contain the names of some sources of energy. The boxes on the right contain properties of some sources of energy.

Draw **two** straight lines **from each box** on the left to the two boxes on the right which describe that source of energy.



[2]

(b) Coal-fired power stations are polluting.

State an advantage of using coal as a source of energy.

.....

.....[1]

(c) A coal-fired power station generates electricity at night when it is not needed.

Some of this energy is stored by pumping water up to a mountain lake. When there is high demand for electricity, the water is allowed to flow back through turbines to generate electricity.

On one occasion, 2.05×10^8 kg of water is pumped up through a vertical height of 500 m.

(i) Calculate the weight of the water.

weight = ...[1]

(ii) Calculate the gravitational potential energy gained by the water.

energy gained = ...[2]

(iii) The electrical energy used to pump the water up to the mountain lake is 1.2×10^{12} J. Only 6.2×10^{11} J of electrical energy is generated when the water is released.

Calculate the efficiency of this energy storage scheme.

efficiency = ...[2]

[Total: 8]

6 Fig. 3.1 shows a skier taking part in a downhill race.

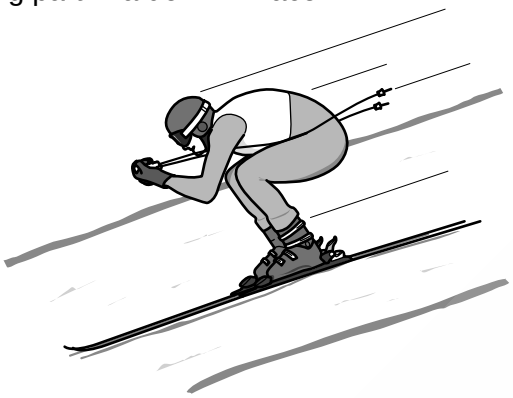


Fig. 3.1

(a) The mass of the skier, including his equipment, is 75 kg. In the ski race, the total vertical change in height is 880 m.

Calculate the decrease in the gravitational potential energy (g.p.e.) of the skier.

decrease in g.p.e. = ...[2]

(b) The skier starts from rest. The total distance travelled by the skier during the descent is 2800 m. The average resistive force on the skier is 220 N.

Calculate

(i) the work done against the resistive force,

work done = ...[2]

(ii) the kinetic energy of the skier as he crosses the finishing line at the end of the race.

kinetic energy = ...[2]

(c) Suggest why the skier bends his body as shown in Fig. 3.1.

.....[1]

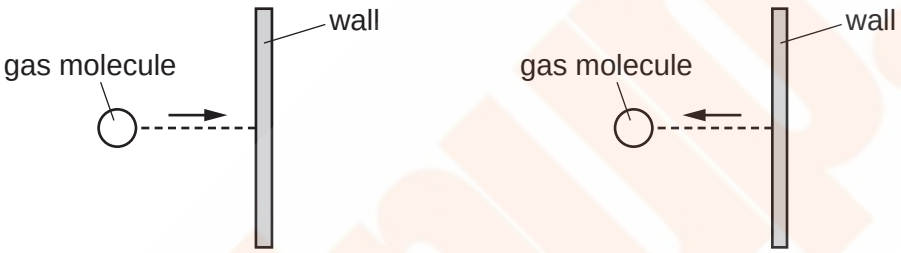
[Total: 7]

1 An object of mass 50 kg accelerates from a velocity of 2.0 m/s to a velocity of 10 m/s in the same direction.

What is the impulse provided to cause this acceleration?

A 250 Ns **B** 400 Ns **C** 850 Ns **D** 2500 Ns

2 A gas molecule strikes the wall of a container. The molecule rebounds with the same speed.



before hitting the wall after hitting the wall

What happens to the kinetic energy and what happens to the momentum of the molecule?

	kinetic energy	momentum
A	changes	changes
B	changes	stays the same
C	stays the same	changes
D	stays the same	stays the same

3 Which quantity is measured in newton seconds (N s)?

A impulse

B moment

C power

D work done

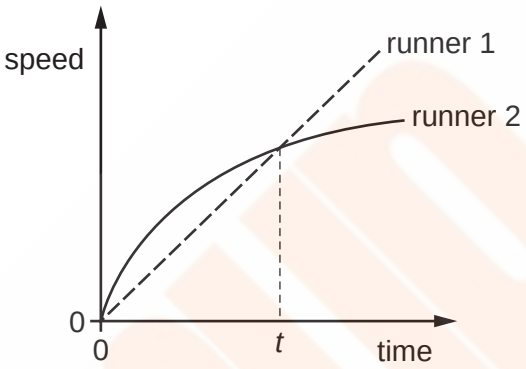
1 A train begins a journey from a station and travels 60 km in a time of 20 minutes.

What is the average speed of the train?

A 3.0 m/s **B** 5.0 m/s **C** 50 m/s **D** 60 m/s

2 Two runners take part in a race.

The graph shows how the speed of each runner changes with time.



What does the graph show about the runners at time *t*?

A Both runners are moving at the same speed.

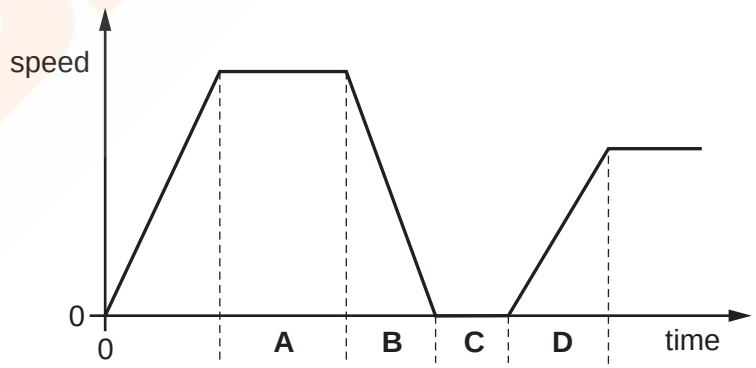
B Runner 1 has zero acceleration.

C Runner 1 is overtaking runner 2.

D Runner 2 is slowing down.

3 The graph shows how the speed of a van changes with time for part of its journey.

In which labelled section is the van decelerating?



