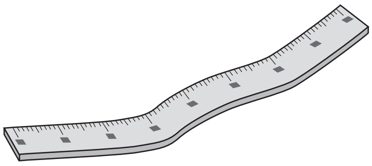
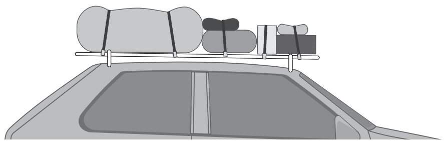
Answer **all** questions in the spaces provided.

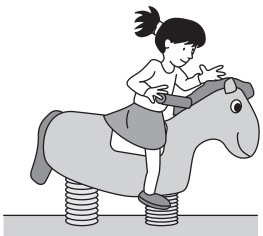
1 (a) The pictures show four objects. Each object has had its shape changed.



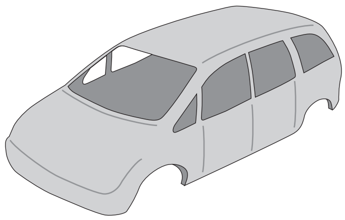
Bent metal ruler
A



Stretched bungee cords
B



Springs on a playground ride
C



Moulded plastic model car body
D

Which of the objects are storing elastic potential energy?

....

Explain the reason for your choice or choices.

....

....

....

....

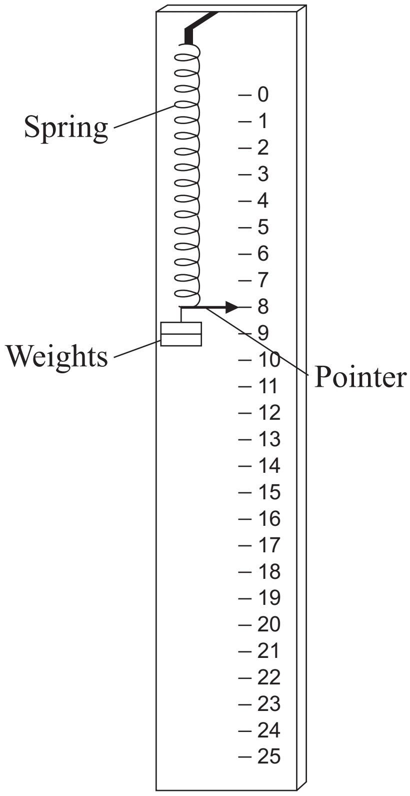
....

....

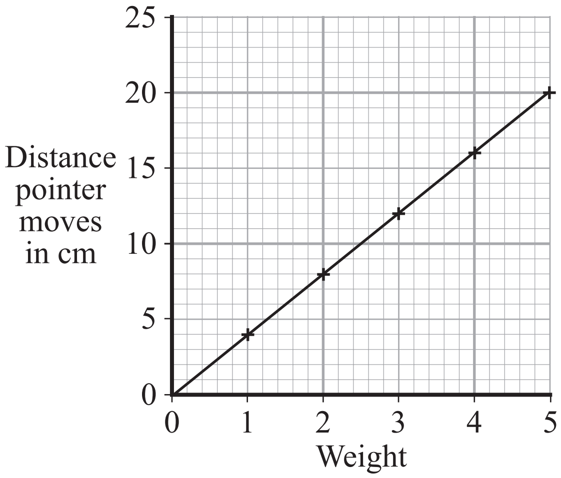
(3 marks)

Question 1 continues on the next page

(b) A student makes a simple spring balance. To make a scale, the student uses a range of weights. Each weight is put onto the spring and the position of the pointer marked.



The graph below shows how increasing the weight made the pointer move further.



(i) Which **one** of the following is the unit of weight?

Draw a ring around your answer.

joule **kilogram** **newton** **watt**

(1 mark)

(ii) What range of weights did the student use?

....

(1 mark)

(iii) How far does the pointer move when 4 units of weight are on the spring?

....

(1 mark)

(iv) The student ties a stone to the spring. The spring stretches 10 cm.

What is the weight of the stone?

....

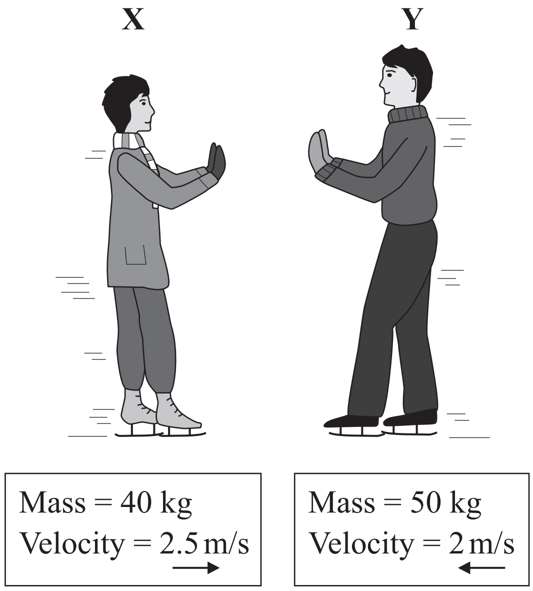
(1 mark)

7

Turn over for the next question

2 The picture shows two children, **X** and **Y**, skating towards each other at an ice rink.

The children collide with each other, fall over and stop.



(a) Before the collision the children had different amounts of kinetic energy.

(i) What are the **two** factors that determine the kinetic energy of the children?

1 ....

2 ....

(2 marks)

(ii) What was the total kinetic energy of the children after they had fallen over and stopped?

....

(1 mark)

(b) The total momentum of the children before and after the collision is zero.

(i) Use the equation in the box and the data given in the diagram to calculate the momentum of child **Y** before the collision.

momentum = mass × velocity

Show clearly how you work out your answer.

....

....

Momentum = ... kg m/s

(2 marks)

(ii) Complete the following sentence using one of the words in the box.

conserved	**decreased**	**increased**

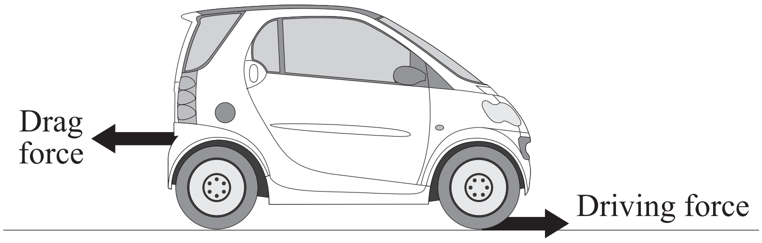
The total momentum of the two children was ....

(1 mark)

6

Turn over for the next question

3 The diagram shows the horizontal forces acting on a car travelling along a straight road.



(a) Complete the following sentences by drawing a ring around the correct word in each box.

(i) When the driving force equals the drag force, the speed of the car is

decreasing
constant
increasing

.

(1 mark)

(ii) Putting the brakes on transforms the car's kinetic energy mainly into

heat
light
sound

.

(1 mark)

(b) The charts, **A**, **B** and **C** give the thinking distance and the braking distance for a car driven under different conditions.

(i) Draw straight lines to match each chart to the correct conditions.

Draw only **three** lines.

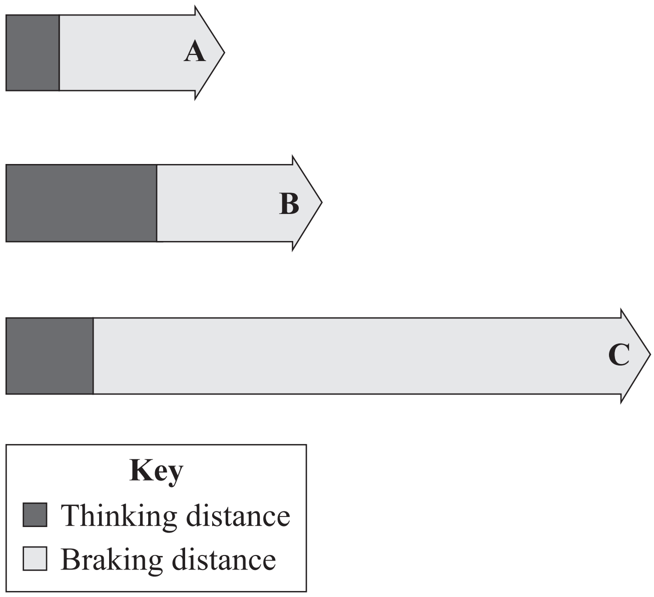
Conditions

Speed = 22 m/s
driver wide awake

Speed = 13 m/s
driver wide awake

Speed = 13 m/s
driver very tired

Charts



(2 marks)

(ii) The three charts above all apply to dry road conditions.

How would the braking distances be different if the road were wet?

....

....

(1 mark)

5

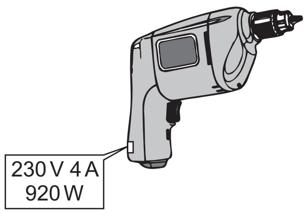
Turn over for the next question

4 (a) Look at this electrical safety information poster.

Get it right!
Choose the right fuse.

Most fuses are 3 A or 13 A.

To choose the right fuse you must know the power of the appliance.



Power is marked on the information plate.

Power over 700 W use a 13 A fuse.	Power under 700 W use a 3 A fuse.
• Fan heaters • Kettles • Dishwashers • Washing machines	• Radios • Table lamps • Portable TVs • Electric blankets

(i) Complete the table to show which size fuse, 3 A or 13 A, should be fitted to each of the appliances.

Appliance	**Power rating**	**Fuse**
Hairdryer	1600 W	
Electric saw	350 W	
Food mixer	1200 W	

(2 marks)

(ii) The plug of an electric kettle has been wrongly fitted with a 3 A fuse.

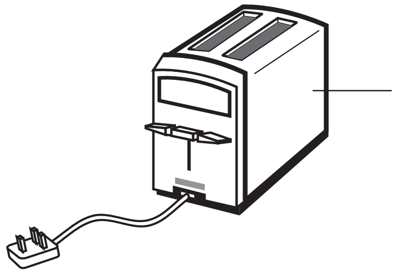
What will happen to the fuse when the kettle is switched on?

....

....

(1 mark)

(b) The drawing shows a toaster, which takes a current of 4 A from the 230 V mains electricity supply.



(i) Use the equation in the box to calculate the power of the toaster.

Power (watt, W)	=	current (ampere, A)	×	potential difference (volt, V)

Show clearly how you work out your answer.

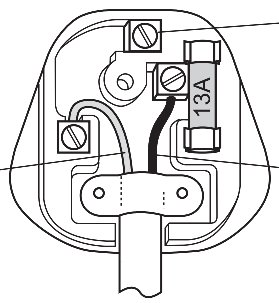
....

....

Power = ... W

(2 marks)

(ii) A householder rewires the toaster with a new cable and plug. The diagram shows how the new cable has been connected to the plug.



Explain why the toaster may **not** be safe to use.

....

....

....

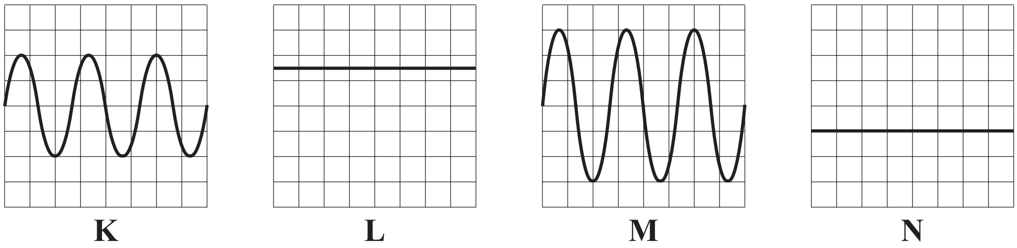
....

(2 marks)

Question 4 continues on the next page

Turn over ▸

(c) The diagram shows the oscilloscope traces produced by four different electricity supplies. The settings on the oscilloscope are the same for each electricity supply.



(i) Which **two** supplies give a direct current (d.c)?

.... and ....
(1 mark)

(ii) Supply **K** provides a peak potential difference of 6 V.

What is the peak potential difference provided by supply **M**?

....
(1 mark)

9

5 The table shows the average background radiation dose from various sources that a person living in Britain receives in one year.

Source of background radiation	**Average amount each year in dose units**
Buildings	50
Food and drink	300
Medical treatments (including X-rays)	300
Radon gas	1250
Rocks	360
Space (cosmic rays)	240
TOTAL	2500

(a) Only **two** of the following statements are true.

Tick (✓) the boxes next to the true statements.

Half the average background radiation dose comes from radon gas. ☐

Everyone receives the same background radiation dose. ☐

Cosmic rays produce less background radiation than food and drink. ☐

(1 mark)

(b) Most sources of background radiation are natural but some are artificial (man-made).

Which source of background radiation given in the table is artificial?

....

(1 mark)

(c) Each time a dental X-ray is taken, the patient receives about 20 units of radiation.

How many dental X-rays would give the yearly average dose for medical treatments?

....

....

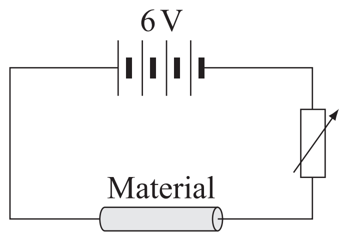
Number of X-rays = ...

(2 marks)

4

Turn over for the next question

6 (a) The diagram shows the circuit used to investigate the resistance of a material. The diagram is incomplete; the ammeter and voltmeter are missing.



(i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places. *(2 marks)*

(ii) How can the current through the material be changed?

