

Questions

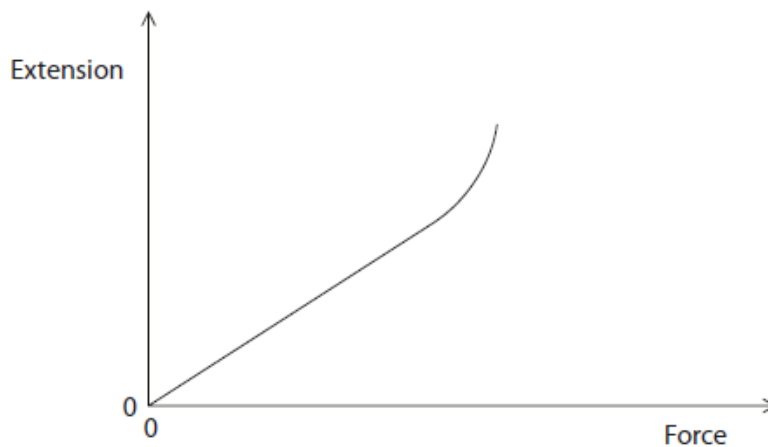
Q1.

This question is about stretching a spring.

(a) The graph shows how the extension of a spring varies when a force is applied to the spring.

The line on the graph shows that the spring has been extended past its elastic limit.

The line has a straight section and a curved section.



(i) Draw a cross on the line to show the elastic limit of the spring.

(1)

(ii) Sketch another line to show how the extension will change when the force is decreased from its maximum value back to 0.

(2)

(b) (i) State which energy store of the spring increases when it is stretched. Assume the spring does not reach its elastic limit.

(1)

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(ii) How is this energy transferred to the spring?

(1)

- ☐ **A** electrically
- ☐ **B** by heating
- ☐ **C** mechanically
- ☐ **D** by radiation

(Total for question = 5 marks)

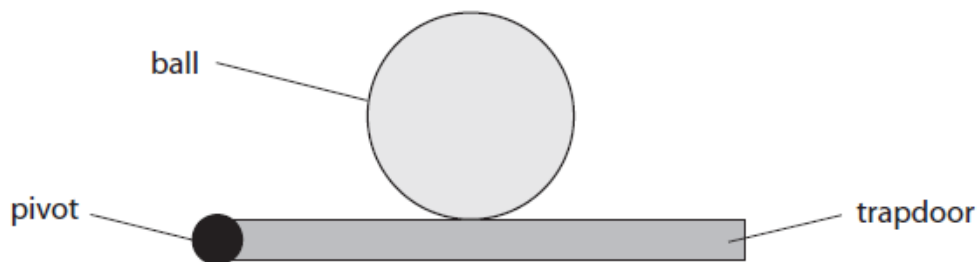
Q2.

This question is about the motion of a ball.

(a) A ball is at rest on a trapdoor.

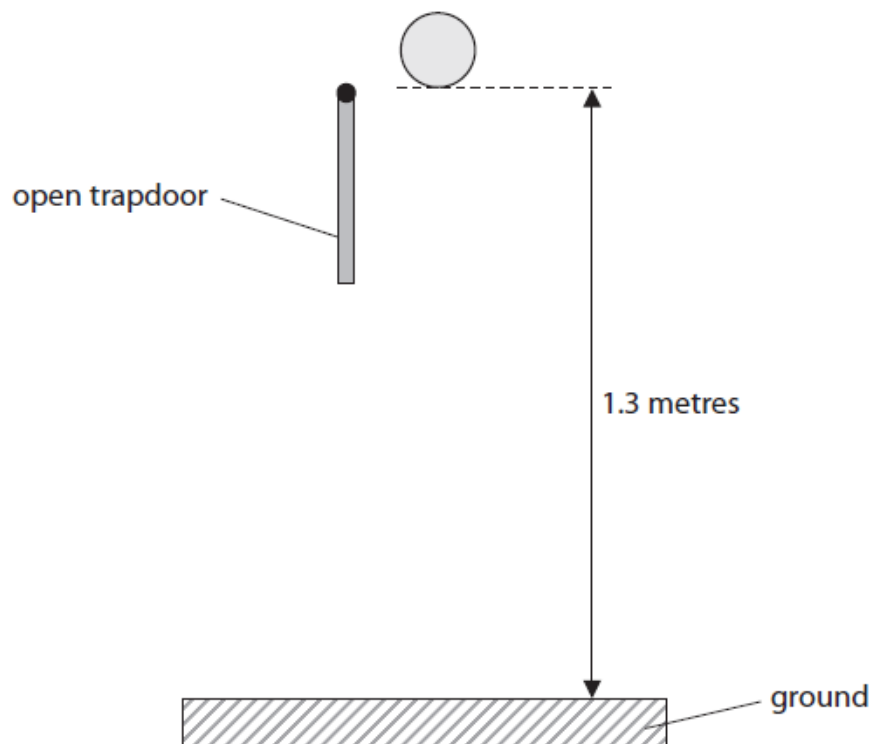
Complete the diagram to show the forces acting on the ball.