4 A large stone is dropped from a bridge into a river. Air resistance can be ignored.

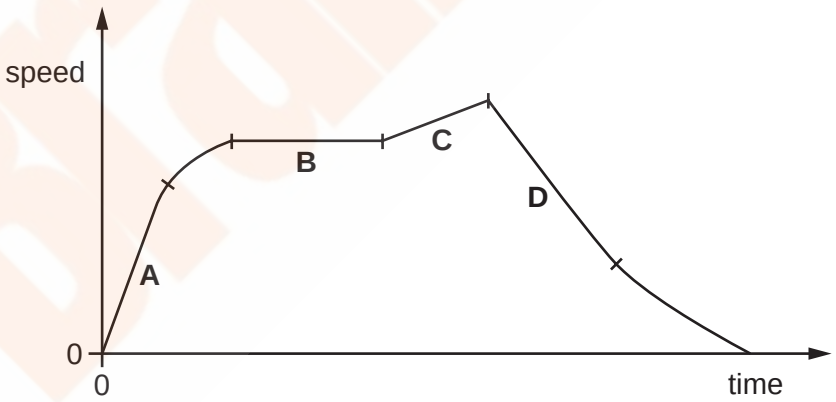
Which row describes the acceleration and the speed of the stone as it falls?

	acceleration of the stone	speed of the stone
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

5 A car travels along a straight road.

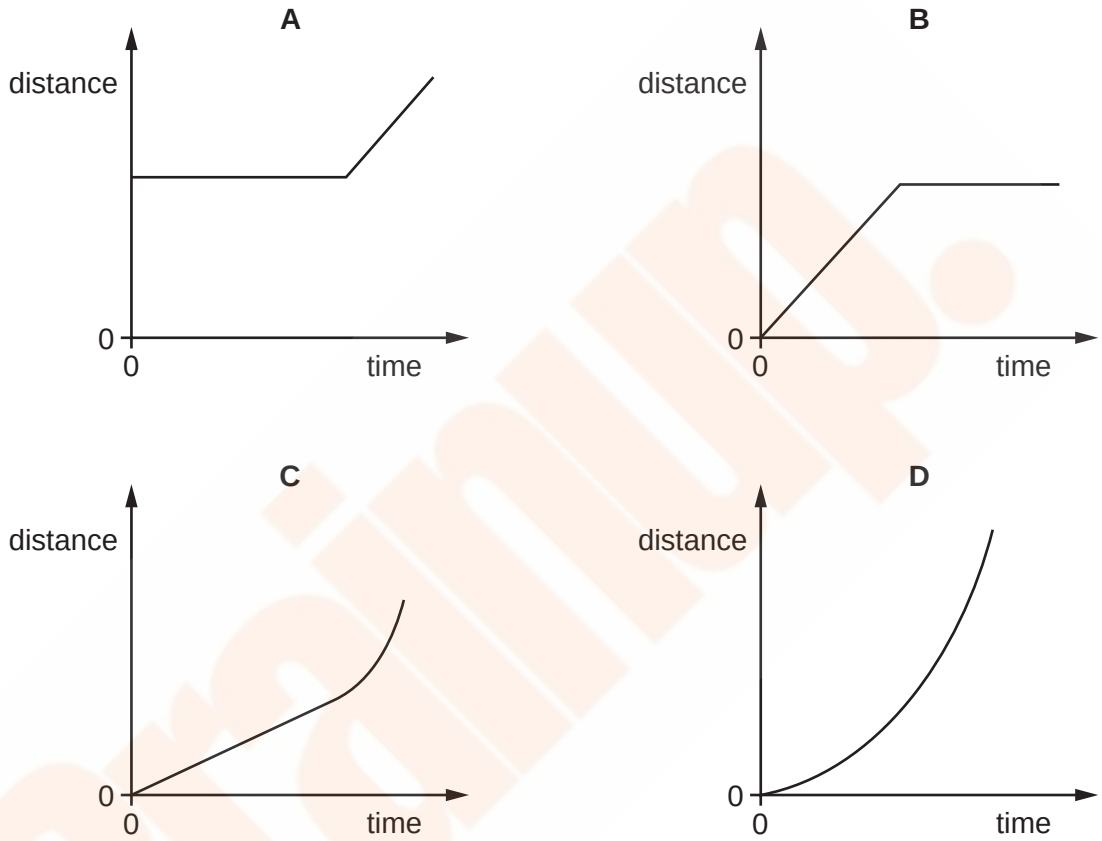
The speed-time graph for this journey is shown.

During which labelled part of the journey is the resultant force on the car zero?



6 An object moves at a constant speed for some time, then begins to accelerate.

Which distance-time graph shows this motion?

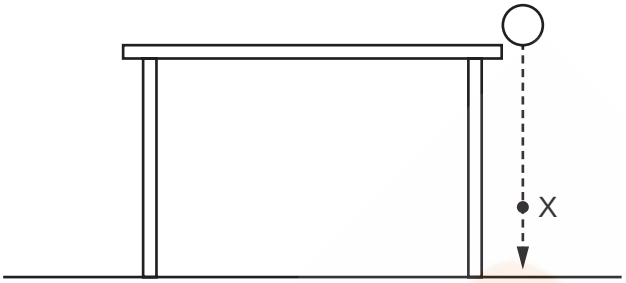


7 A car travels at an average speed of 60 km / h for 15 minutes.

How far does the car travel in this time?

A 4.0 km **B** 15 km **C** 240 km **D** 900 km

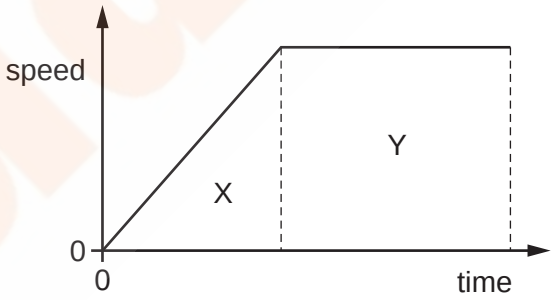
8 A ball is dropped from a table-top. Air resistance may be ignored.



Which row describes the velocity and the acceleration of the ball at point X?

	acceleration	velocity
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

9 The diagram shows the speed-time graph for a car.



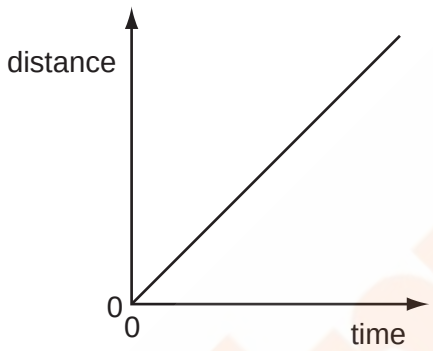
Which area represents the distance travelled while the car is accelerating?

A X **B** X + Y **C** Y **D** Y – X

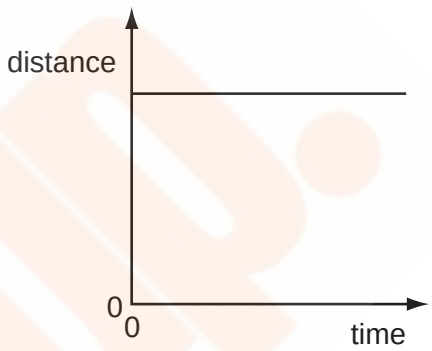
10 Two distance-time graphs and two speed-time graphs are shown.