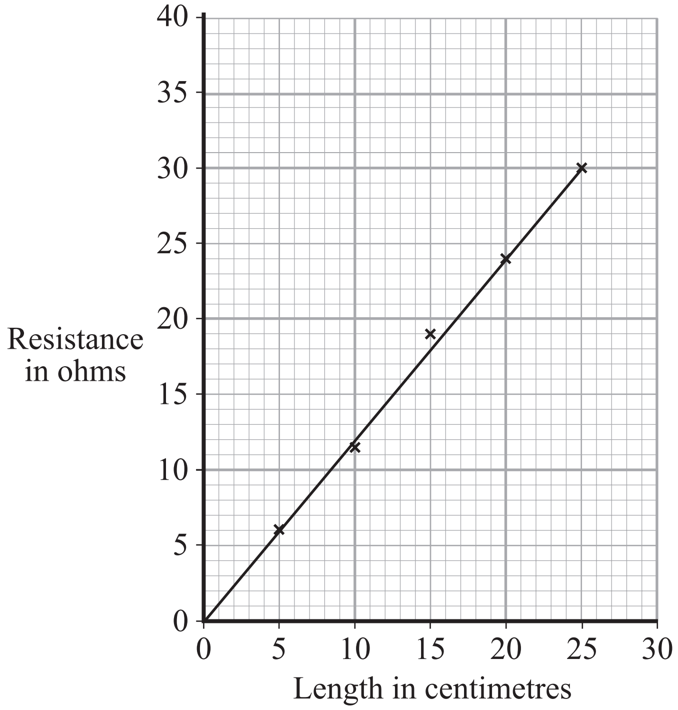
....

....
(1 mark)

(b) The material, called conducting putty, is rolled into cylinders of different lengths but with equal thicknesses.

Graph 1 shows how the resistance changes with length.

Graph 1



(i) Why has the data been shown as a line graph rather than a bar chart?

....

....
(1 mark)

(ii) The current through a 30 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 30 cm length of conducting putty.

Resistance = ... ohms
(1 mark)

(iii) Use your answer to (b)(ii) and the equation in the box to calculate the potential difference across a 30 cm length of conducting putty.

potential difference = current × resistance

Show clearly how you work out your answer.

....

....

....

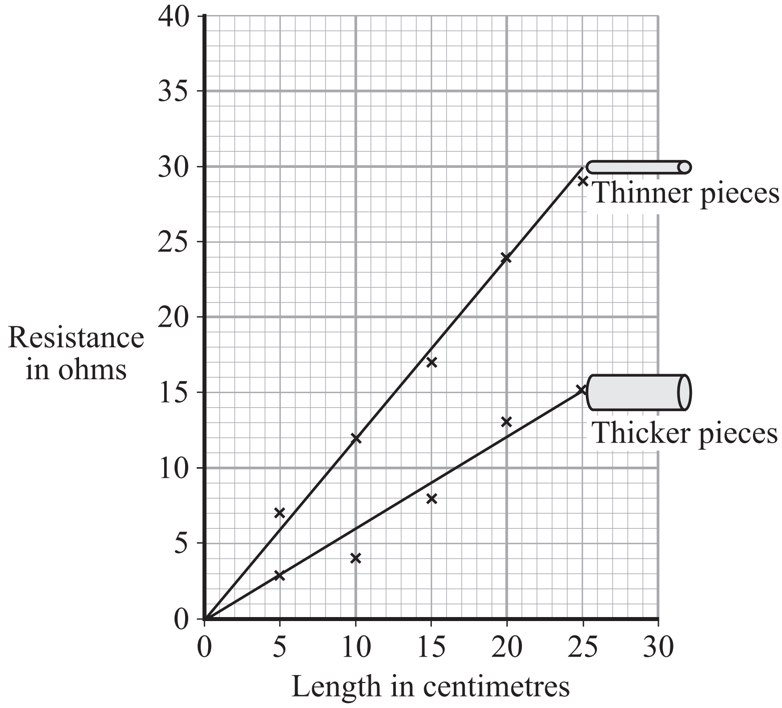
Potential difference = ... volts
(2 marks)

Question 6 continues on the next page

Turn over ▸

(c) A second set of data was obtained using thicker pieces of conducting putty. Both sets of results are shown in **Graph 2**.

Graph 2



(i) What is the relationship between the resistance and the thickness of the conducting putty?

....

....

(1 mark)

(ii) Name **one** error that may have reduced the accuracy of the results.

....

(1 mark)

(iii) How could the reliability of the data have been improved?

....

....

(1 mark)

10

7 During car journeys, the driver will often become electrostatically charged. This is more noticeable on dry days than on damp, humid days.

(a) Explain what happens to cause the driver to become charged.

....

....

....

....

(2 marks)

(b) Scientists were asked to find out whether the build-up of charge on the driver depends on the type of material used to make the driver's clothes. The results of the investigation are given in the table.

Material	**Humidity**	**Temperature in ºC**	**Charge on the driver in millicoulombs**
Nylon	48%	18	3.0 to 3.2
Wool	48%	18	2.4 to 2.5
Cotton	48%	18	1.4 to 1.7

Humidity is a measure of how much water vapour the air can hold.

(i) Why was it important that the scientists controlled the humidity?

....

....

(1 mark)

(ii) Does the data in the table show that the charge on the driver would always be less if they were to wear cotton clothing?

Give a reason for your answer.

....

....

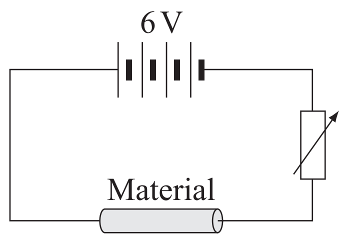
(1 mark)

4

END OF QUESTIONS

Answer **all** questions in the spaces provided.

1 (a) The diagram shows the circuit used to investigate the resistance of a material. The diagram is incomplete: the ammeter and voltmeter are missing.



(i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places. *(2 marks)*

(ii) How can the current through the material be changed?

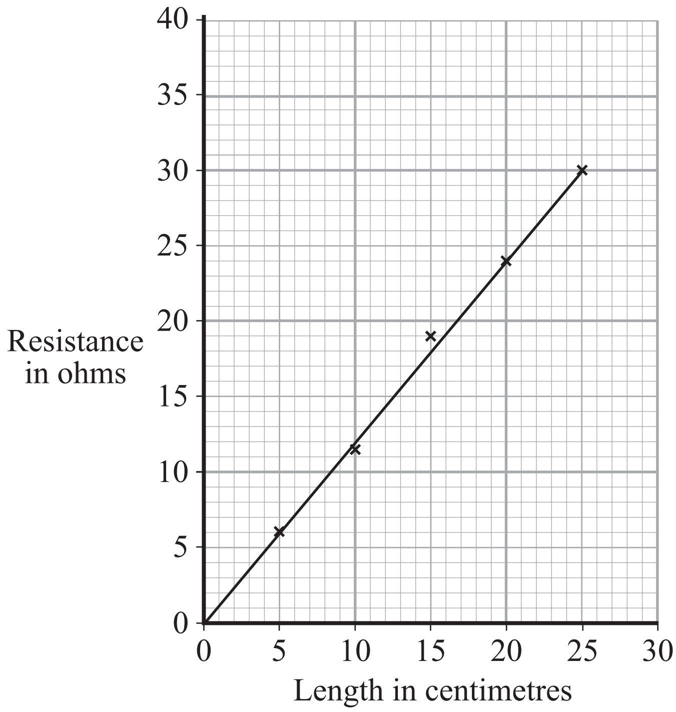
....

....
(1 mark)

(b) The material, called conducting putty, is rolled into cylinders of different lengths but with equal thicknesses.

Graph 1 shows how the resistance changes with length.

Graph 1



(i) Why has the data been shown as a line graph rather than a bar chart?

....

....

(1 mark)

(ii) The current through a 30 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 30 cm length of conducting putty.

Resistance = ... ohms

(1 mark)

(iii) Use your answer to (b)(ii) and the equation in the box to calculate the potential difference across a 30 cm length of conducting putty.

potential difference = current × resistance

Show clearly how you work out your answer.

....

....

....

Potential difference = ... volts

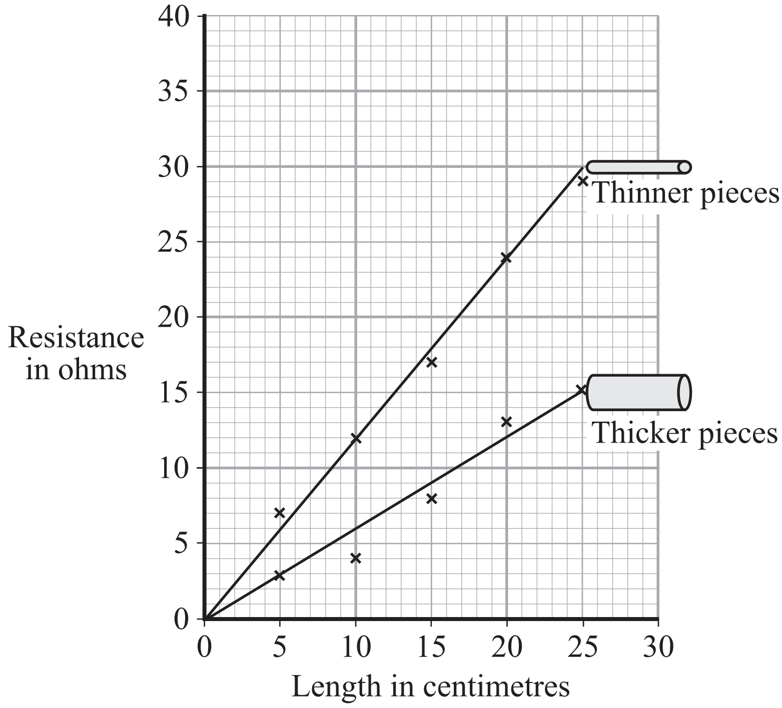
(2 marks)

Question 1 continues on the next page

Turn over ▸

(c) A second set of data was obtained using thicker pieces of conducting putty. Both sets of results are shown in **Graph 2**.

Graph 2



(i) What is the relationship between the resistance and the thickness of the conducting putty?

....

....

(1 mark)

(ii) Name **one** error that may have reduced the accuracy of the results.

....

(1 mark)

(iii) How could the reliability of the data have been improved?

....

....

(1 mark)

10

2 During car journeys, the driver will often become electrostatically charged. This is more noticeable on dry days than on damp, humid days.

(a) Explain what happens to cause the driver to become charged.

....

....

....

....

(2 marks)

(b) Scientists were asked to find out if the build up of charge on the driver depends on the type of material the driver's clothes are made from. The results of the investigation are given in the table.

Material	**Humidity**	**Temperature in °C**	**Charge on the driver in millicoulombs**
Nylon	48%	18	3.0 to 3.2
Wool	48%	18	2.4 to 2.5
Cotton	48%	18	1.4 to 1.7

Humidity is a measure of how much water vapour the air can hold.

(i) Why was it important that the scientists controlled the humidity?

....

....

(1 mark)

(ii) Does the data in the table show that the charge on the driver would always be less if they were to wear cotton clothing?

Give a reason for your answer.

....

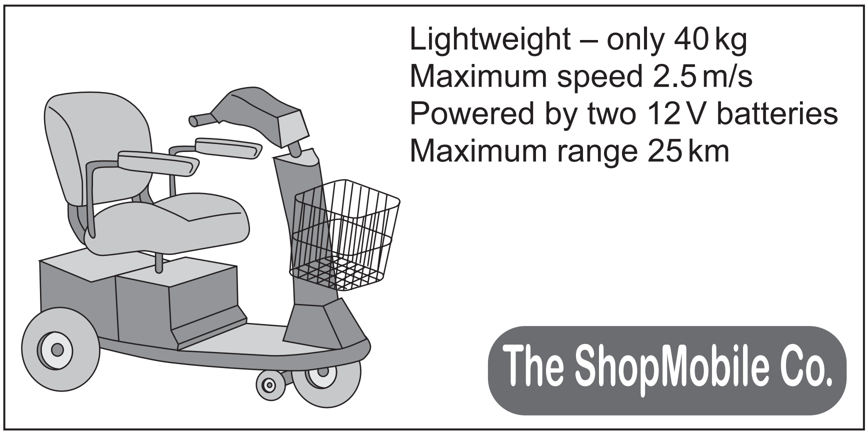
....

(1 mark)

4

Turn over ▸

3 The picture shows an advert for an electric mobility scooter.



(a) The batteries are joined in series.

(i) What is the potential difference provided by the batteries to the motor?

....

(1 mark)

(ii) The batteries supply a *direct current (d.c.)*.

What is a *direct current (d.c.)*?

....

....

(1 mark)

(b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

(i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

....

....

....

....

(2 marks)

(ii) What effect does travelling uphill have on the range of the scooter?

....

(1 mark)

(c) The mass of the scooter driver is 80 kg.

Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

kinetic energy = $\frac{1}{2}$ × mass × speed^2

Show clearly how you work out your answer.

....

....

Kinetic energy = ... J

(2 marks)

(d) A battery which has run down is recharged in 8 hours. The average current delivered by the battery charger is 1.5 A.

Use the equation in the box to calculate the maximum charge stored by **both** batteries.

charge = current × time

Show clearly how you work out your answer and give the unit.

....

....

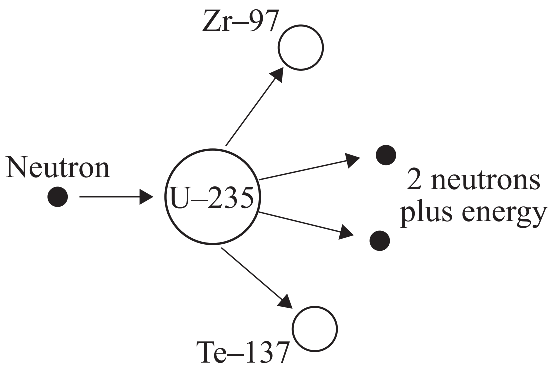
Charge stored = ...

(3 marks)

10

Turn over for the next question

4 (a) The diagram shows what can happen when the nucleus of a uranium atom absorbs a neutron.



(i) What name is given to the process shown in the diagram?

....

(1 mark)

(ii) Explain how this process could lead to a chain reaction.

You may wish to add further detail to the diagram to help your answer.

....

....

....

....