Label the forces.

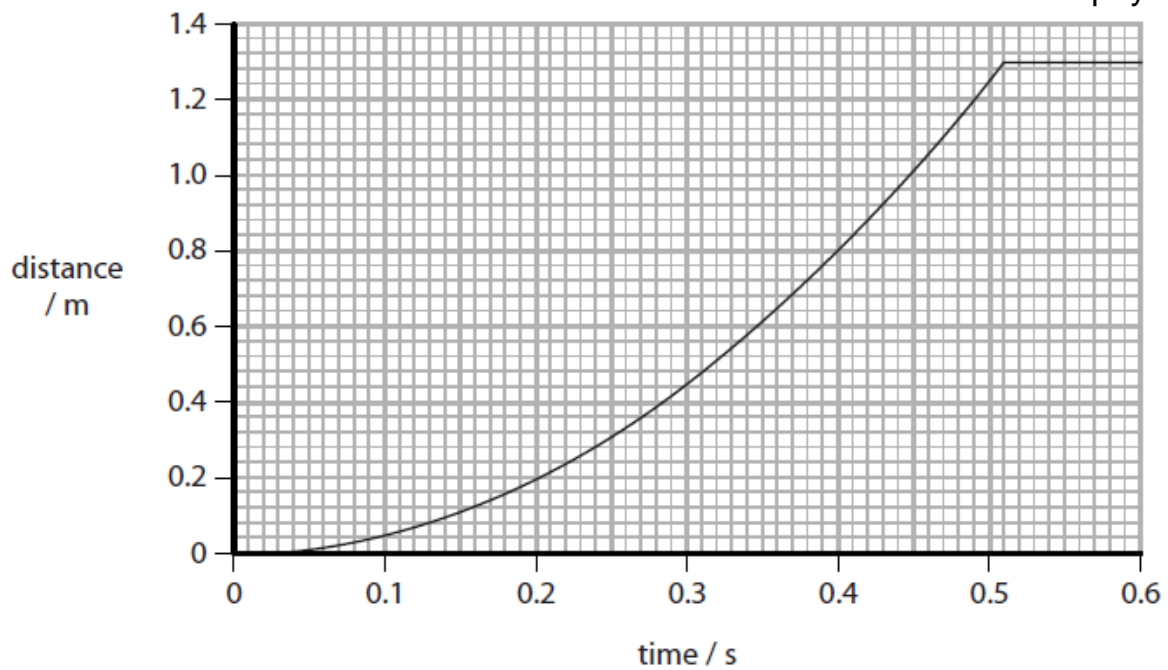
(3)

(b) The trapdoor swings open and the ball falls to the ground.

The ball does not bounce when it hits the ground.



The graph shows how the distance travelled by the ball changes with time.



(i) Determine the time taken for the ball to hit the ground.

(1)

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(ii) Explain how the graph shows that the ball accelerates when it falls.

(3)

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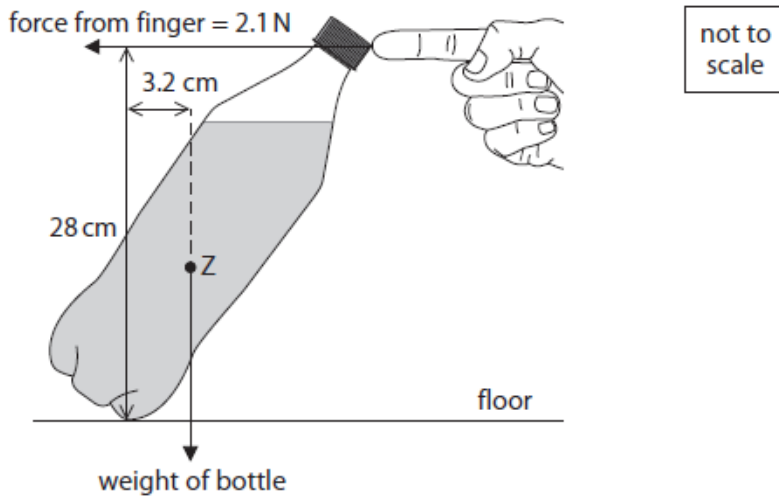
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(Total for question = 7 marks)

Q3.

The diagram shows a bottle supported by a finger.



(a) State the name of point Z.

(1)

(b) (i) State the formula linking moment, force and perpendicular distance from the pivot.

(1)

(ii) The bottle does not move.

Calculate the weight of the bottle.