Which graph represents an object that is at rest?

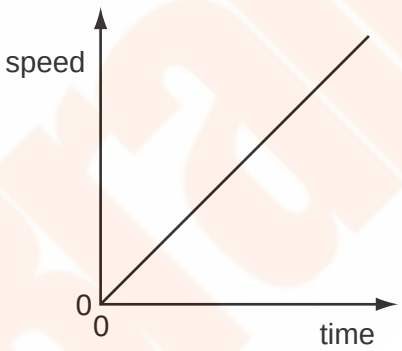
A



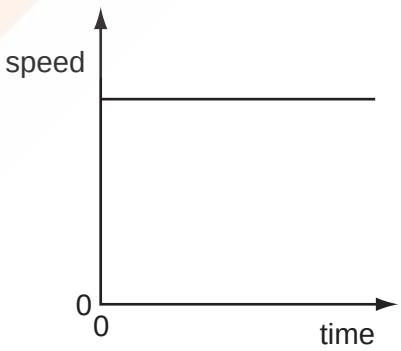
B



C

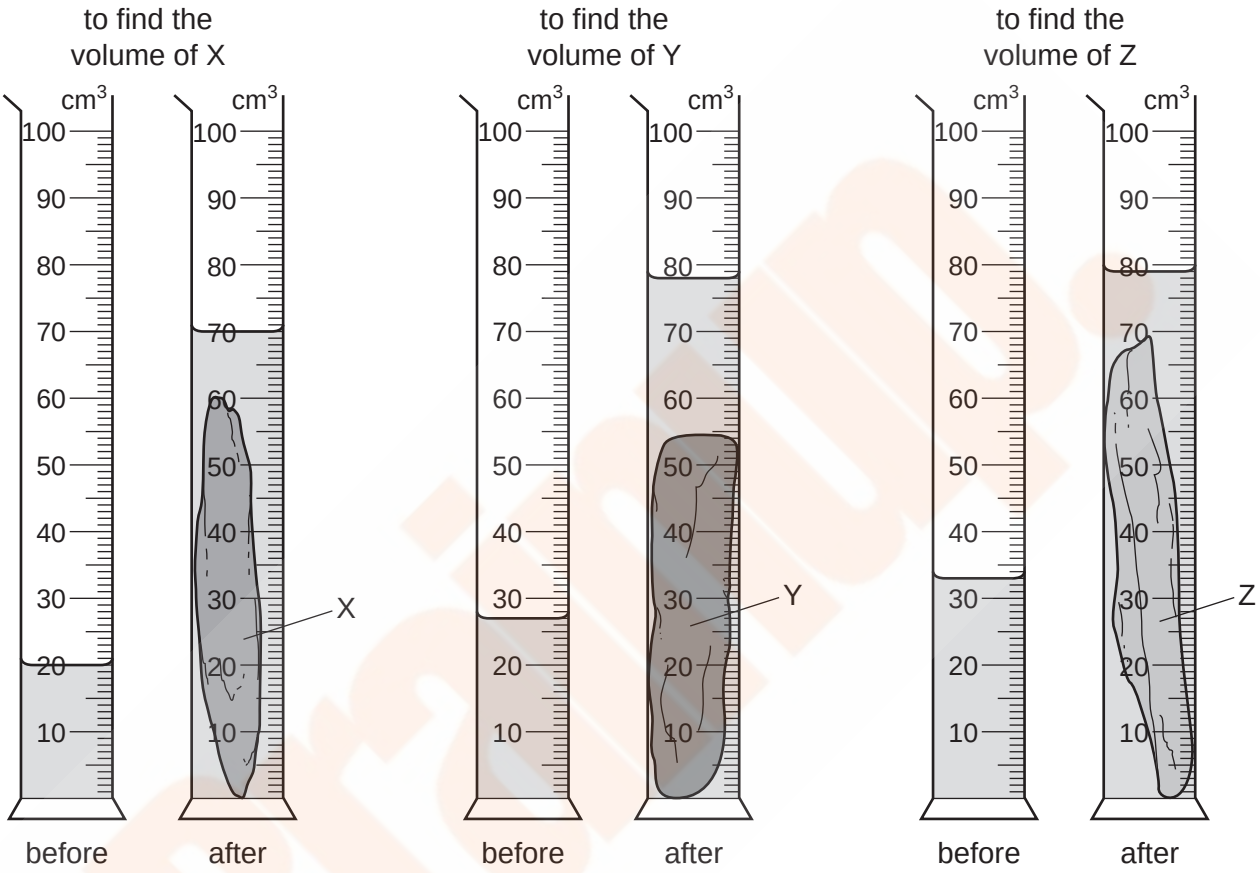


D



11 A geologist compares the volumes of three rocks, X, Y and Z. Three measuring cylinders contain different volumes of water. He places each rock into one of the measuring cylinders.

The diagrams show the measuring cylinders before and after the rocks are put in.

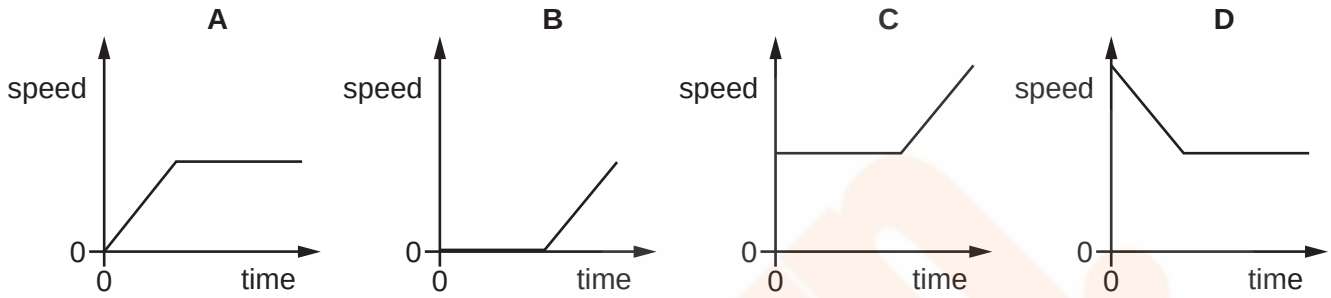


Which row shows the volumes of X, Y and Z in order, from largest to smallest?

	largest volume → smallest volume		
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

12 A car moves with constant speed and then constant acceleration.

Which graph is the speed-time graph for the car?