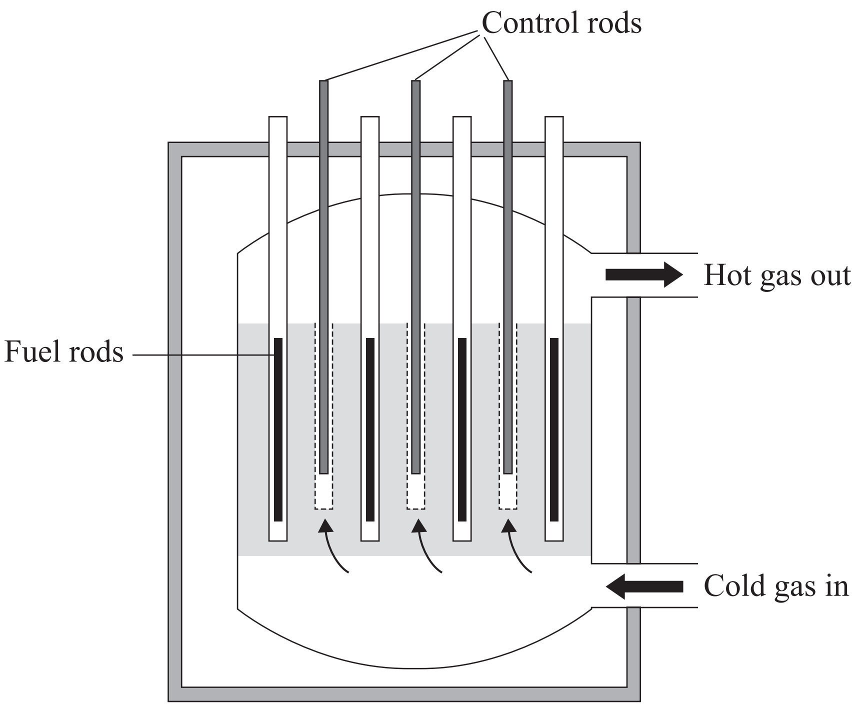
(2 marks)

(iii) How does the mass number of an atom change when its nucleus absorbs a neutron?

....

(1 mark)

(b) Uranium-235 is used as a fuel in some nuclear reactors.



The reactor contains control rods used to absorb neutrons.

Suggest what happens when the control rods are lowered into the reactor.

....

....

....

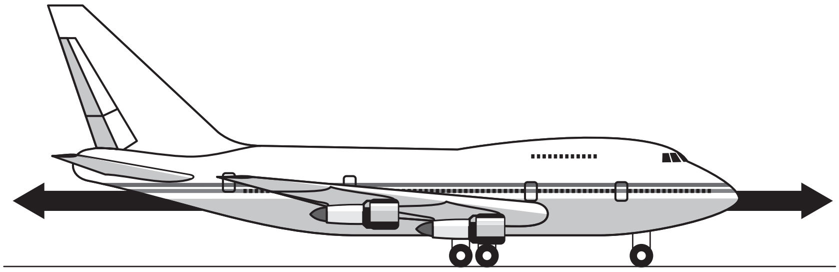
....

(2 marks)

6

Turn over for the next question

5 (a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

....

....
(1 mark)

(ii) Describe the movement of the aircraft when the resultant force is zero.

....

....
(1 mark)

(b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Use the equation in the box to calculate the maximum acceleration of the aircraft.

resultant force = mass × acceleration

Show clearly how you work out your answer and give the unit.

....

....

....

Acceleration = ...
(3 marks)

(c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

Explain why.

....

....

....

....

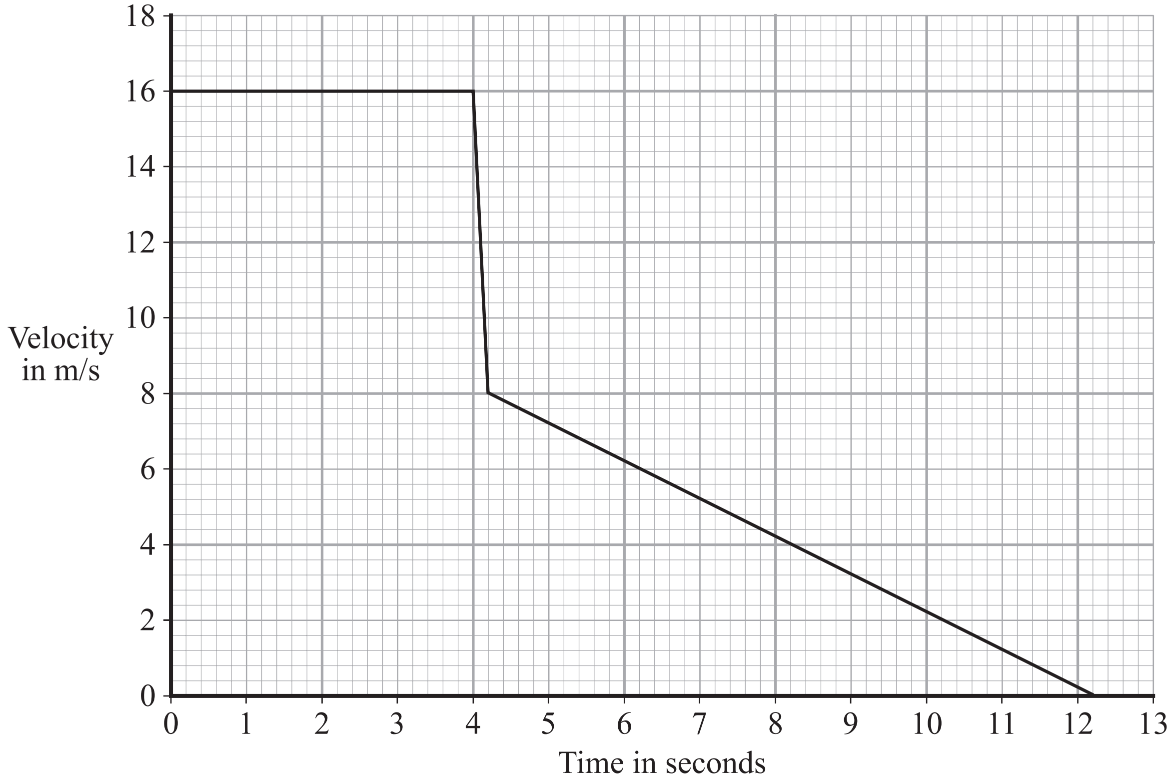
(2 marks)

7

Turn over for the next question

6 In an experiment at an accident research laboratory, a car driven by remote control was crashed into the back of an identical stationary car. On impact the two cars joined together and moved in a straight line.

(a) The graph shows how the *velocity* of the remote-controlled car changed during the experiment.



(i) How is the *velocity* of a car different from the speed of a car?

....

(1 mark)

(ii) Use the graph to calculate the distance travelled by the remote-controlled car before the collision.

Show clearly how you work out your answer.

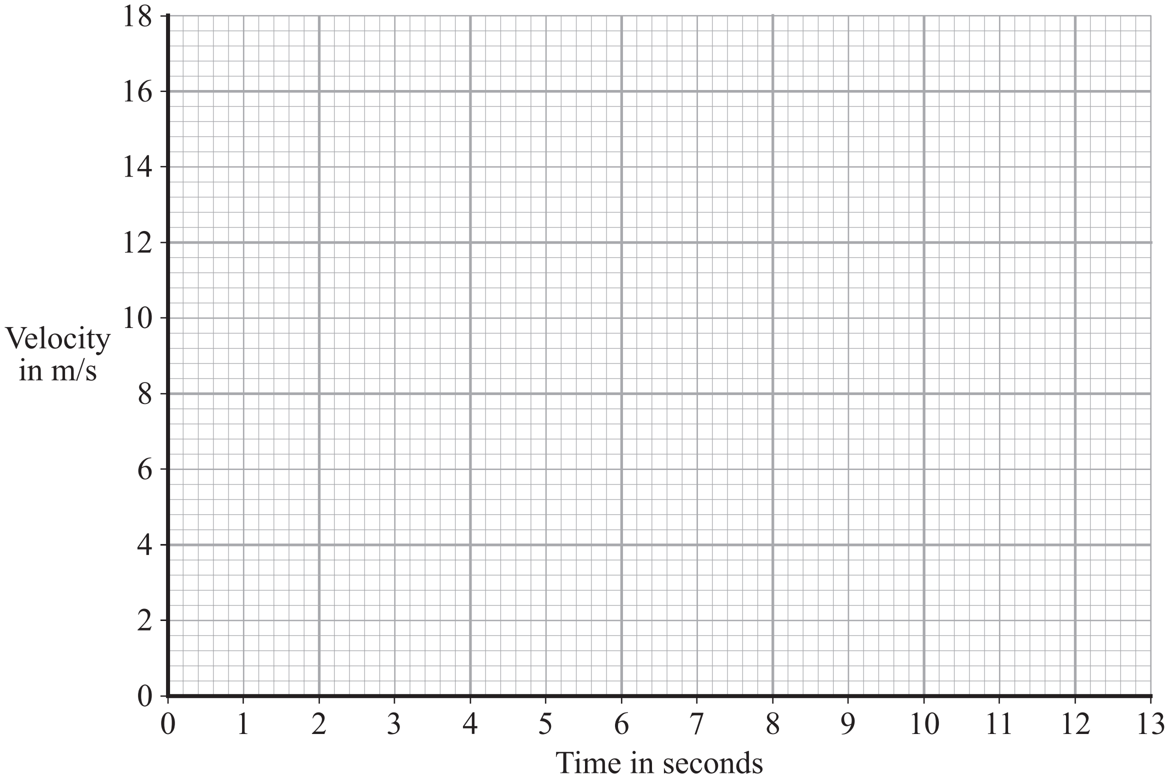
....

....

Distance = ... m

(2 marks)

(iii) Draw, on the grid below, a graph to show how the velocity of the second car changed during the experiment.



(2 marks)

(iv) The total momentum of the two cars was not conserved.

What does this statement mean?

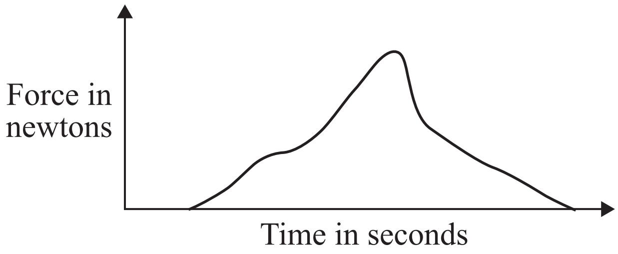
....

....

(1 mark)

Question 6 continues on the next page

(b) The graph line shows how the force from a seat belt on a car driver changes during a collision.



Scientists at the accident research laboratory want to develop a seat belt that produces a constant force throughout a collision.

Use the idea of momentum to explain why this type of seat belt would be better for a car driver.

....

....

....

....

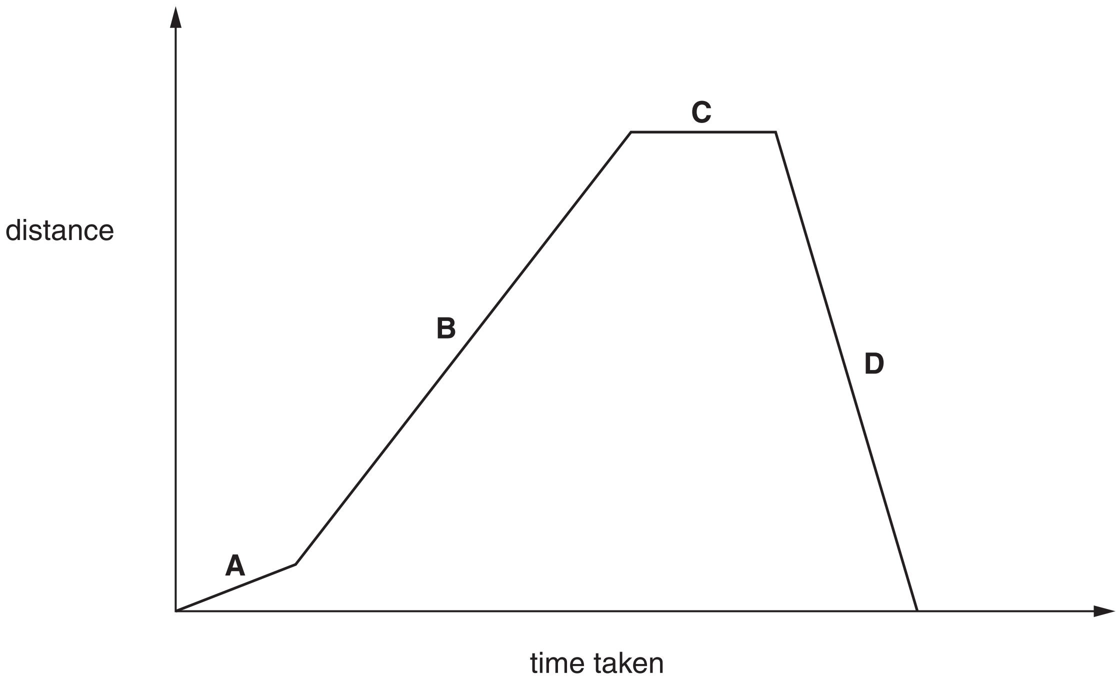
(2 marks)

8

END OF QUESTIONS

1 Dan goes to buy a newspaper for his granddad in the morning. He walks in a straight line to the shop and back.

(a) The graph shows the distance Dan is from home and the time it takes.



Complete the table below.

Each letter may be used once, more than once or not at all.

what Dan is doing	part of the graph (**A**, **B**, **C** or **D**)
standing still	
walking at his fastest speed	
at the shop buying the newspaper	
walking with a negative velocity	

[4]

(b) Dan is walking, so he has momentum.

The equation linking momentum, mass and velocity is:

momentum = mass × velocity

Dan has a mass of 60 kg.

At one time his velocity is 2 m / s.

Which of the following is his momentum?

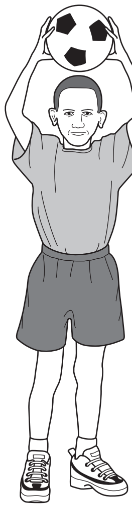
Put a ring around the correct answer.

30 **58** **62** **120**

[1]

[Total: 5]

2 Bobby is playing with a ball.



Complete the following sentences.

Choose words from this list.

distance

kinetic

mass

potential

weight

Bobby lifts the ball up from the ground above his head.

To calculate the work done you must multiply the force by the ……………………………… .

When Bobby holds the ball above his head it has more gravitational ……………………………… energy.