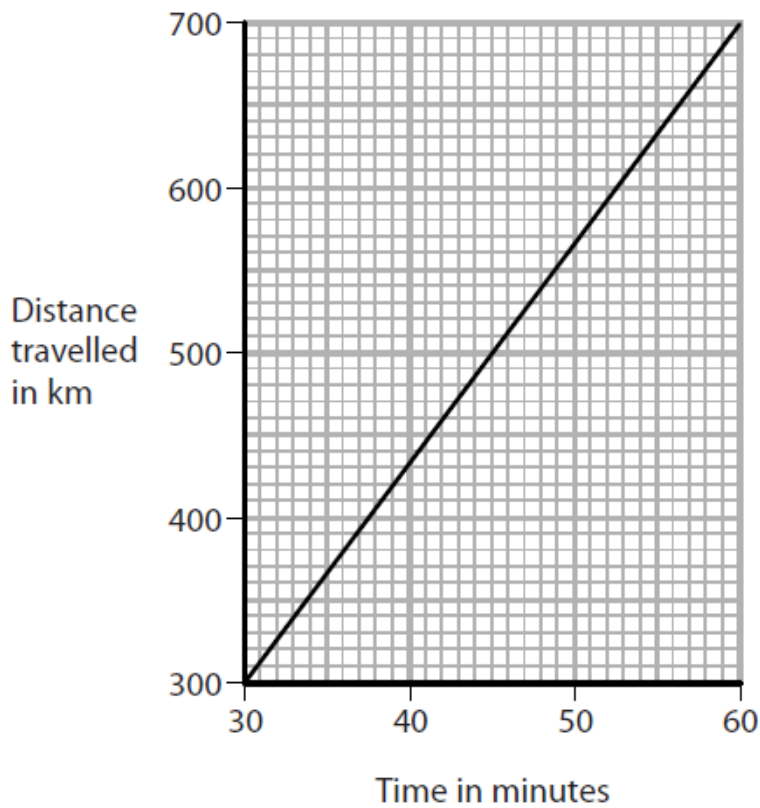
(4)

weight of bottle = N

(Total for question = 6 marks)

Q4.

The graph shows how the distance travelled by an aeroplane changes during part of its journey.



(a) (i) State the formula linking average speed, distance moved and time taken.

(1)

(ii) Calculate the average speed of the aeroplane during this part of its journey.

Give a suitable unit.

(4)

average speed = unit

(b) During the flight, the height of the aeroplane decreases.

As the height of the aeroplane decreases, the temperature outside the aeroplane increases.

Explain how the air pressure outside the aeroplane changes as the height of the aeroplane decreases.

(3)

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Q5.

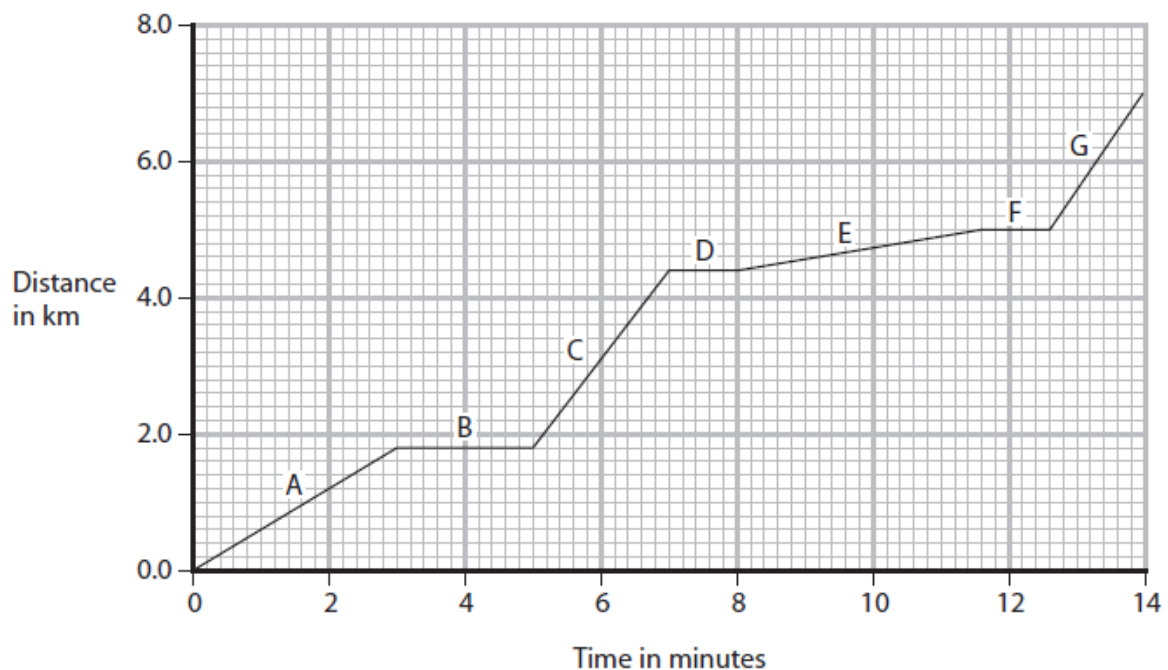
A bus transports passengers.



© Mikbiz/Shutterstock

(a) The bus stops at certain points in its journey to let passengers get on or off the bus.

The distance-time graph shows part of the bus journey, with sections labelled A to G.



(i) Give the letters of the sections where the bus is stationary.

(1)

(ii) Calculate the speed of the bus during section C of the journey.

Give your answer in m / s.