13 What does the area under a speed-time graph represent?

A acceleration

B average speed

C deceleration

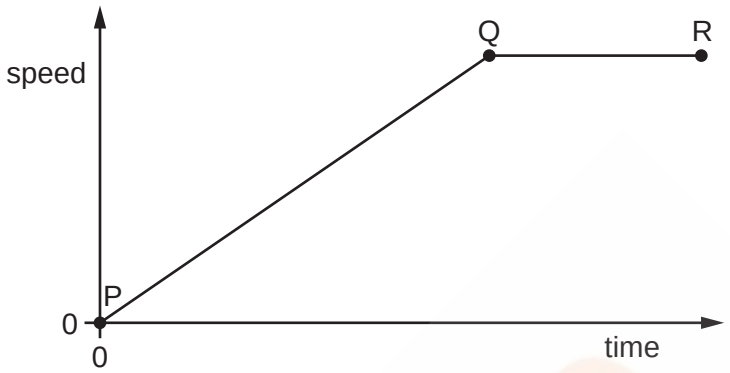
D distance travelled

14 A car travels 100 km. The journey takes two hours. The highest speed of the car is 80 km / h, and the lowest speed is 40 km / h.

What is the average speed for the journey?

A 40 km / h **B** 50 km / h **C** 60 km / h **D** 120 km / h

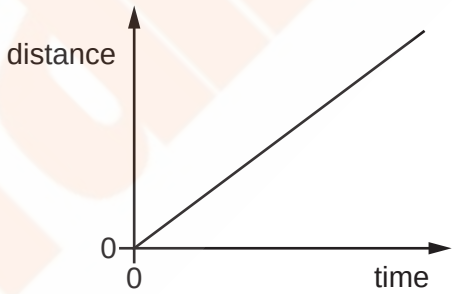
15 The speed-time graph shows the motion of a car.



Which row describes the motion?

	between P and Q	between Q and R
A	accelerating	moving at constant speed
B	accelerating	not moving
C	moving at constant speed	decelerating
D	moving at constant speed	not moving

16 The diagram shows the distance-time graph of an object.



Which statement describes the object?

A It is accelerating.

B It is moving at a constant speed.

C It is slowing down.

D It is stationary.

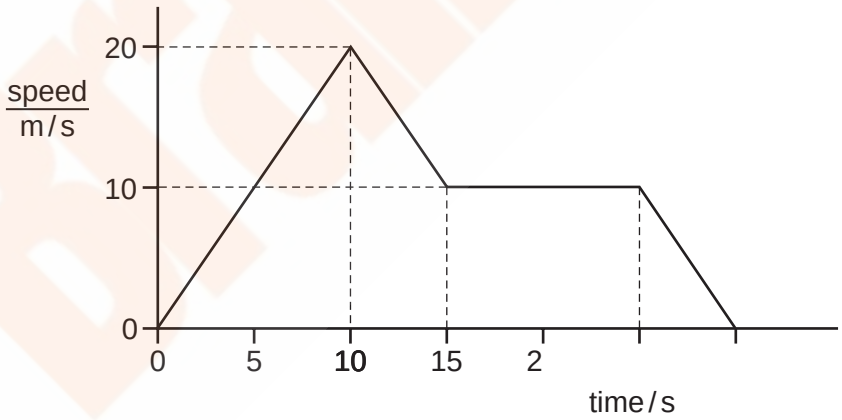
17 A tennis player hits a ball hard and 0.40 s later hears the echo from a wall.

The speed of sound in air is 330 m / s.

How far away is the player from the wall?

A 66 m **B** 132 m **C** 264 m **D** 825 m

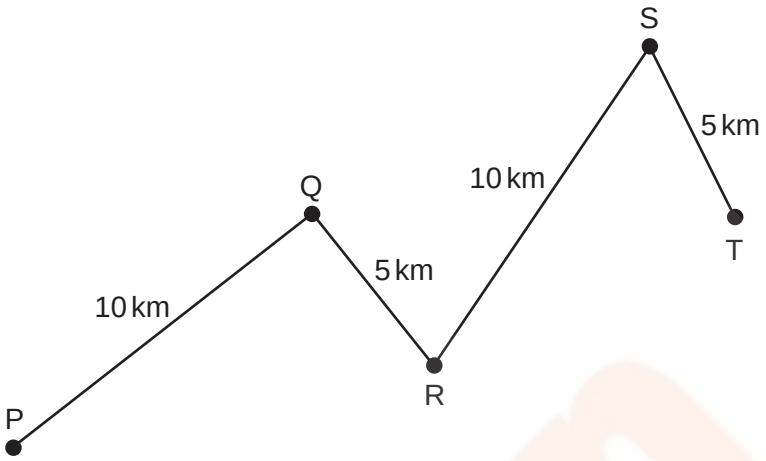
18 The graph represents the motion of a car.



What is the distance travelled by the car while it is moving at a constant speed?

A 100 m **B** 150 m **C** 250 m **D** 300 m

19 A car travels along the route PQRST in 30 minutes.



What is the average speed of the car?

A 10 km / hour **B** 20 km / hour **C** 30 km / hour **D** 60 km / hour

20 The table shows the readings on a car speedometer at 5 second intervals.

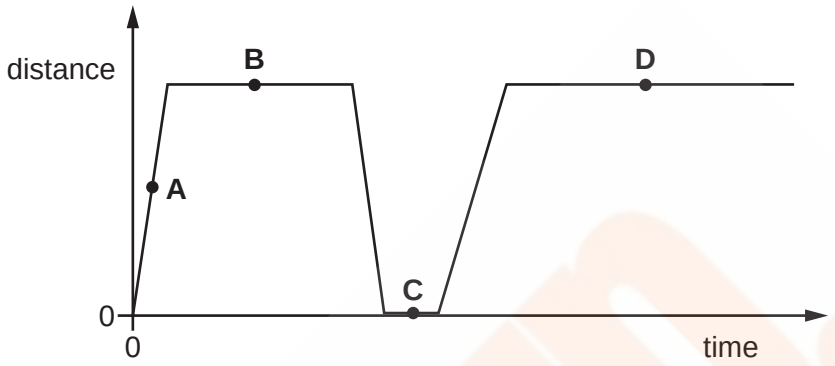
time / s	speed / km/h
0	0
5	30
10	50
15	60
20	65

Which row describes the speed and the acceleration of the car?