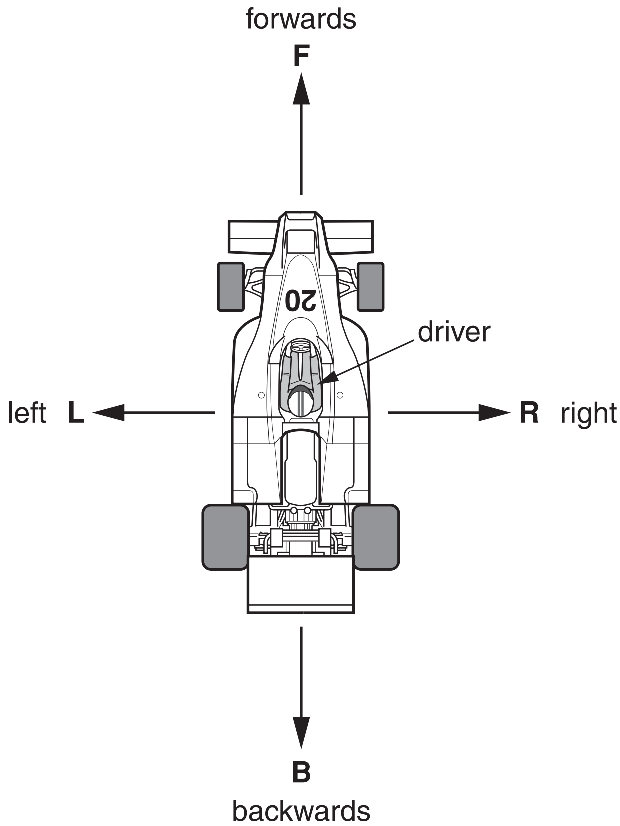
Bobby lets the ball fall to the ground.

The ball speeds up and gains ……………………………… energy.

The ball is pulled down by its ……………………………… . [4]

[Total: 4]

3 A driver in a car experiences forces in different directions as he drives forwards.



(a) (i) The car speeds up in a straight line.

Which force, **F**, **R**, **L** or **B**, does the car exert **on the driver**?

answer .... [1]

(ii) The car slows down **and** turns left.

Which two forces, **F**, **R**, **L** or **B**, does the car exert **on the driver**?

.... and .... [2]

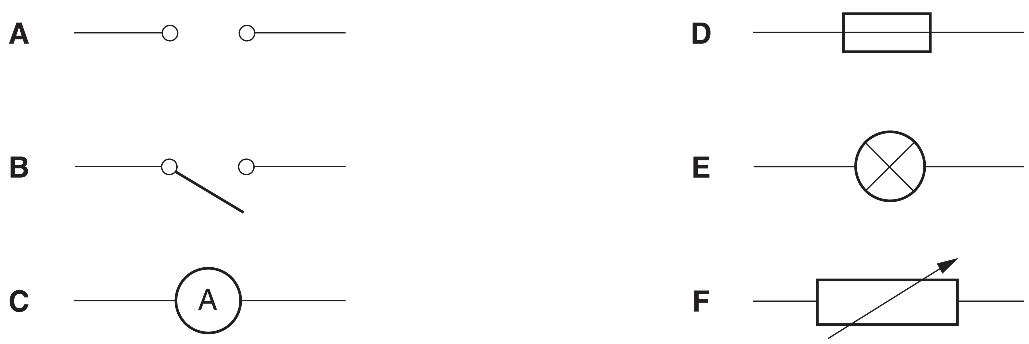
(b) The car speeds up in a straight line.

Which force, **F**, **R**, **L** or **B**, does the driver exert **on the car**?

answer .... [1]

[Total: 4]

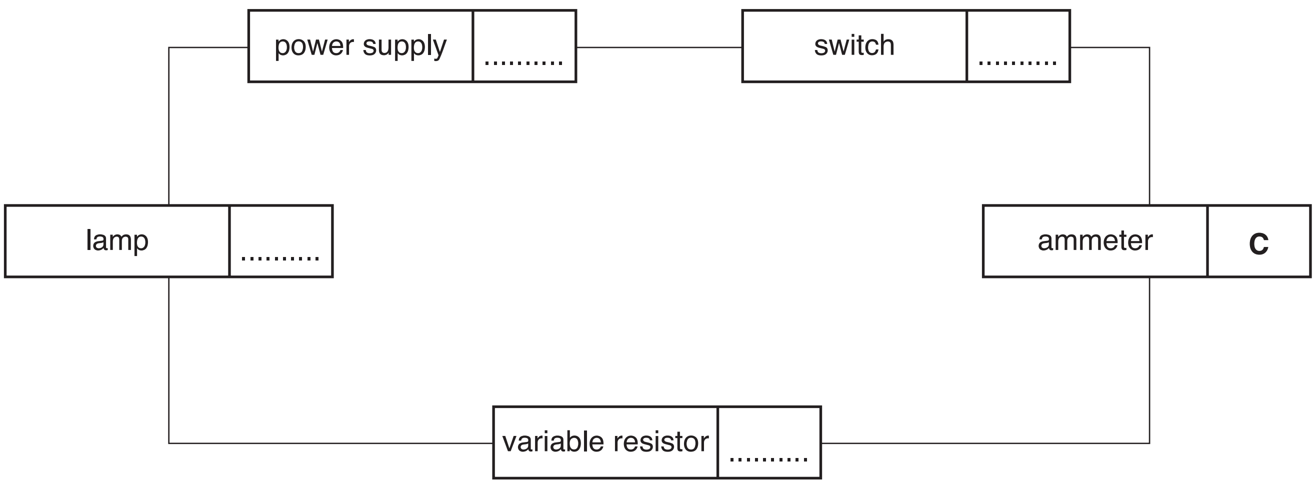
4 Here are some circuit symbols for electrical components.



This circuit uses some of the components.

Write the **letter** for each component symbol in the correct box in the circuit.

One has been done for you.



[4]

[Total: 4]

5 The most commonly used model of electric circuits uses ideas about current and electrons.

Complete the sentences. Choose statements from this list.

a flow of charge

a repulsive force

a continuous loop

an attractive force

a negative charge

(a) An electron has ………………………………………………… .

(b) In a circuit the electrons move in ……………………………………………………… .

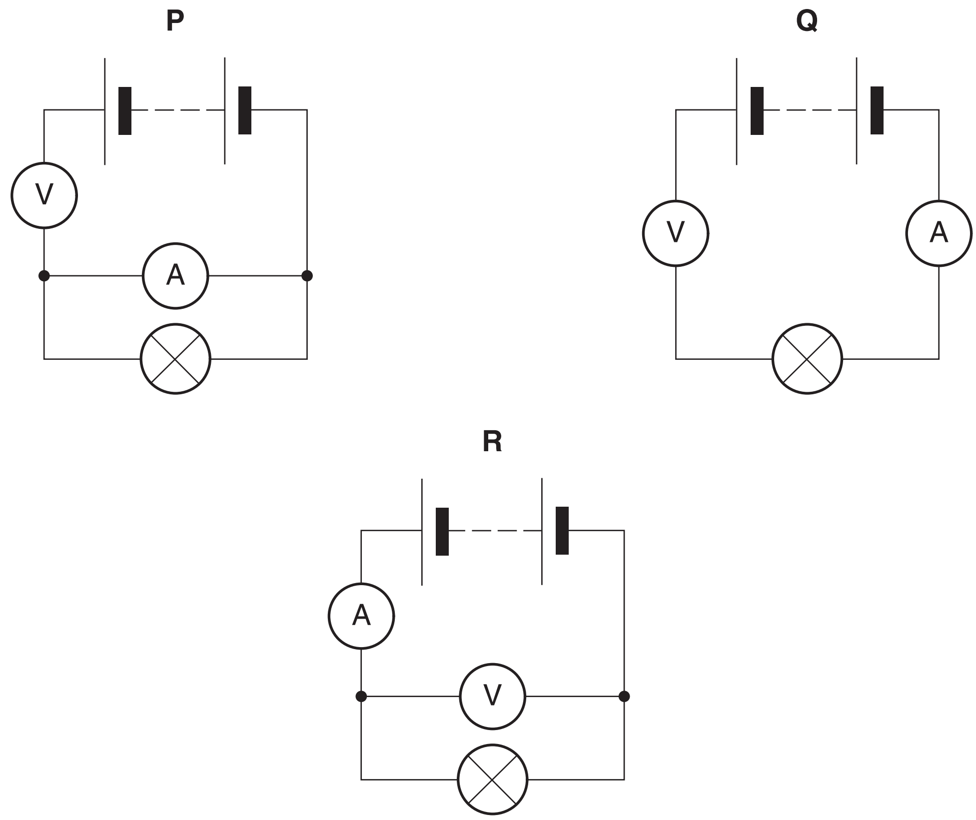
(c) Electric current is ………………………………………………… .

(d) Two negative charges are pushed apart by ………………………………………………… .

[4]

[Total: 4]

6 This question is about making measurements in an electric circuit.



(a) Which circuit, **P**, **Q** or **R**, is correct for measuring the current through the lamp and the voltage across the lamp?

answer .... [1]

(b) Put a ring around the word which means the same as potential difference.

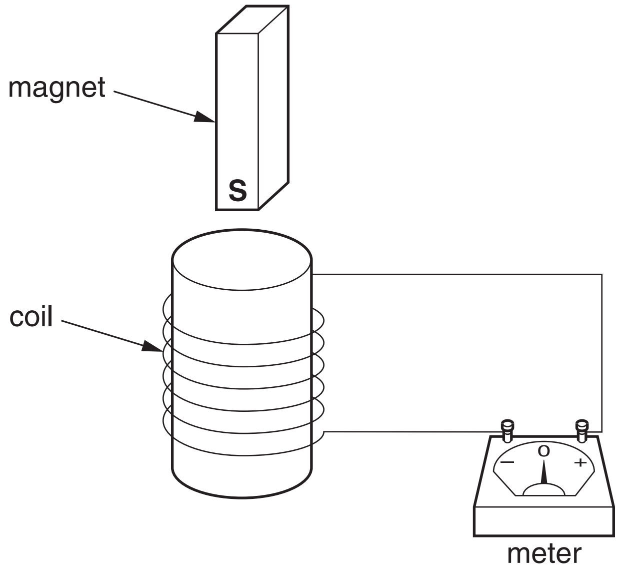
charge **current** **power** **voltage**

[1]

[Total: 2]

7 Electricity can be generated by moving a magnet in a coil of wire.

The diagram shows a magnet held above a coil of wire.



Experiments with this apparatus can show how the electricity is generated.

(a) Draw a straight line from each **experiment** to **what happens on the meter**.

The first line has been done for you.

experiment	**what happens on the meter**
push the South end of the magnet into the coil	needle flicks to right
pull the South end of the magnet out of the coil	needle does not move
push the North end of the magnet into the coil	needle flicks to left
hold the magnet still in the coil	

[3]

(b) What is the name for this method of producing a voltage?

Put a ring around the correct answer.

deduction **induction** **reduction** **transformation**

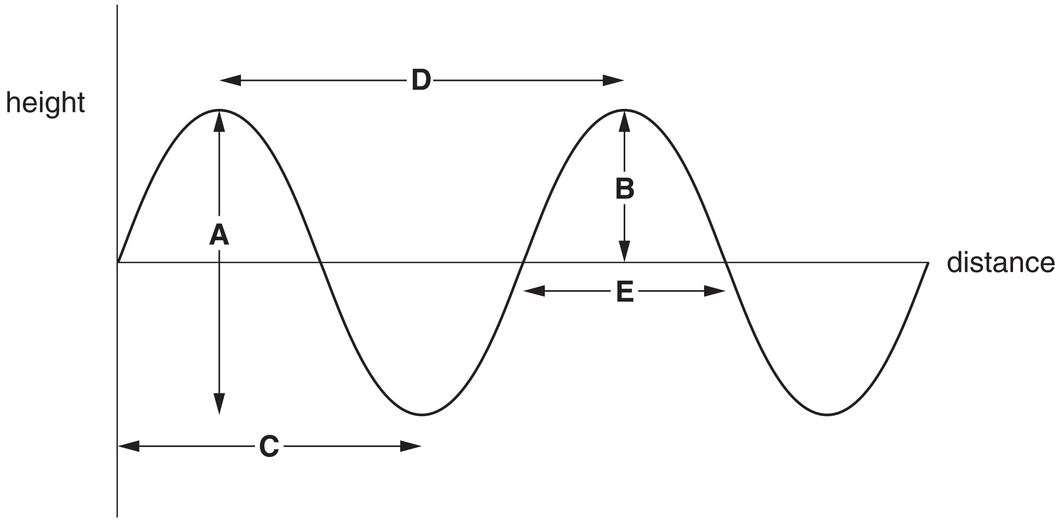
[1]

[Total: 4]

[Turn over

8 Water waves and sound waves are different.

(a) This is a diagram of a water wave.



(i) Which letter, **A**, **B**, **C**, **D** or **E**, shows the amplitude of the wave?

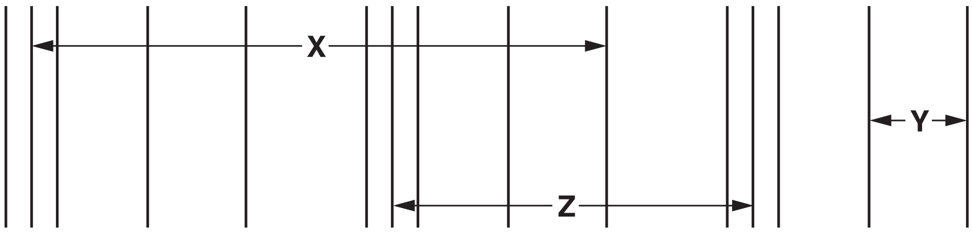
answer ....

(ii) Which letter, **A**, **B**, **C**, **D** or **E**, shows the wavelength of the wave?

answer ....

[2]

(b) Sound waves are shown differently.



Which letter, **X**, **Y** or **Z**, shows a wavelength?

answer .... [1]

(c) Draw a straight line from each **name** to its **wave type** and

draw another straight line from each **name** to its **description**.