(4)

speed = m / s

(iii) Explain what the graph shows about the speed of the bus in section E compared with the speed of the bus in section A.

(2)

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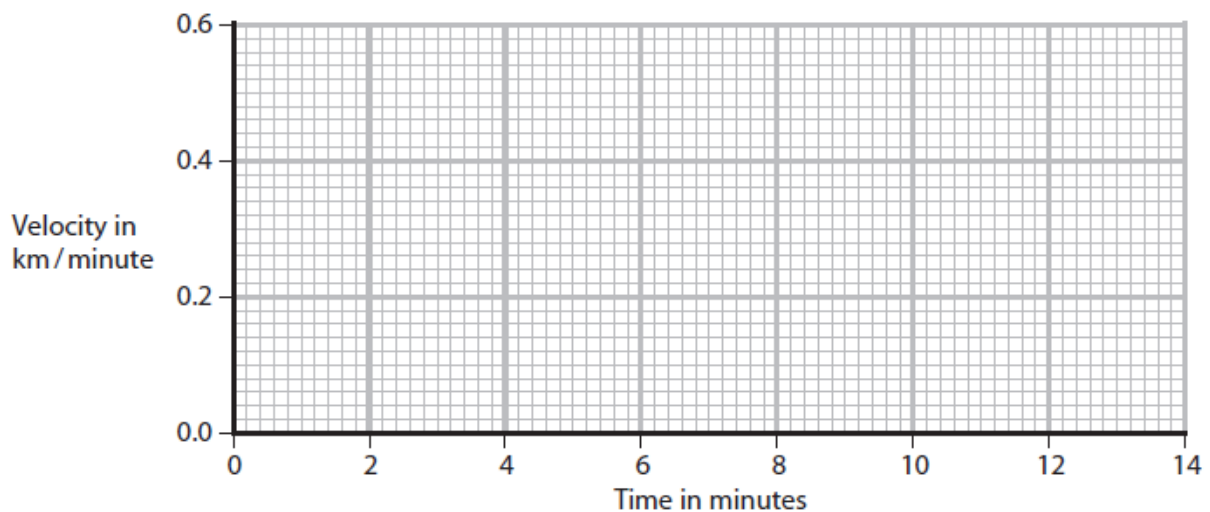
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(b) Another bus travels a distance of 7.0 km in a time of 14 minutes.

This bus travels at a constant velocity.

Complete the velocity-time graph to show the motion of this bus.

(2)



(Total for question = 9 marks)

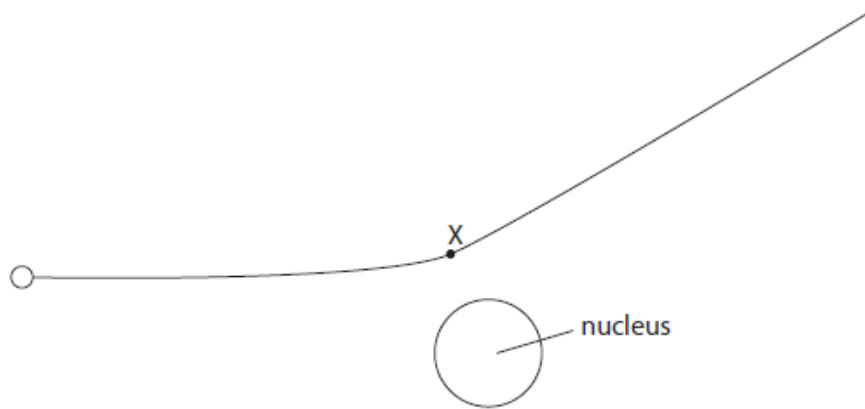
Q6.

This is a question about alpha particles.

(a) Describe the nature of an alpha particle.

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 (b) The diagram shows the path of an alpha particle as it passes close to a nucleus.



(i) Draw an arrow from point X to show the force on the alpha particle due to the nucleus.

Label this force Y.

(2)

(ii) Draw an arrow to show the force on the nucleus due to the alpha particle.

Label this force Z.

(2)

(iii) Explain how the path of the alpha particle shows whether the nucleus is positive, negative or neutral.

(3)

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 (c) The alpha particle experiences a resultant force of 3.6 N and has a mass of 6.6×10^{-27} kg.

Calculate the acceleration of the alpha particle.

(3)

acceleration = m/s^2

(Total for question = 11 marks)

Q7.

A tennis racket is used to hit a tennis ball.

The ball is in contact with the racket for 0.20 seconds and leaves the racket with a horizontal velocity of 46 m/s.



(a) (i) State the equation relating acceleration, change in velocity and time taken.

(1)

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(ii) Calculate the acceleration of the tennis ball assuming it is at rest when it is hit.

Give the unit.

(3)

acceleration =unit.....

(b) The tennis ball has a mass of 57 grams.

(i) State the equation relating momentum, mass and velocity.

(1)

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(ii) Calculate the momentum of the tennis ball when its velocity is 46 m/s.