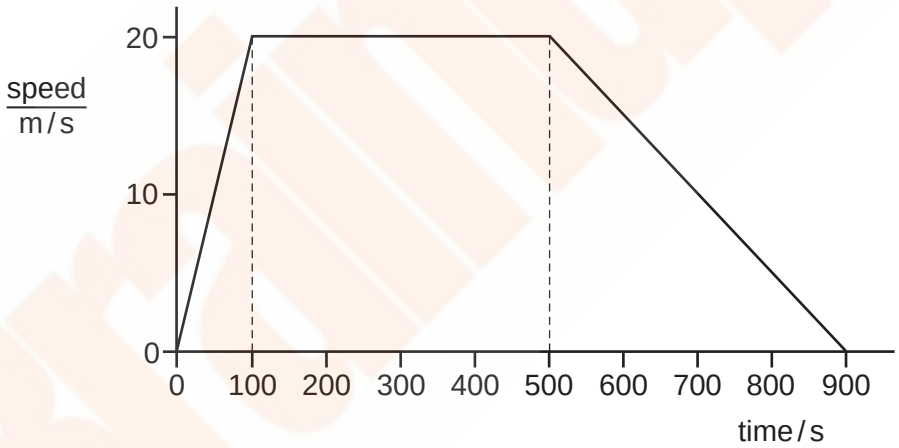
	speed	acceleration
A	decreasing	zero
B	decreasing	not zero
C	increasing	zero
D	increasing	not zero

21 The diagram shows the distance-time graph for a car.

At which labelled point is the car moving with constant speed?



22 The graph represents the motion of a train travelling between two stations.



Which statement about the train is correct?

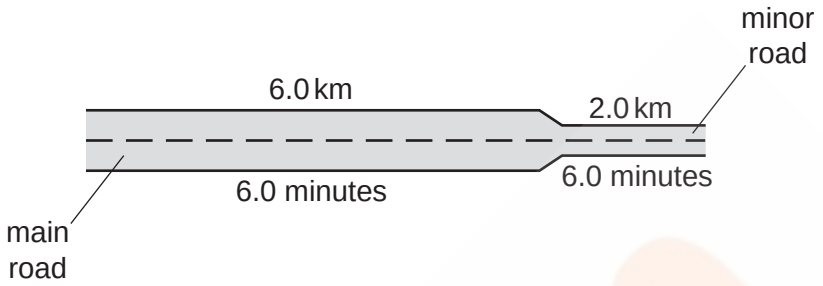
A Its acceleration takes a longer time than its deceleration.

B It travels at constant speed for less than half of its journey time.

C It travels 2000 m in the first 100 s.

D It travels 10 000 m at constant speed.

23 A car travels 6.0 km along a main road in 6.0 minutes. It then travels 2.0 km along a minor road in 6.0 minutes.



Which calculation of average speed for the whole journey is correct?

A 8.0 ÷ 12.0 = 0.67 km / minute

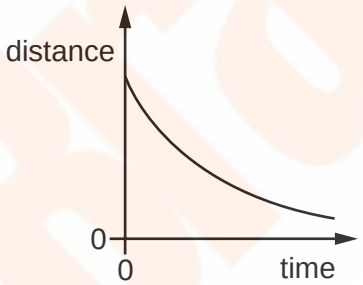
B 12.0 ÷ 8.0 = 1.5 km / minute

C 8.0 + 12.0 = 20 km / minute

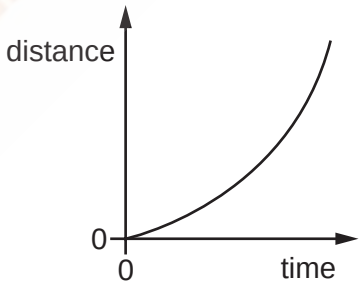
D 8.0 × 12.0 = 96 km / minute

24 Which distance / time graph represents the motion of an object moving at constant speed?

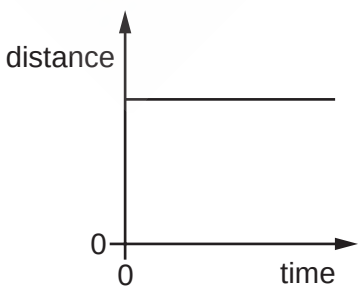
A



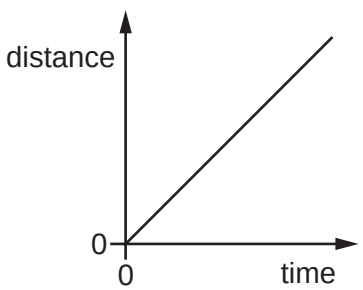
B



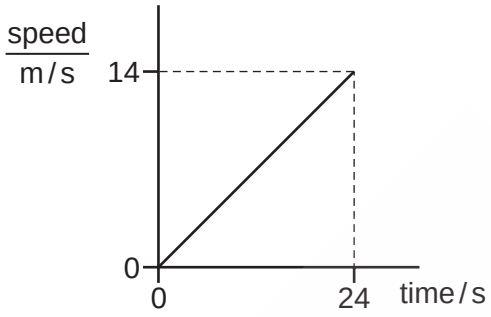
C



D



25 The graph shows how the speed of a car changes with time.



Which calculation gives the distance travelled by the car in 24 seconds?

A $\left(\frac{14}{24}\right)$m

B $\left(\frac{24}{14}\right)$m

C $\left(\frac{24 \times 14}{2}\right)$m

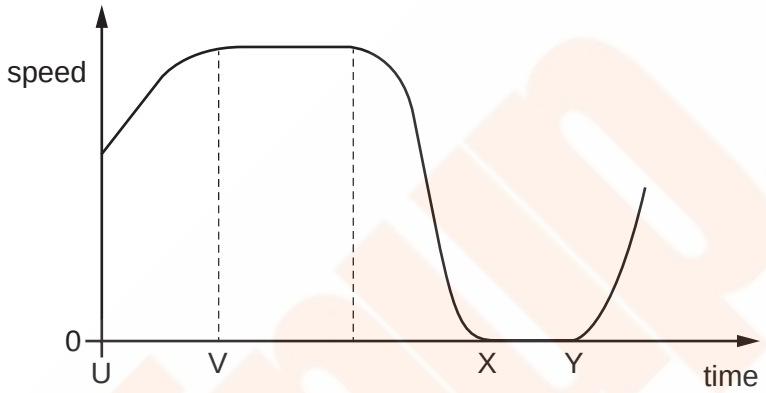
D (24×14)m

26 A car takes 15 minutes to travel along a road that is 20 km long.

What is the average speed of the car?

A 0.75 km/h **B** 5.0 km/h **C** 80 km/h **D** 300 km/h

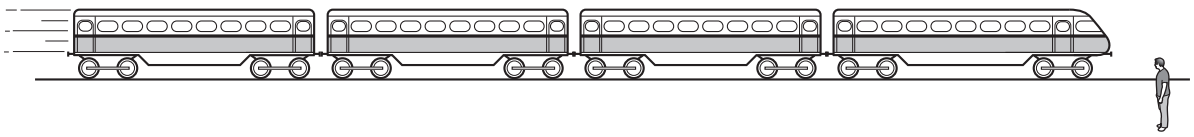
27 The graph shows how the speed of a car changes with time.