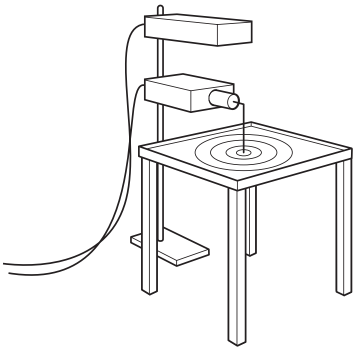
wave type	name	description
		particles move at right angles to wave direction
transverse	sound wave	
		particles move in same direction as wave
longitudinal	water wave	
		particles do not move at all

[2]

[Total: 5]

[Turn over

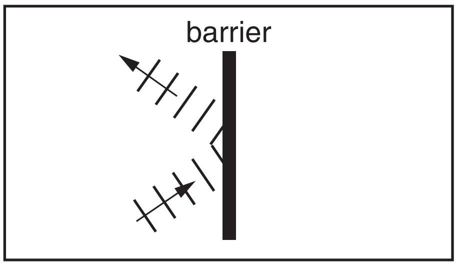
9 Susan is experimenting with water waves in a ripple tank.

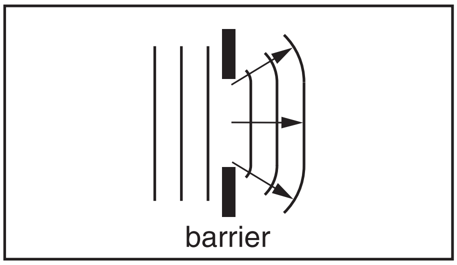


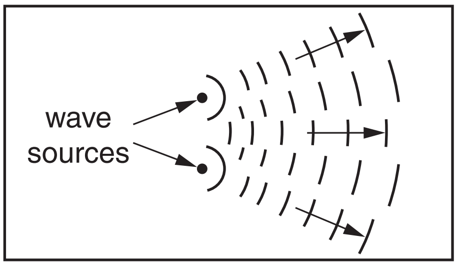
She draws some diagrams to show different wave properties.

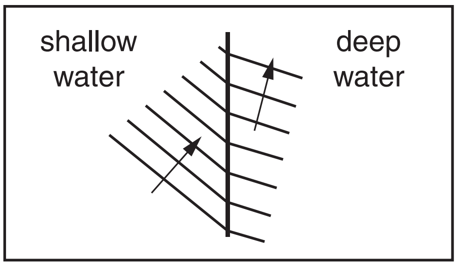
Draw a straight line from each **diagram** to the **wave property** it shows.

diagram









wave property

refraction

interference

reflection

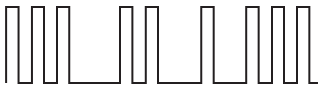
diffraction

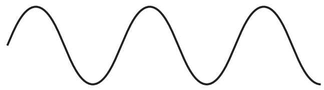
[3]

[Total: 3]

10 Information can be sent using analogue or digital signals. Here are four different signals.

A 

B 

C 

D 

(a) Which diagram, **A**, **B**, **C** or **D**, shows an analogue signal?

answer .... [1]

(b) Which diagram, **A**, **B**, **C** or **D**, shows a digital signal with no noise?

answer .... [1]

(c) Signal **D** is the **output** from an amplifier. Which diagram, **A**, **B** or **C**, shows the input signal to the amplifier?

answer .... [1]

[Total: 3]

11 Here are different parts of the electromagnetic spectrum.

gamma radiation

infrared

microwaves

radio waves

ultraviolet

visible light

X-rays

(a) Put the parts of the electromagnetic spectrum in order of **increasing wavelength**.

The first one has been done for you.

shortest wavelength	**gamma radiation**
longest wavelength	

[3]

(b) Photons with the highest frequency have the most energy.

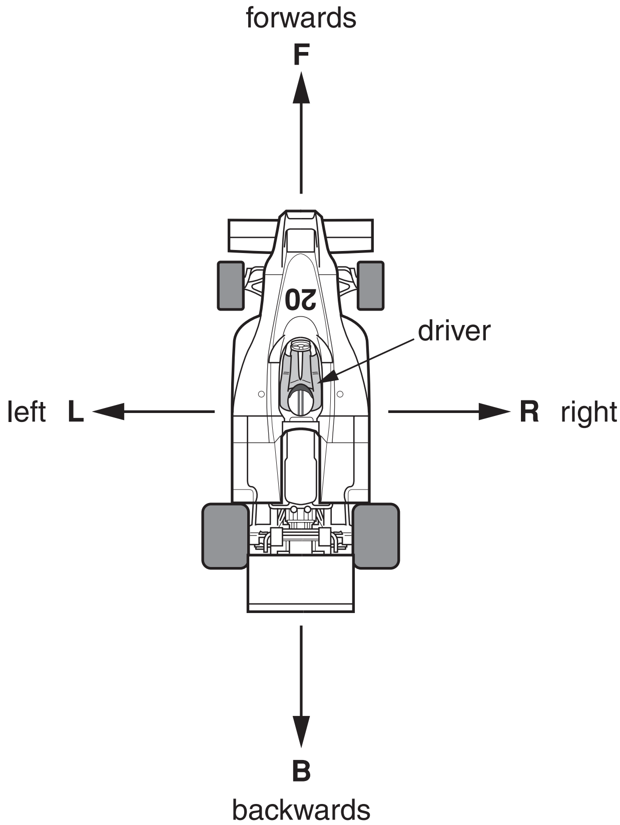
Write down the name of the part of the spectrum that has photons with the most energy.

answer .... [1]

[Total: 4]

END OF QUESTION PAPER

1 A driver in a car experiences forces in different directions as he drives forwards.



(a) **(i)** The car speeds up in a straight line.

Which force, **F**, **R**, **L** or **B**, does the car exert **on the driver**?

answer .... [1]

(ii) The car slows down **and** turns left.

Which two forces, **F**, **R**, **L** or **B**, does the car exert **on the driver**?

.... and .... [2]

(b) The car speeds up in a straight line.

Which force, **F**, **R**, **L** or **B**, does the driver exert **on the car**?

answer .... [1]

[Total: 4]

[Turn over

2 Bobby throws a ball vertically in the air.

(a) The ball weighs 10 N.

(i) How much gravitational potential energy is gained by the ball when it goes up 2.5 m?

Put a ring around the correct answer.

0.04 J **2.5 J** **4 J** **25 J** **40 J** **250 J**

[1]

(ii) At the top of the throw the ball is stationary.

As the ball falls it loses gravitational potential energy, transferring it to kinetic energy.

Which equation correctly shows the velocity of the ball when all the energy has transferred to kinetic energy?

Put a tick (✓) in the correct box.

$$\text{velocity} = \sqrt{\frac{2 \times \text{energy}}{\text{mass}}}$$ ☐

$$\text{velocity} = \frac{\text{energy}}{\text{mass}}$$ ☐

$$\text{velocity} = \sqrt{\text{energy} \times \text{mass}}$$ ☐

$$\text{velocity} = \sqrt{\frac{2 \times \text{energy}^2}{\text{mass}}}$$ ☐

[1]

(iii) The velocity is actually less than that calculated by the equation in part **(ii)**.

Put a tick (✓) in the box next to the best explanation of this.

The mass increases as it falls. ☐

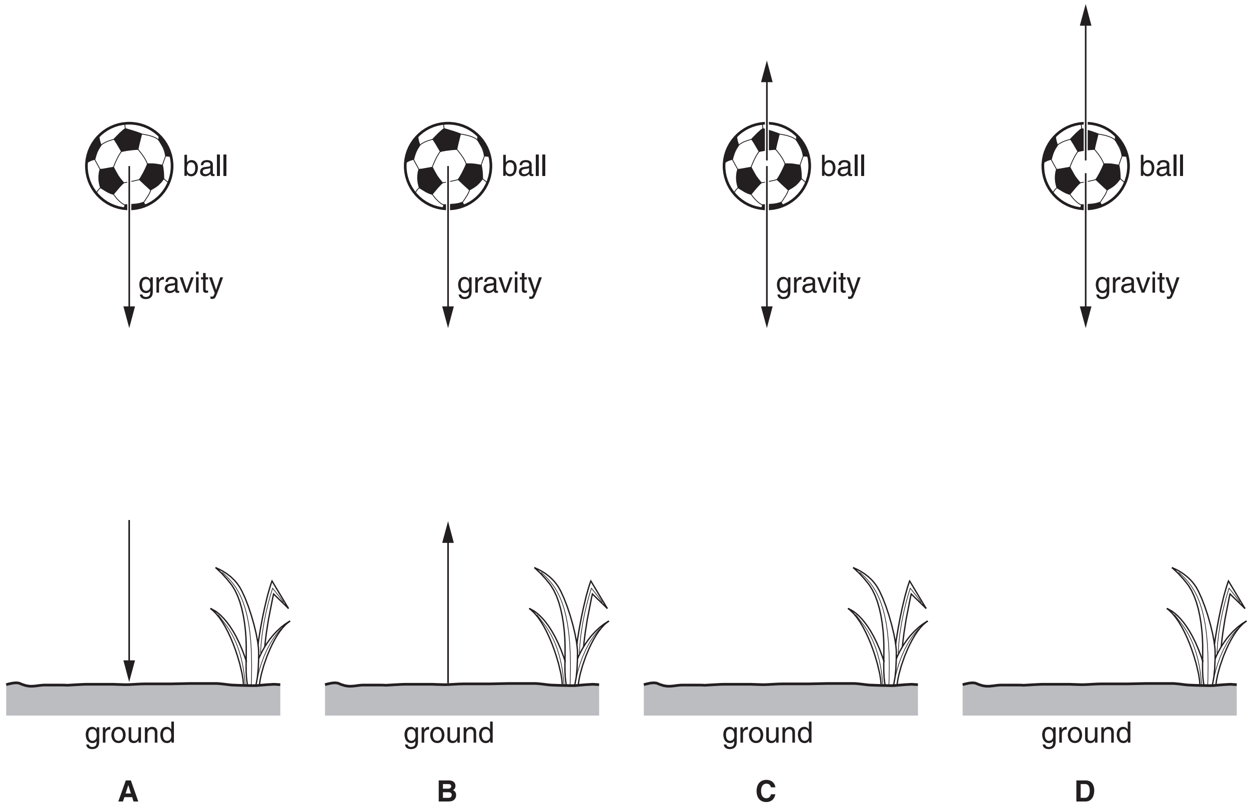
The air resistance increases as it falls. ☐

The momentum increases as it falls. ☐

The energy increases as it falls. ☐

[1]

(b) Gravity is the force pulling the ball down as it falls towards the ground.



The gravity force is one half of an interaction pair.

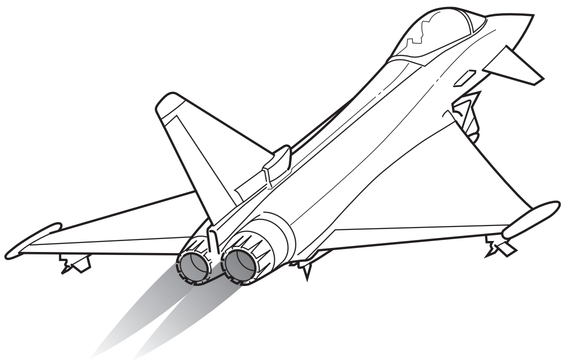
Which of these diagrams, **A**, **B**, **C** or **D**, correctly shows both forces of the interaction pair?

answer .... [1]

[Total: 4]

[Turn over

3



A jet plane works by firing a stream of hot exhaust gas particles backwards.

(a) Some of the following statements are true and some are false. Complete the table with either **true** or **false**.

	true or **false**
The force on each gas particle equals the momentum of the jet plane.	
The change in momentum of the exhaust gas particles equals the change in momentum of the plane, ignoring air resistance.	
The force on one gas particle equals the total force on the jet plane.	
The change in momentum of the gas particles equals the force on the plane multiplied by the time for which it acts.	

[2]

(b) Which of the following would be needed to calculate the momentum of the **exhaust gases**?

Put a tick (✓) in each correct box.

mass of a single exhaust gas particle ☐

weight of jet engine ☐

number of exhaust gas particles ☐

velocity of exhaust gas particles ☐

force due to gravity ☐

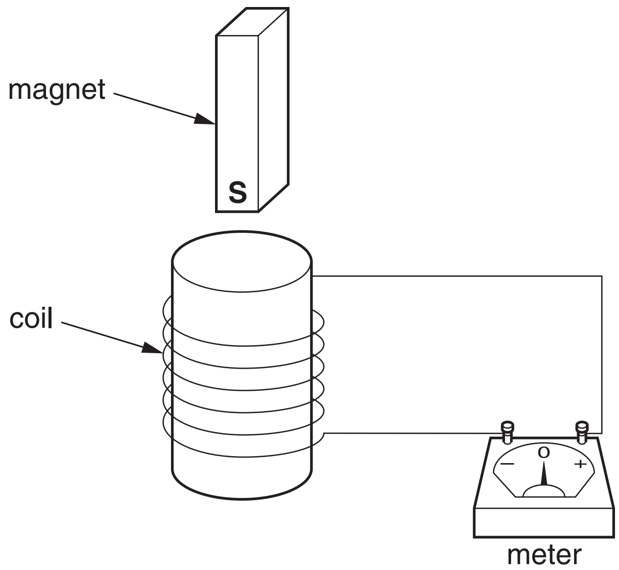
temperature of jet engine ☐

[3]

[Total: 5]

4 Electricity can be generated by moving a magnet in a coil of wire.

The diagram shows a magnet held above a coil of wire.



Experiments with this apparatus can show how the electricity is generated.

(a) Draw a straight line from each **experiment** to **what happens on the meter**.

The first line has been done for you.

experiment	**what happens on the meter**
push the South end of the magnet into the coil	needle flicks to right
pull the South end of the magnet out of the coil	needle does not move
push the North end of the magnet into the coil	needle flicks to left
hold the magnet still in the coil	

[3]

[Turn over

(b) What is the name for this method of producing a voltage?

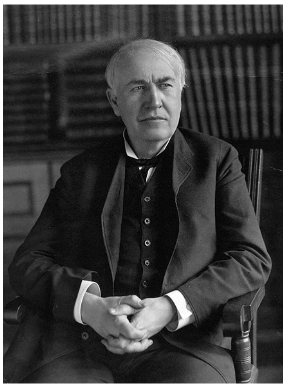
Put a ring around the correct answer.

deduction	**induction**	**reduction**	**transformation**

[1]

[Total: 4]

5



© Wellcome Library, London

Thomas Edison was the first person to set up a company to provide electricity to houses. He used a direct current (d.c.) supply.