(3)

momentum = kg m/s

(c) The bottom of a tennis player's shoes are thick and made from a material that compresses when the player's feet land on the ground.

Explain why these shoes reduce the risk of injury to the tennis player.

(3)

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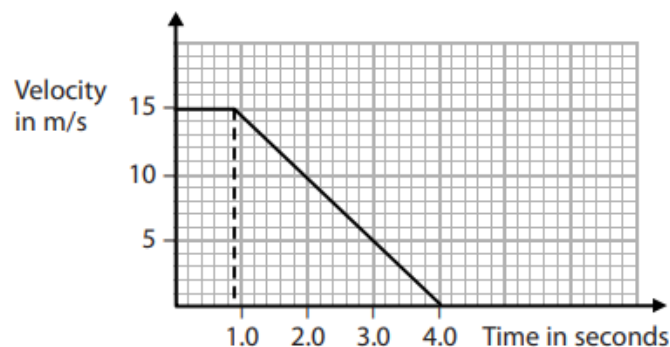
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(Total for question = 11 marks)

Q8.

A car driver sees a hazard on the road ahead.

The graph shows the velocity of the car from when the driver sees the hazard.



(a) (i) Use the graph to determine the reaction time of the driver.

(1)

reaction time = s

(ii) Calculate the stopping distance of the car.

(4)

stopping distance = m

(iii) Calculate the acceleration of the car when the car is braking.

(3)

acceleration = m/s^2

(b) The speed of the car affects the thinking distance and the braking distance.

Discuss other factors that affect the thinking distance and the braking distance of the car.

(4)

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(Total for question = 12 marks)

Q9.

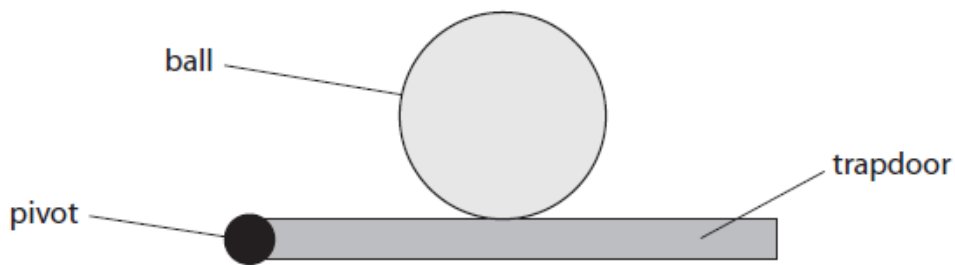
This question is about the motion of a ball.

(a) A ball is at rest on a trapdoor.

Complete the diagram to show the forces acting on the ball.

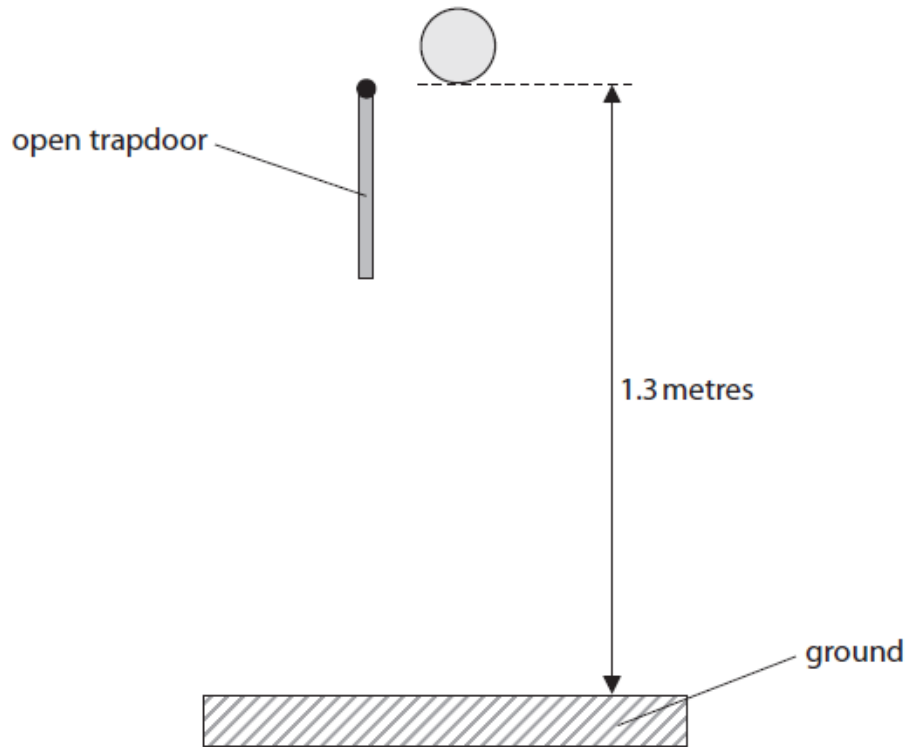
Label the forces.

(3)



(b) The trapdoor swings open and the ball falls to the ground.