Between which two times is the car stationary?

A U and V **B** V and W **C** W and X **D** X and Y

28 A man stands by a railway track.

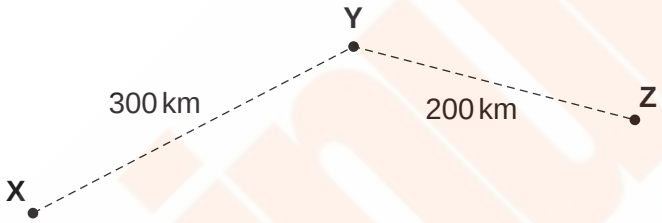


A train travelling at 40 m / s takes 2.0 s to pass the man.

What is the length of the train?

A 20 m **B** 38 m **C** 40 m **D** 80 m

29 An aeroplane flies from town **X** to town **Z**, stopping for 1 hour at town **Y** to pick up more passengers. The distances between the towns are shown in the diagram.



The total time taken between leaving **X** and arriving at **Z** is 3 hours.

What is the average speed of the aeroplane **in the air**?

A $\frac{500}{4}$ km / h **B** $\frac{500}{3}$ km / h **C** $\frac{500}{2}$ km / h **D** $\frac{500}{1}$ km / h

30 Which person is experiencing an acceleration?

A a driver of a car that is braking to stop at traffic lights

B a passenger in a train that is stationary in a railway station

C a shopper in a large store ascending an escalator (moving stairs) at a uniform rate

D a skydiver falling at constant speed towards the Earth

31 A car travels at various speeds during a short journey.

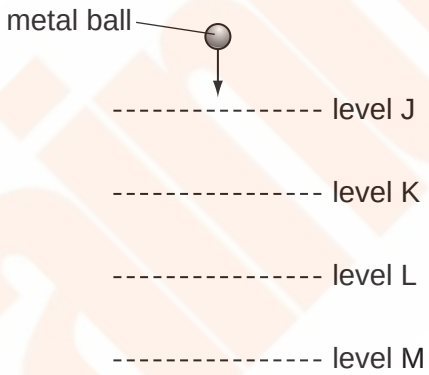
The table shows the distances travelled and the times taken during each of four stages P, Q, R and S.

stage	P	Q	R	S
distance travelled / km	1.8	3.6	2.7	2.7
time taken / minutes	2	2	4	3

During which two stages is the car travelling at the same average speed?

A P and Q **B** P and S **C** Q and R **D** R and S

32 A heavy metal ball falls vertically downwards through air past four equally spaced levels J, K, L and M.

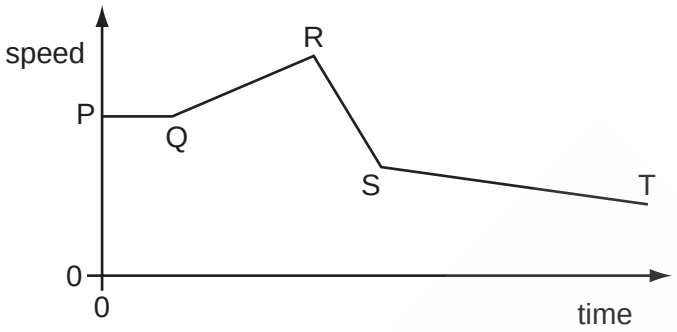


The times taken to fall from one level to the next are measured.

Where is the speed of the ball greatest and which time is shortest?

	speed is greatest between	time is shortest between
A	J and K	J and K
B	J and K	L and M
C	L and M	J and K
D	L and M	L and M

33 The diagram shows the speed / time graph for a train as it travels along a track.



For which part of the graph is the train's speed changing at the greatest rate?

A PQ **B** QR **C** RS **D** ST

34 A small steel ball is dropped from a low balcony.

Ignoring air resistance, which statement describes its motion?

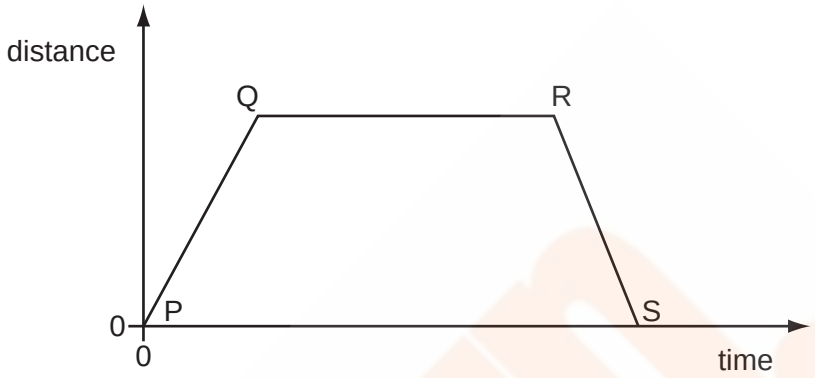
A It falls with constant acceleration.

B It falls with constant speed.

C It falls with decreasing speed.

D It falls with increasing acceleration.

35 The graph shows how the distance travelled by a vehicle changes with time.



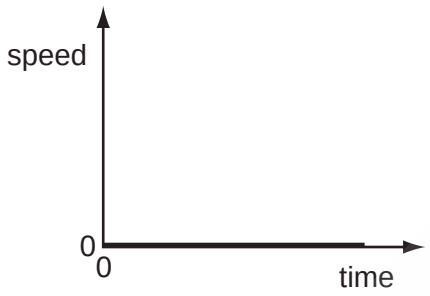
Which row describes the speed of the vehicle in each section of the graph?

	P to Q	Q to R	R to S
A	constant	zero	constant
B	constant	zero	decreasing
C	increasing	constant	decreasing
D	increasing	zero	decreasing

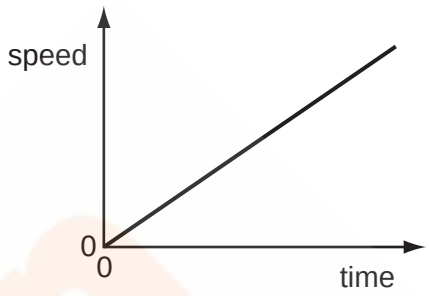
36 A car is moving downhill along a road at a constant speed.

Which graph is the speed / time graph for the car?