(a) We now use an alternating current (a.c.) electricity supply.

Explain why we use a.c. and not d.c.

Put ticks (✓) in the boxes next to the **two** correct explanations.

d.c. is old fashioned	☐
it is easier to generate a.c.	☐
Thomas Edison was unpopular so people would not buy his d.c. electricity	☐
a.c. can be distributed more efficiently	☐
d.c. is more expensive because it can only travel in straight lines	☐

[2]

(b) The main advantage of Thomas Edison's d.c. system was that it used low voltages.

He thought this was safer than a.c.

What is the voltage used for the mains supply to homes in the United Kingdom?

Put a ring around the correct answer.

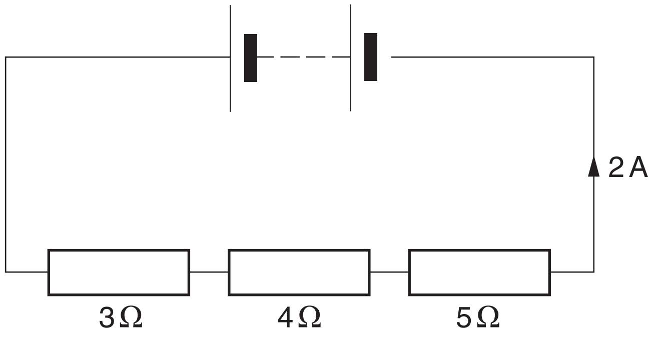
12V **120V** **230V** **11000V** **33000V**

[1]

[Total: 3]

[Turn over

6 This question is about resistors in a series circuit.



(a) What is the voltage across the 3 Ω resistor?

voltage = ... V [1]

(b) Which resistor will have the highest voltage across it?

Put a ring around the correct answer.

3 Ω **4 Ω** **5 Ω** **all the same**

[1]

(c) Which statements describe how to find the voltage across the battery?

Put a tick (✓) in each of the **two** correct boxes.

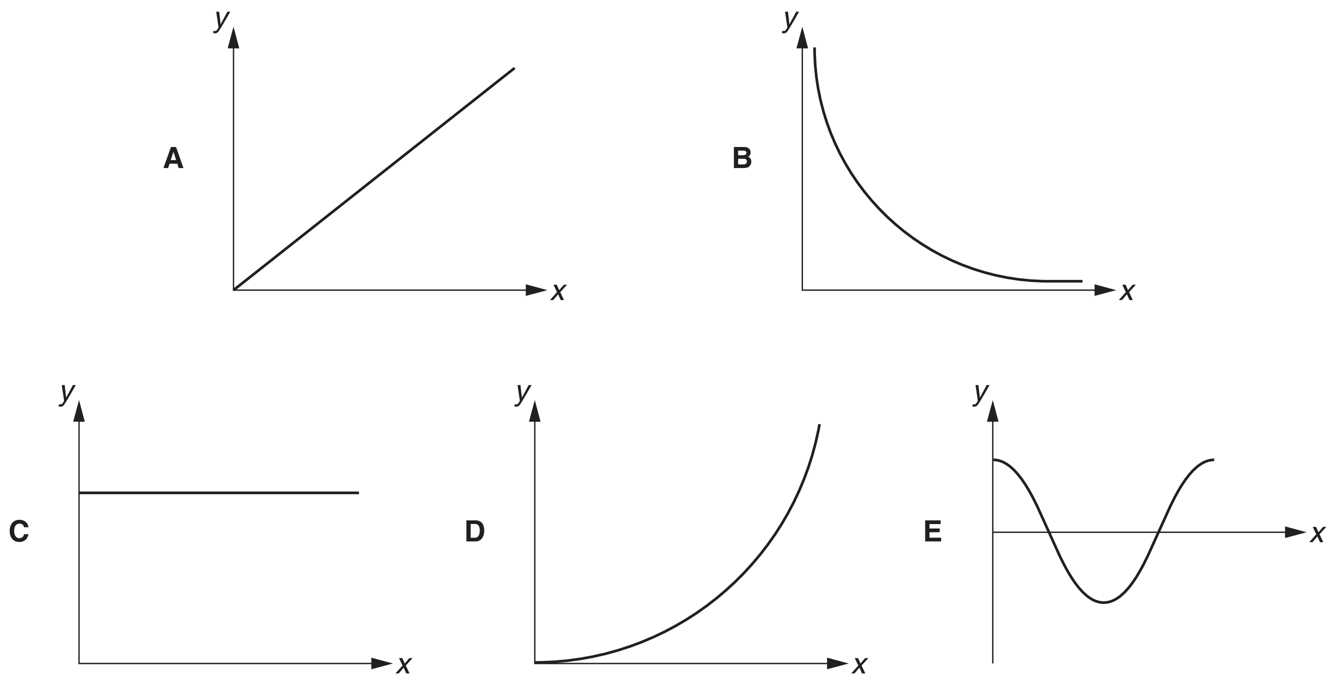
find the total resistance and divide by the current	☐
add the voltage across each of the resistors together	☐
multiply the voltage across each resistor by its resistance	☐
multiply the current by the total resistance	☐
divide each resistance by the current and add the answers together	☐

[2]

[Total: 4]

7 Sarah has been doing various electrical tests.

Unfortunately she forgot to label the axes (x and y) on her graphs.



Write down the letter, **A**, **B**, **C**, **D** or **E**, of the graph that best fits each experiment.

Graphs may be used once, more than once or not at all.

(a) How the resistance of an LDR (y) changes with light intensity (x).

answer .... [1]

(b) How the current (y) varies with the voltage (x) when the resistance does not change.

answer .... [1]

(c) How the voltage across the coil of an a.c. generator (y) changes with time (x).

answer .... [1]

(d) How the resistance of a thermistor (y) changes with temperature (x).

answer .... [1]

(e) The brightness of a lamp (y) connected to a battery as the length of the connecting wires (x) is decreased.

answer .... [1]

[Total: 5]

[Turn over

8 Here are different parts of the electromagnetic spectrum.

gamma radiation

infrared

microwaves

radio waves

ultraviolet

visible light

X-rays

(a) Put the parts of the electromagnetic spectrum in order of **increasing wavelength**.

The first one has been done for you.

shortest wavelength	**gamma radiation**
longest wavelength	

[3]

(b) Photons with the highest frequency have the most energy.

Write down the name of the part of the spectrum that has photons with the most energy.

answer .... [1]

[Total: 4]

9 Waves can refract, diffract and interfere.

Each of the observations below can be explained by one of these processes.

Use straight lines to connect each **observation** to its correct **process** and each **process** to its correct **explanation**.

observation	**process**	**explanation**
TV signals received from behind a hill	refraction	waves add as they pass through each other
	diffraction	waves spread out from the edge of a barrier
spectrum formed by a prism	interference	waves change speed at a boundary

[4]

[Total: 4]

10 Hermione reads a passage about transmitting information. The diagrams of waves are missing from the passage.

Choose the **best** wave diagram to use for each missing diagram in the passage.

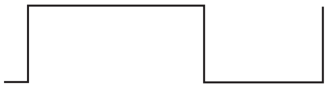
Write down the letter, **A**, **B**, **C**, **D**, **E** or **F**, for each diagram.

Diagrams may be used once, more than once or not at all.

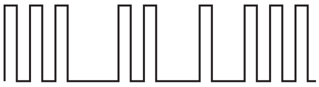
The last one has been done for you.

A

D

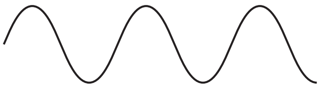


B

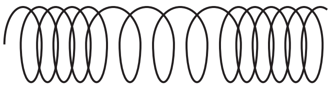


E

C



F



A sound wave is an analogue wave.

diagram …………… [1]

The sound wave is converted into a digital code.

The digital signal is sent as a series of short pulses.

diagram …………… [1]

Digital signals can be transmitted with higher quality than analogue signals.

As the signal is transmitted, it decreases in intensity and picks up noise.

diagram …………… [1]

When the signal is received it is amplified.

diagram …………… [1]

The signal is cleaned up to remove the noise.

diagram …………… [1]

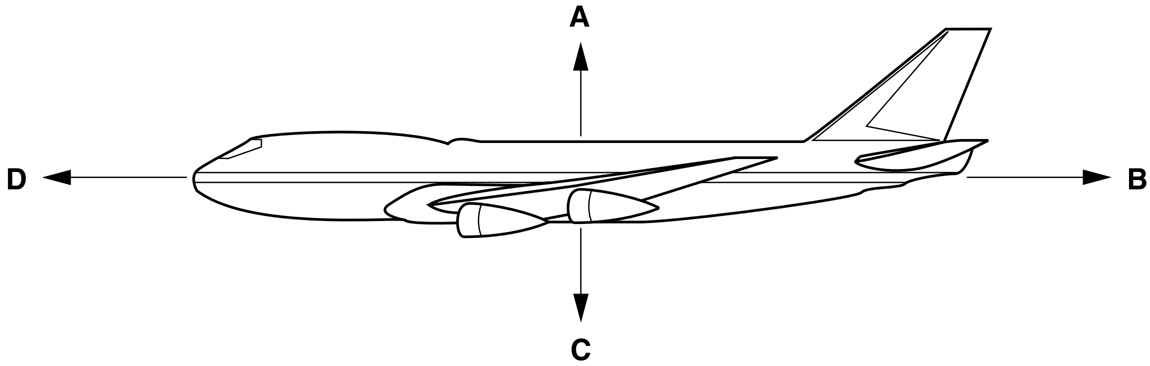
The digital signal is then decoded to reproduce the original sound wave.

diagram ……C……

[Total: 5]

END OF QUESTION PAPER

1 An aeroplane in flight has four forces, **A**, **B**, **C** and **D**, acting on it.



(a) For each of the following put a ring around the correct force **A**, **B**, **C** or **D**.

(i) Which force is gravity? **A** **B** **C** **D**

(ii) Which force is the driving force? **A** **B** **C** **D**

(iii) Which force is air resistance? **A** **B** **C** **D**

[3]

(b) The plane flies at a steady speed and height.

Which two pairs of forces will be equal in size?

Put ticks (✓) in the boxes next to the **two** correct answers.

A and **B** ☐

A and **C** ☐

A and **D** ☐

B and **C** ☐

B and **D** ☐

C and **D** ☐

[2]

(c) When the plane comes into land it gets slower and drops toward the ground.

Complete the following sentence by writing the letter of the missing force.

Force **D** must be smaller than force ....

[1]

(d) Choose words from this list to answer the following questions.

electrical

gravitational potential

heat

kinetic

light

(i) The plane has energy because it is moving.

What is this energy called? .... **[1]**

(ii) As the plane descends towards the ground at a steady speed it loses energy.

What type of energy is lost? .... **[1]**

(e) The plane travels 600 miles in 3 hours.

What is its average speed?

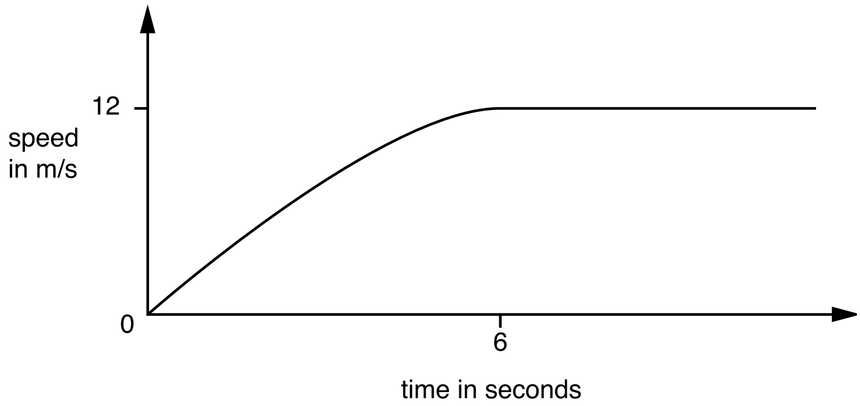
Put a ring around the correct answer.

200 mph **603 mph** **597 mph** **1800 mph**

[1]

[Total: 9]

2 A sprinter runs a 100 m race.
The graph shows how his speed changed during the race.



(a) The highest speed of the sprinter was 12 m/s.

Which two of the following statements together explain why the average speed was less than 12 m/s.

Put ticks (✓) in the **two** boxes next to the correct answers.

The sprinter's speed was 12 m/s only for the last part of the race.	☐
The sprinter gets tired at the end of the race.	☐
The sprinter increases his speed at the beginning of the race.	☐
The sprinter moves at a constant speed of 10 m/s.	☐

[2]

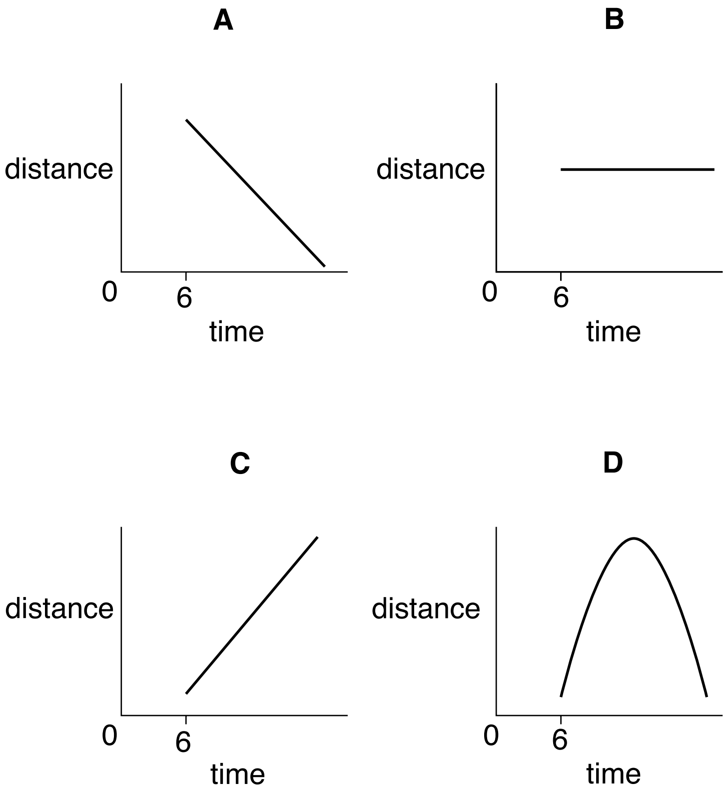
(b) Which of the following is the best meaning of instantaneous speed?