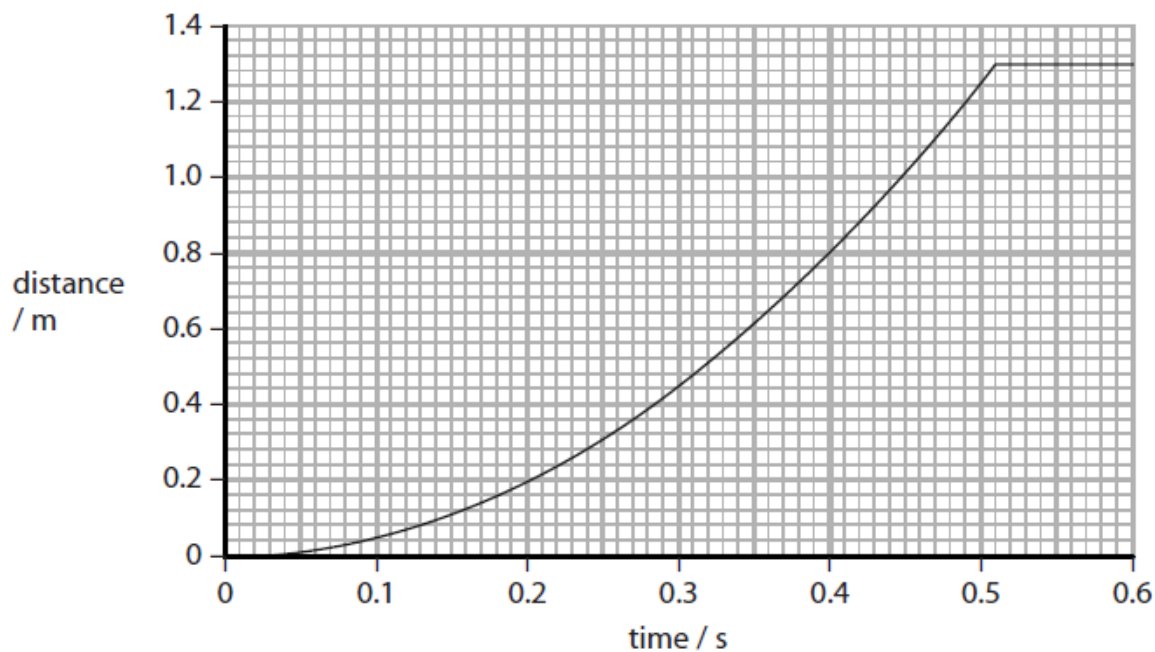
The ball does not bounce when it hits the ground.



Show that the final speed of the ball at the instant before it hits the ground is about 5 m/s.

(3)

(c) The graph shows how the distance travelled by the ball changes with time.



(i) Determine the time taken for the ball to hit the ground.

(1)

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(ii) State the equation relating average speed, distance moved and time taken.

(1)

(iii) Calculate the average speed of the ball after 0.40 s.

(1)

average speed = m/s

(iv) Explain how the graph shows that the ball accelerates when it falls.

(3)

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(Total for question = 12 marks)

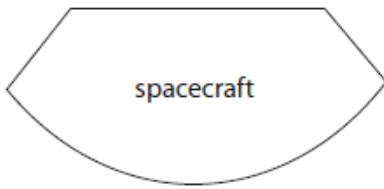
Q10.

Schiaparelli is a spacecraft that was sent to Mars in 2016.

(a) Schiaparelli slowed down as it fell vertically through the atmosphere of Mars.

(i) Draw labelled arrows on the diagram to show the forces acting on Schiaparelli as it fell.

(3)



(ii) Schiaparelli then opened a parachute to slow down.

Explain how the spacecraft reached a low terminal velocity after opening its parachute.

Use ideas about forces in your answer.

(4)

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(b) The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.

[acceleration of free-fall on Mars = 3.4 m/s^2]

(4)

speed = m/s

(c) Suggest why Mars has a lower gravitational field strength than Earth.

(1)

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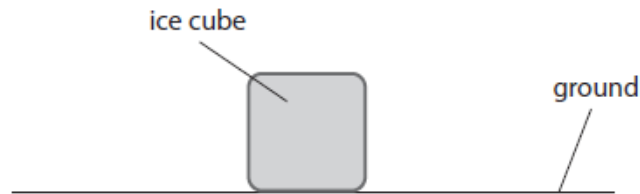
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(Total for question = 12 marks)

Q11.

This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is $2.6 \times 10^{-4} \text{ m}^2$.

Calculate the pressure the ice cube exerts on the ground.

(4)

pressure = Pa

(ii) The ice cube melts and becomes a puddle with a larger cross-sectional area.

Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

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(b) Ice melts at a temperature of 0°C .

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of -10°C to a temperature of 20°C .

(3)



(c) Explain the changes that occur when a solid melts.

Refer to particles in your answer.