A



B



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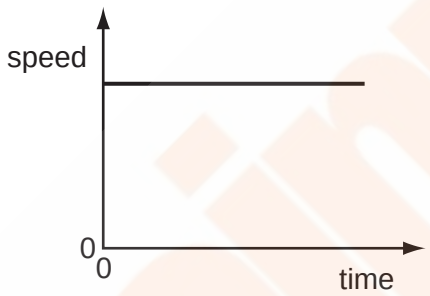

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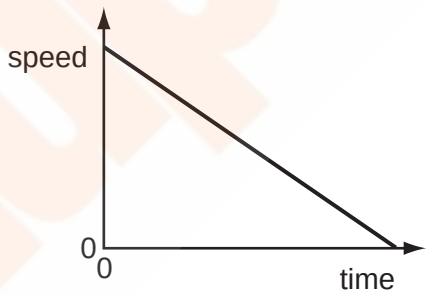


37 In a race, a car travels 60 times around a 3.6 km track. This takes 2.4 hours.

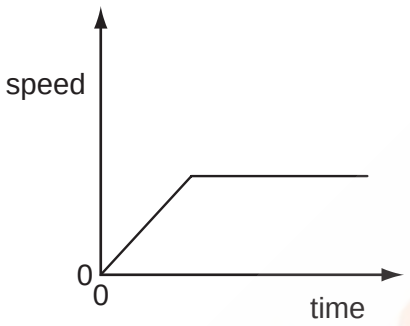
What is the average speed of the car?

A 1.5 km / h **B** 90 km / h **C** 144 km / h **D** 216 km / h

38 An object moves initially with constant speed and then with constant acceleration.

Which graph shows this motion?

A



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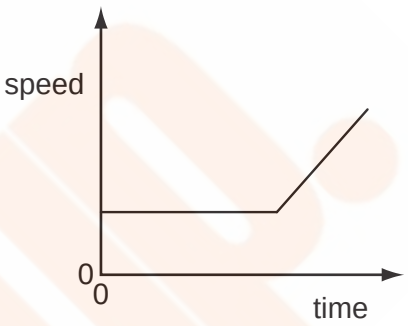

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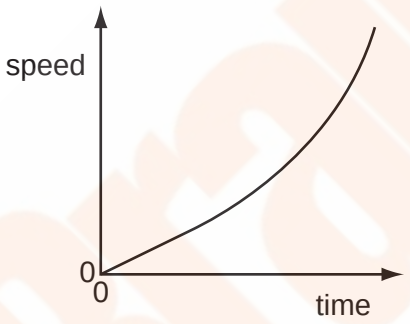
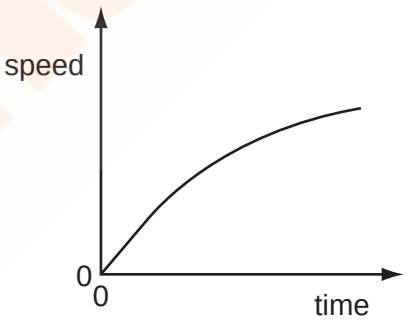




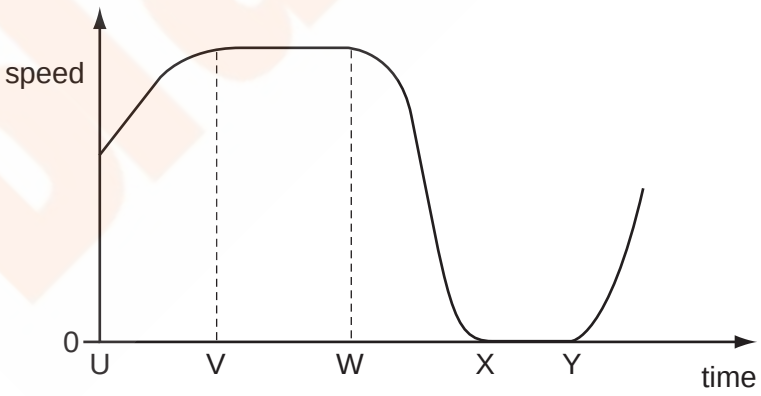
39 A tennis player hits a ball hard and 0.40 s later hears the echo from a wall.

The speed of sound in air is 330 m / s.

How far away is the player from the wall?

A 66 m **B** 132 m **C** 264 m **D** 825 m

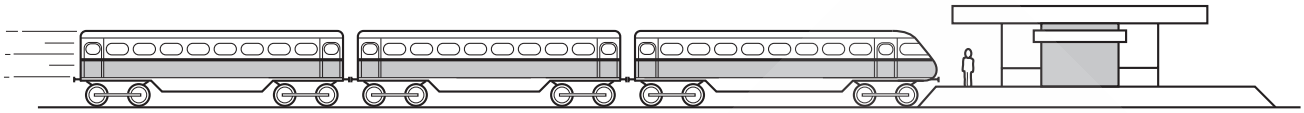
40 The graph shows how the speed of a car changes with time.



Between which two times is the car stationary?

A U and V **B** V and W **C** W and X **D** X and Y

41 A child is standing on the platform of a station.

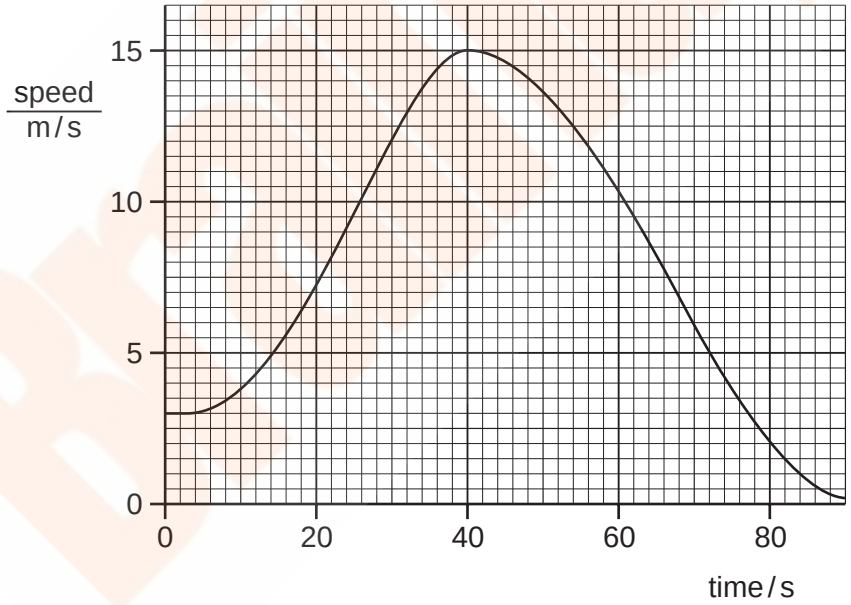


A train travelling at 30 m / s takes 3.0 s to pass the child.

What is the length of the train?