Put a tick (✓) in the box next to the correct answer.

A very quick speed.	☐
An average speed over a very short time.	☐
A constant speed.	☐

[1]

(c) Which of the following graphs **A**, **B**, **C** and **D** could be the distance time graph for the sprinter during the last part of the race?

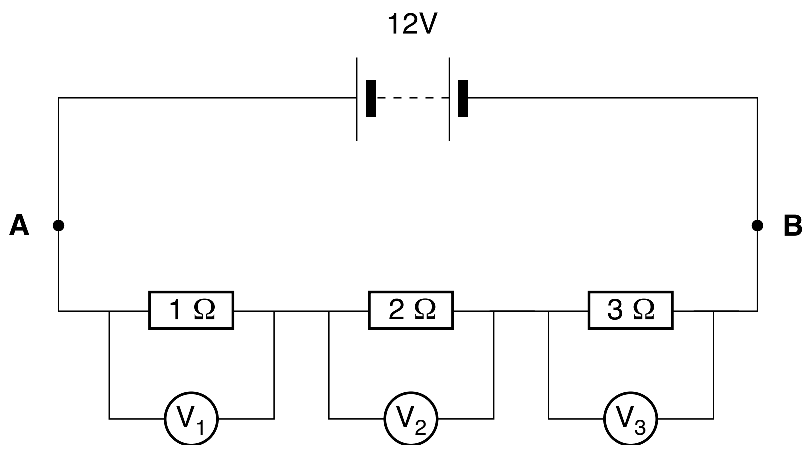


answer .... **[1]**

[Total: 4]

3 Jilly is investigating how resistors affect electric circuits.

(a) She builds a series circuit.



(i) The current at **A** is 2 Amps.

What is the current at **B**?

Put a ring around the correct answer.

0 A **2 A** **4 A** **6 A** **12 A**

[1]

(ii) What is the potential difference between **A** and **B**?

Put a ring around the correct answer.

4 V **6 V** **12 V** **36 V**

[1]

(iii) Which voltmeter will show the highest voltage?

Put a ring around the correct answer.

V_1 **V_2** **V_3**

[1]

(iv) Jilly makes some notes about voltage.

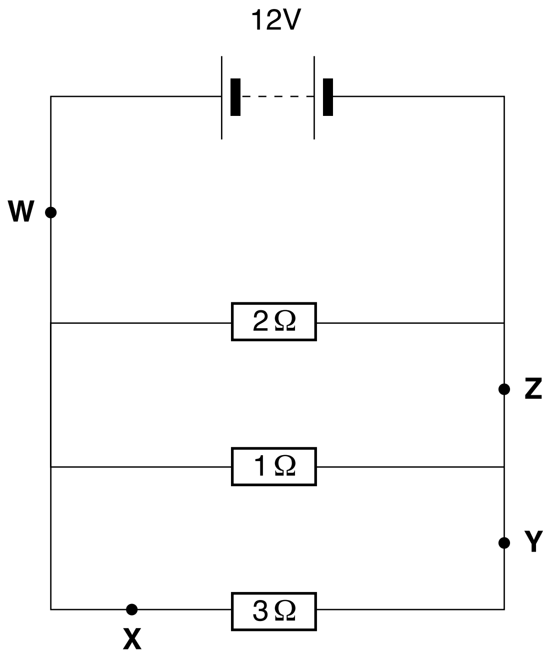
Only two of her notes are correct.

Put ticks (✓) in the **two** boxes next to the correct notes.

The voltage is the flow of charge in the circuit.	☐
The voltage of the battery measures the push it gives charges.	☐
The bigger the voltage across a resistor the more energy is lost by a charge going through it.	☐
The voltage measures the total resistance in the circuit.	☐

[2]

(b) Jilly now builds a parallel circuit.



(i) Where is the current the largest in the parallel circuit, **W**, **X**, **Y or Z**?

Put a ring around the correct answer.

W **X** **Y** **Z**

[1]

(ii) Which resistor will have the largest electric current flowing through it?

Put a ring around the correct answer.

1 Ω **2** Ω **3** Ω

[1]

[Total: 7]

Turn over

4 James is building a fire alarm.

He wants his alarm to detect light and heat.

He decides to use an LDR and a thermistor in his circuit.

(a) Complete the sentence by choosing the best words from the list.

decreases

does not change

increases

speeds up

stops

The resistance of the thermistor decreases when the temperature .... **[1]**

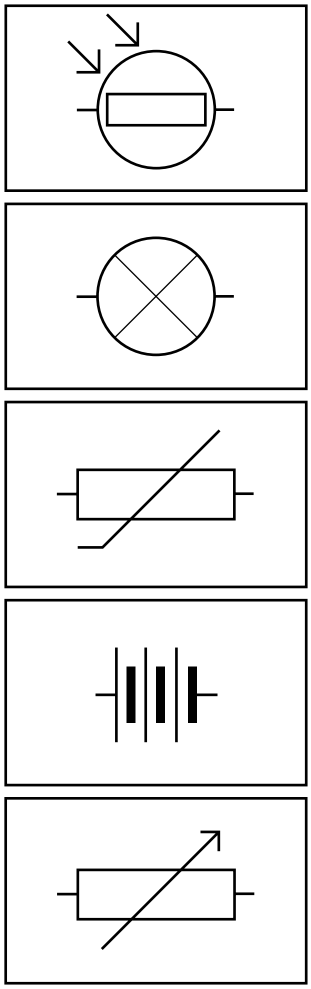
(b) Draw a straight line from each **component** to its **circuit symbol**.

component

thermistor

LDR

circuit symbol



[2]

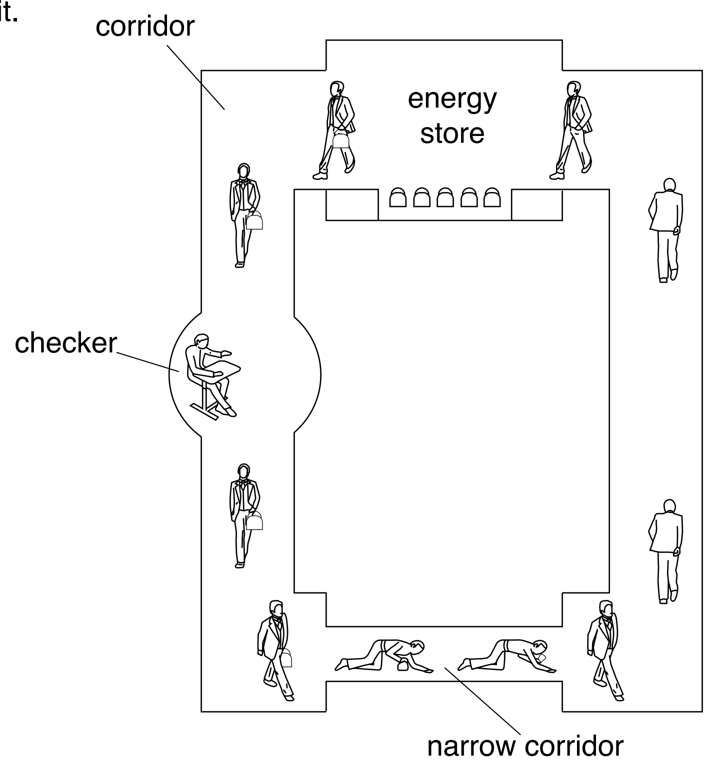
[Total: 3]

5 Barry suggests a model of an electric circuit.

The **people** pick up bags of sugar from the **energy store**.

The **narrow corridor** is hard to get through. It gets very warm as people struggle through it.

The **checker** uses a stopwatch to measure the rate that the people pass him.



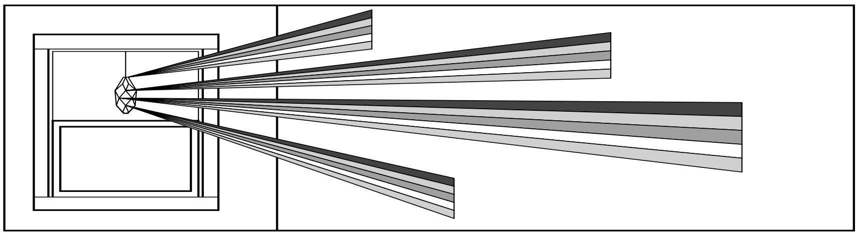
The boxes show parts in the model and parts in an electric circuit.
Draw a straight line from each **part in the model** to the correct **part in an electric circuit**.

part in the model	part in an electric circuit
	electrons
narrow corridor	
	resistor
people	
	voltmeter
energy store	
	ammeter
checker	
	battery

[4]

[Total: 4]

6 Tristram has a crystal hanging on his window.
The crystal produces visible light spectrums on his wall.



(a) A visible light spectrum is made up of different colours of light.

Which of the following are always different for different colours of light?

Put ticks (✓) in the boxes next to the **two** correct answers.

wavelength	☐
speed	☐
frequency	☐
amplitude	☐
intensity	☐

[2]

(b) Visible light is a type of electromagnetic radiation.

(i) The electromagnetic spectrum includes visible light.

gamma	**A**	ultraviolet	**B**	infrared	**C**	radio

Which letter **A**, **B** or **C** shows the position of visible light? ....

[1]

(ii) Which of the statements about visible light are true?

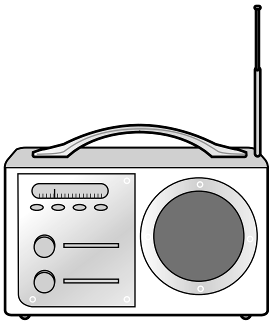
Put ticks (✓) in the boxes next to the **two** correct statements.

visible light travels at a very high speed	☐
visible light cannot travel through empty space	☐
visible light is not absorbed much by glass	☐
visible light has no photons	☐

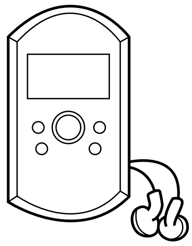
[2]

[Total: 5]

7 Radio programmes in the United Kingdom are now broadcast as both analogue and digital signals.



Analogue radio



Digital radio

(a) For each statement decide whether it applies to **analogue** signals, **digital** signals or **both**.

Put a tick (✓) in the correct box for each statement.

statement	analogue signals	digital signals	both analogue and digital
the signal varies in the same way as the original sound wave			
the signal is a code made up of **1** s and **0** s			
the signal is transmitted as an electromagnetic wave			
the signal is made up of short pulses			

[4]

(b) Complete the sentences by choosing the best word from this list.

aerial **decoder** **receiver**

(i) In an analogue radio a copy of the original sound wave is made by a

.... **[1]**

(ii) In a digital radio a copy of the original sound wave is made by a .... **[1]**

[Total: 6]

8 Katie plays a domino game in a lesson about waves.

Each domino has a word and a meaning of a different word.

word
meaning of a different word

Dominos must be put down with the correct word **below** its meaning.

The first one has been done for you.

Frequency x wavelength is speed, so **F** is the domino placed below **A**.

Write the correct letter in the boxes beside the grey dominos.

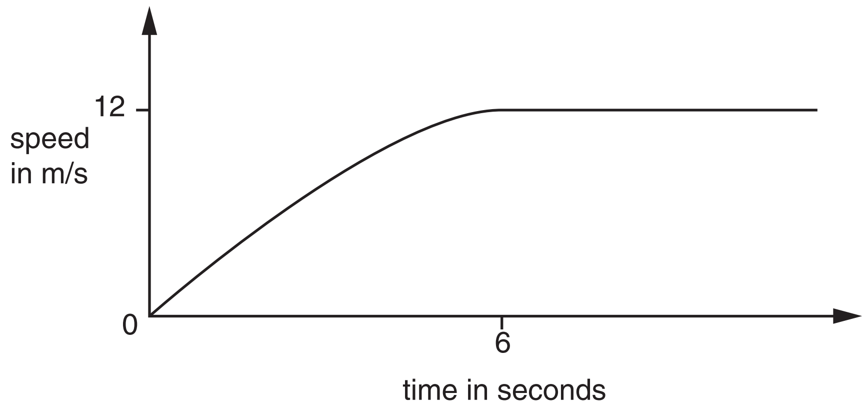
A	**amplitude** frequency x wavelength		
F	**speed** a wave bounces from a surface	**B**	**diffraction** direction of a wave changes as it enters a different medium
		C	**interference** waves spread out from a narrow gap
		D	**reflection** two waves meet and their effects add together
		E	**refraction** the distance from the height of the wave to the undisturbed position
		F	**speed** a wave bounces from a surface

[4]

[Total: 4]

END OF QUESTION PAPER

1 A sprinter runs a 100 m race.
The graph shows how his speed changed during the race.



(a) The highest speed of the sprinter was 12 m/s.

Which two of the following statements together explain why the average speed was less than 12 m/s.

Put ticks (✓) in the **two** boxes next to the correct answers.

The sprinter's speed was 12 m/s only for the last part of the race. ☐

The sprinter gets tired at the end of the race. ☐

The sprinter increases his speed at the beginning of the race. ☐

The sprinter moves at a constant speed of 10 m/s. ☐

[2]

(b) Which of the following is the best meaning of instantaneous speed?

Put a tick (✓) in the box next to the correct answer.