(2)

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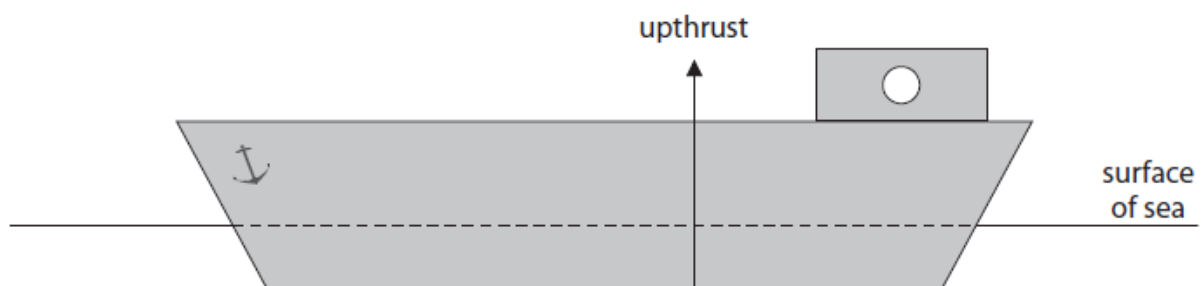
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(Total for question = 11 marks)

Q12.

A ship floats on the sea.



(a) The ship floats because of the forces acting on it.

(i) The upward force acting on the ship is called upthrust.

This force is shown on the diagram.

Draw another labelled arrow on the diagram to show the other vertical force acting on the ship.

(2)

(ii) Forces are vector quantities.

State what is meant by the term **vector quantity**.

(2)

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(iii) Give another example of a vector quantity.

(1)

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(b) The upthrust force acting on the ship is proportional to the pressure difference between the bottom of the ship and the surface of the sea.

The pressure acting on the ship at the surface of the sea is 100 kPa.

(i) State the formula linking pressure difference, height, density and gravitational field strength (g).

(1)

(ii) The bottom of the ship is 15.8 m below the surface of the sea.

Show that the pressure acting on the bottom of the ship is approximately 260 kPa.

[density of seawater = 1030 kg/m^3]

(3)

(iii) Explain why the bottom of the ship is deeper below the surface of the sea when the ship is fully loaded with cargo.

(2)

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(Total for question = 11 marks)

Q13.

Curling is a sport played on ice.

A player slides stone A across the ice towards a scoring zone.

The ice reduces friction so that there is negligible friction when the stone is sliding.



© Corepics VOF/Shutterstock

(a) Stone A leaves the player's hand with a velocity of 2.90 m/s .

The mass of stone A is 17 kg .

(i) State the formula linking momentum, mass and velocity.

(1)

(ii) Show that the momentum of stone A is approximately 50 kg m/s .

(2)

(b) Stone A slides towards the scoring zone.

In the scoring zone, stone A collides with a stationary stone, B.



© Michael715/Shutterstock

(i) After the collision, both stones move in the same direction as the initial direction of stone A.

The velocity of stone A after the collision is 0.40 m/s.

Calculate the velocity of stone B after the collision.

[mass of stone B = 19 kg]

(4)

velocity of stone B = m/s

(ii) When the stones collided, they were in contact for a time of 25 ms.

Calculate the magnitude of the force stone A exerted on stone B in this collision.

(3)

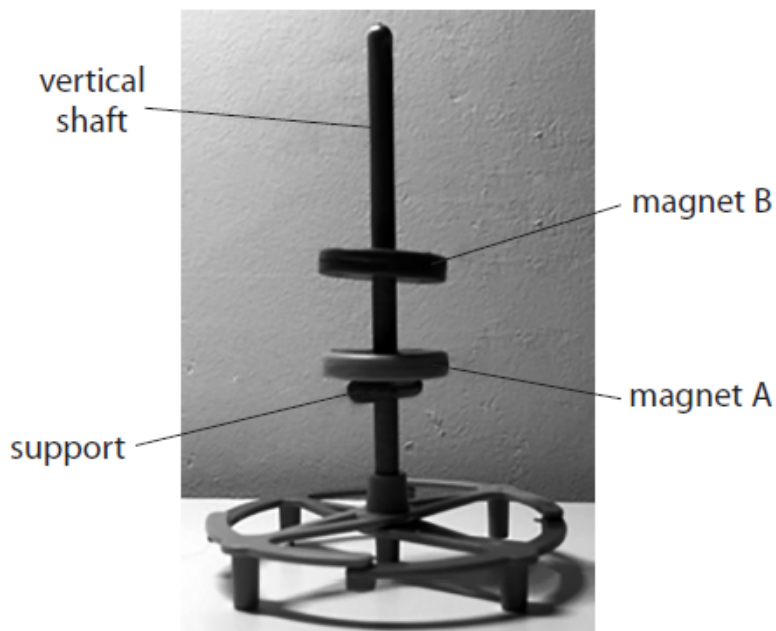
force = N

(Total for question = 10 marks)

Q14.

Photograph 1 shows a child's toy.

The toy has two magnets on a vertical shaft.



Photograph 1

(a) Magnet A rests on a support near the bottom of the vertical shaft.

A student places magnet B at the top of the vertical shaft and releases it from rest.

Magnet B is repelled by magnet A causing it to come to rest again at the position shown.