A 10 m **B** 27 m **C** 30 m **D** 90 m

42 The speed-time graph shown is for a car moving in a straight line.

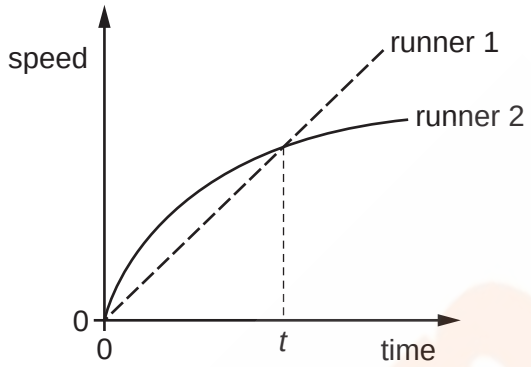


What is the acceleration of the car when the time is 40 s?

A $0\,m/s^2$ **B** $\frac{15\ \ 3}{40}\,m/s^2$ **C** $\frac{15}{40}\,m/s^2$ **D** $(15-3)\,m/s^2$

43 Two runners take part in a race.

The graph shows how the speed of each runner changes with time.



What does the graph show about the runners at time *t*?

A Both runners are moving at the same speed.

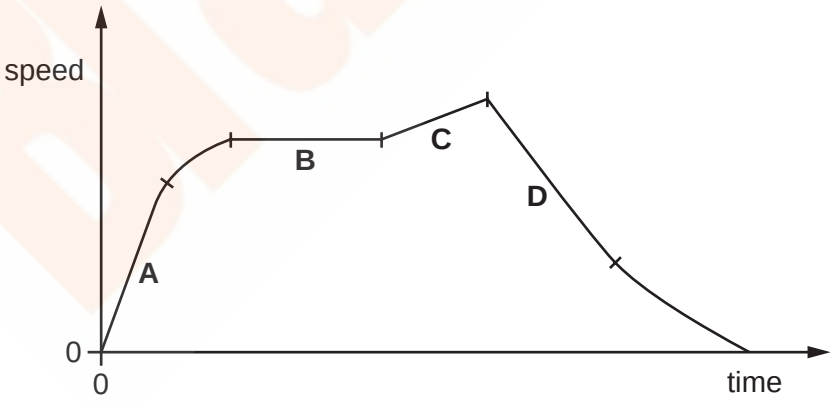
B Runner 1 has zero acceleration.

C Runner 1 is overtaking runner 2.

44 A car travels along a straight road.

The speed-time graph for this journey is shown.

During which labelled part of the journey is the resultant force on the car zero?



45 A large stone is dropped from a bridge into a river. Air resistance can be ignored.

Which row describes the acceleration and the speed of the stone as it falls?

	mass	weight
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

46 Below are four statements about acceleration.

Which statement is **not** correct?

A Acceleration always involves changing speed.

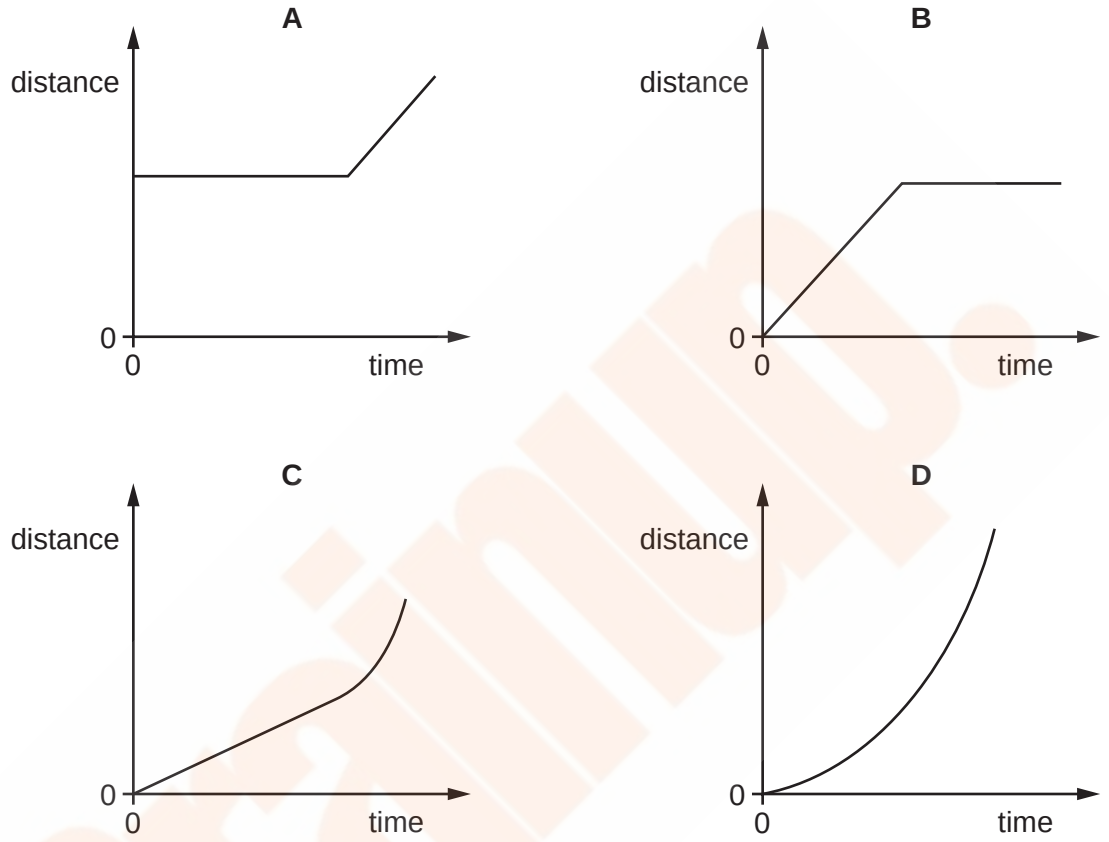
B Changing direction always involves acceleration.

C Changing speed always involves acceleration.

D Circular motion always involves acceleration.

47 An object moves at a constant speed for some time, then begins to accelerate.

Which distance-time graph shows this motion?



48 A heavy object is released near the surface of the Earth and falls freely. Air resistance can be ignored.

Which statement about the acceleration of the object due to gravity is correct?

A The acceleration depends on the mass of the object.

B The acceleration depends on the volume of the object.

C The acceleration is constant.

D The acceleration is initially zero and increases as the object falls.

49 An object is released from rest and falls to Earth. During its fall, the object is affected by air resistance. The air resistance eventually reaches a constant value.

Which description about successive stages of the motion of the object is correct?

A constant acceleration, then constant deceleration

B constant deceleration, then zero acceleration

C decreasing acceleration, then constant deceleration

D decreasing acceleration, then zero acceleration