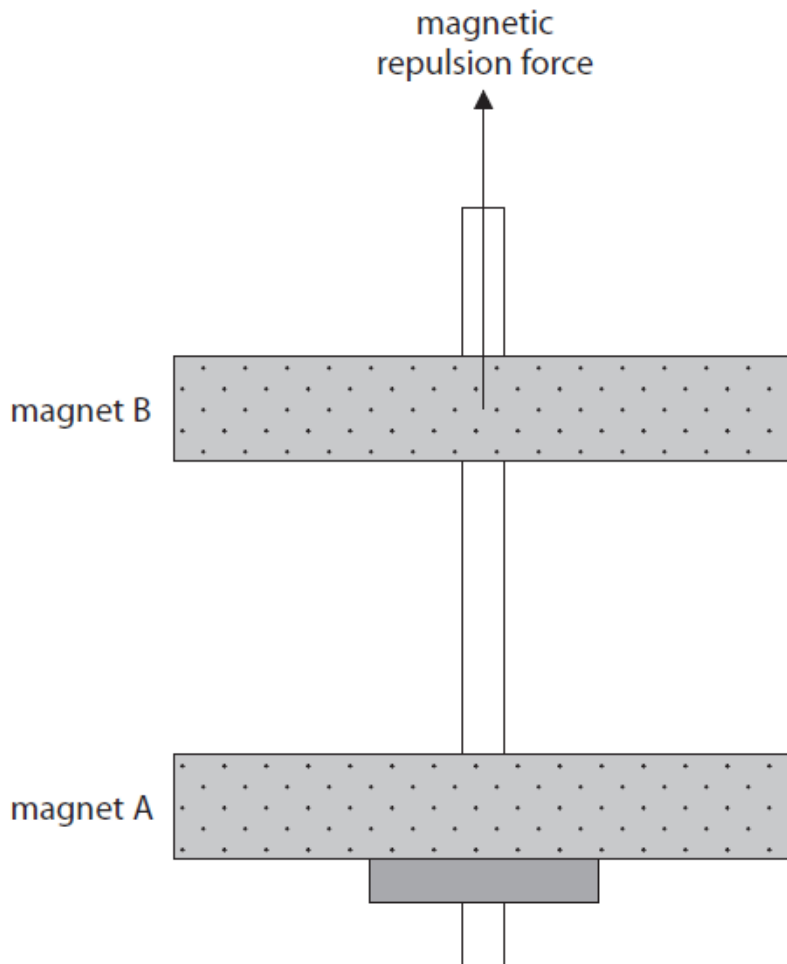
The table shows some energy stores in magnet B.

Put ticks (✓) in the correct boxes to show whether the amount of energy in each store of magnet B increases, decreases or stays the same when compared to its value at the top of the vertical shaft.

(3)

Energy store in magnet B	Increases	Decreases	Stays the same
gravitational			
magnetic			
kinetic			

(b) This is a diagram of the toy shown in photograph 1.



One of the forces acting on magnet B is shown.

Draw another labelled arrow on the diagram to show the other force acting on magnet B.

(2)

(c) The student adds a 10 g mass on top of magnet B when it is stationary above magnet A and observes that the distance between the magnets decreases.

He carries out an investigation to see how the distance changes as more masses are added.

In your answer, you should refer to

- the measuring equipment required
- the independent and dependent variables
- a way to check the reliability of the data

You may draw a diagram to help your answer.

(5)

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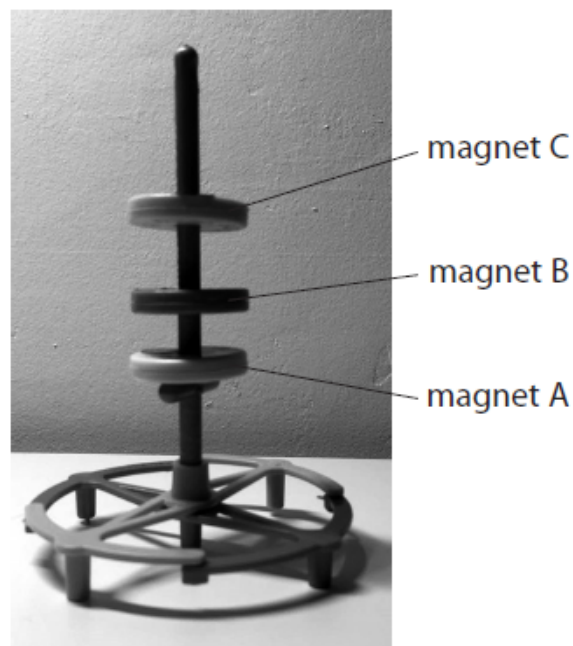
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(d) The student removes the masses from magnet B.

He then adds magnet C on to the vertical shaft.



Photograph 2

Photograph 2 shows that when magnet C is added, magnet B moves further down the shaft until it is at rest again.

Explain why the distance between magnet A and magnet B has decreased.

(3)

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(Total for question = 13 marks)