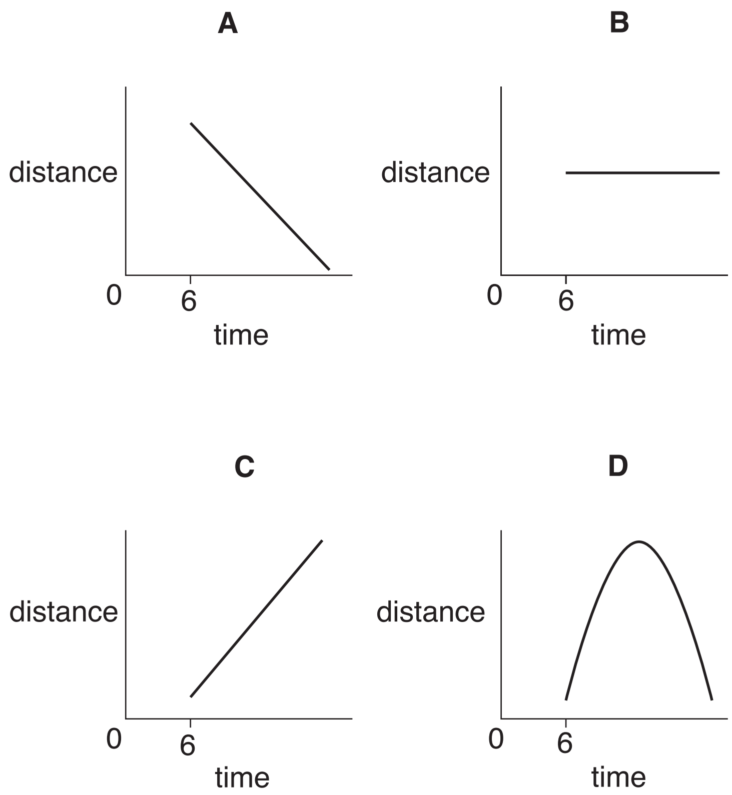
A very quick speed. ☐

An average speed over a very short time. ☐

A constant speed. ☐

[1]

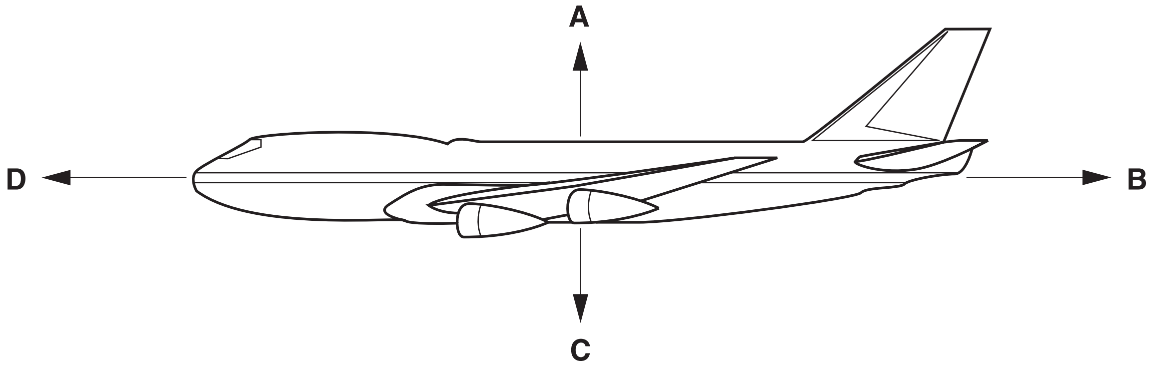
(c) Which of the following graphs **A**, **B**, **C** and **D** could be the distance-time graph for the sprinter during the last part of the race?



answer .... **[1]**

[Total: 4]

2 There are four forces **A**, **B**, **C**, and **D**, acting on an aeroplane as it flies.



(a) When the plane is flying at a steady speed and a constant height, which of the following combinations of forces must equal zero?

Put ticks (✓) in the boxes next to the correct answers.

A and **B** ☐

A and **C** ☐

A and **D** ☐

B and **C** ☐

B and **D** ☐

C and **D** ☐

[2]

(b) Each of the forces on the plane is one of an interaction pair.

One force of the interaction pair acts on the plane, the other force acts on a different object.

Draw a straight line from each **force on the plane** to the **object its interaction pair is acting on**.

force on the plane	**object its interaction pair is acting on**
A	exhaust particles from jet engine
B	the Earth
C	molecules of air
D	

[4]

(c) The table below has four statements about energy changes for the plane.

You must decide if the statement is correct when the plane is:

- taking off and climbing
- in level flight at a steady speed
- descending and landing

For each statement put ticks (✓) in the box or boxes that are correct for each statement.

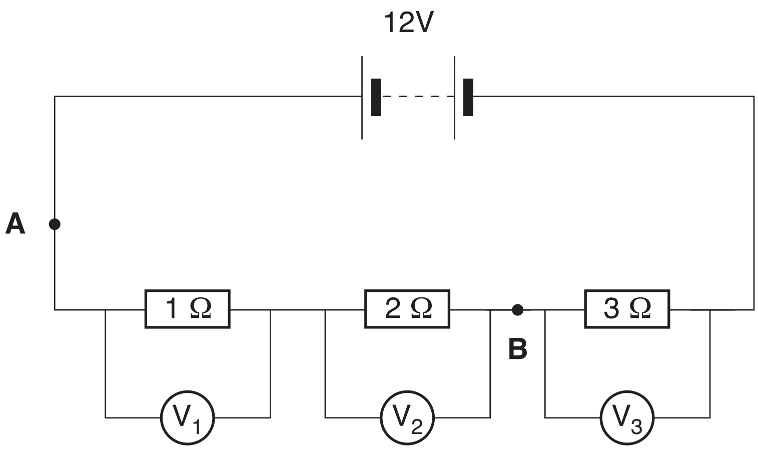
	take off and climb	**level flight**	**descent and landing**
gains kinetic energy and gains gravitational potential energy	☐	☐	☐
work done by the engine is dissipated as heat	☐	☐	☐
energy is conserved	☐	☐	☐

[3]

[Total: 9]

Turn over

3 Jilly builds a circuit to test some ideas about voltage and current.



(a) Jilly records the voltmeter readings.

(i) Which of the equations is correct?

Put a tick (✓) in the box next to the correct answer.

$V_1 + V_2 + V_3 = \frac{12}{3}$ Volts ☐

$V_1 + V_2 + V_3 = 12$ Volts ☐

$V_1 + 2V_2 + 3V_3 = 12$ Volts ☐

$\frac{V_1 + V_2 + V_3}{3} = 12$ Volts ☐

[1]

(ii) What will be the voltage between points **A** and **B**?

Put a ring around the correct answer.

1V **2V** **4V** **6V** **8V** **12V**

[1]

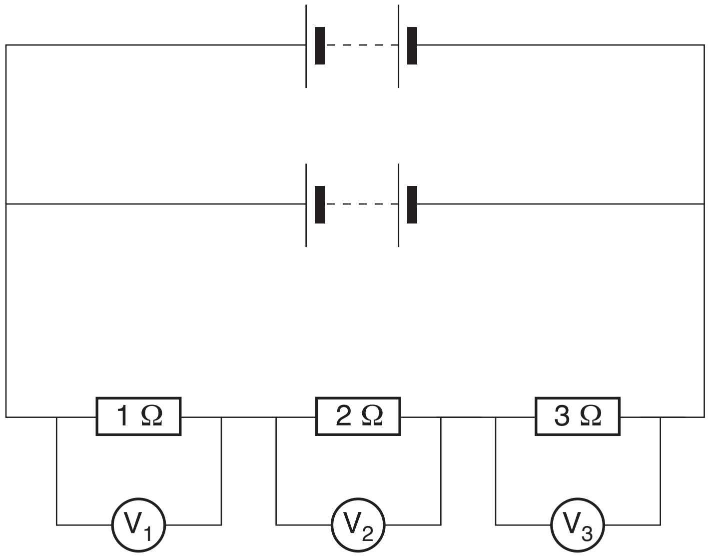
(iii) What is the current through the 2 Ω resistor?

Put a ring around the correct answer.

2 A **4 A** **6 A** **12 A** **24 A**

[1]

(b) Jilly adds another 12V battery **in parallel** with the first battery.



What effect will the additional battery have on the voltage across the resistors?

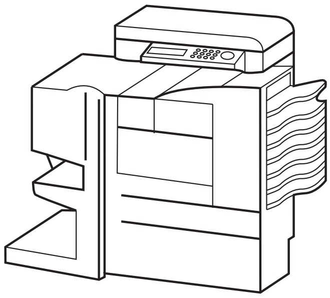
Put a tick (✓) in the box next to the correct answer.

voltage increases but does not double	☐
voltage doubles	☐
no change to voltage	☐
voltage halves	☐
voltage decreases but does not halve	☐

[1]

[Total: 4]

4



Photocopiers usually plug into the mains electrical supply.

But the internal workings need a variety of different voltages.

Transformers are used to change the voltages.

(a) Which of the following statements describe how a transformer works?

Put ticks (✓) in the **three** boxes next to the best answers.

A moving magnet induces a voltage in a coil of wire.	☐
Two separate coils of wire are wound around an iron core.	☐
A changing magnetic field is produced by a changing electric current.	☐
An iron core is a good conductor of electric current.	☐
A changing magnetic field induces a voltage in a coil of wire.	☐
The voltage is changed by the transformer but the electric current stays the same.	☐

[3]

(b) One transformer in a photocopier is used to produce 6000 V from 600 V.

The transformer has 100 coils on the 600 V side.

(i) How many coils will the transformer have on the 6000 V side?

Put a ring around the correct answer.

10 **600** **1000** **6000** **10 000**

[1]

(ii) Which formula would allow you to correctly calculate the number of coils?

Put ticks (✓) in the box next to the correct answers.

$N_s = \frac{V_p}{V_s} + N_p$ ☐

$N_s = N_P \frac{V_p}{V_s}$ ☐

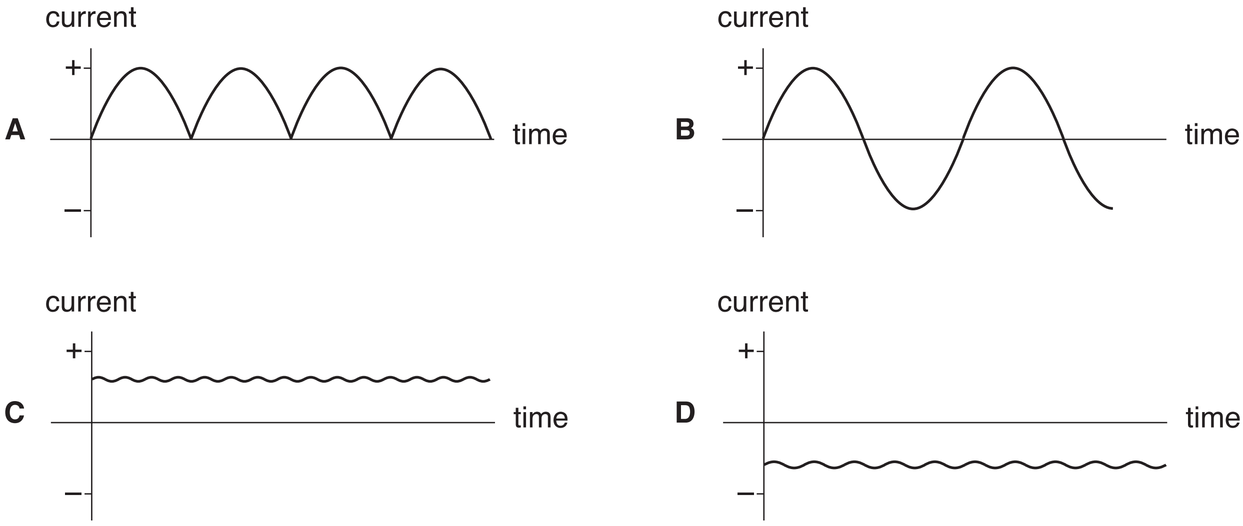
$N_s = N_P \frac{V_s}{V_p}$ ☐

$N_s = N_P + \frac{V_s}{V_p}$ ☐

[1]

(c) The alternating current from the transformer is converted into a direct current.

The graphs show how different currents change with time.



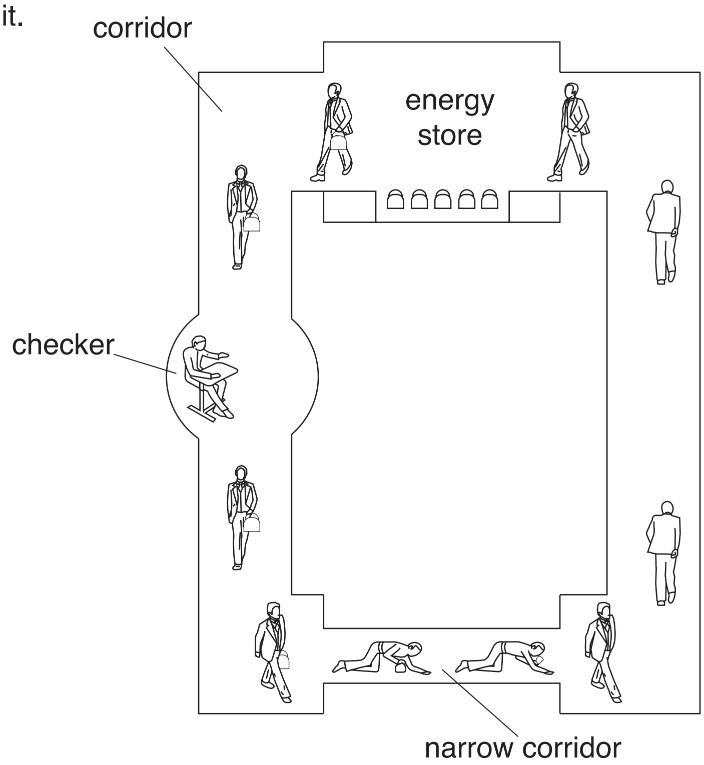
Which of the graphs **A**, **B**, **C** and **D**, show direct current?

Write down the letters of the graphs.

graphs .... **[2]**

[Total: 7]

5 Barry suggests a model of an electric circuit.



The **people** pick up bags of sugar from the **energy store**.

The **narrow corridor** is hard to get through. It gets very warm as people struggle through it.

The **checker** uses a stopwatch to measure the rate that the people pass him.

The boxes show parts in the model and parts in an electric circuit.
Draw a straight line from each **part in the model** to the correct **part in an electric circuit**.

part in the model	**part in an electric circuit**
	electrons
narrow corridor	resistor
people	voltmeter
energy store	ammeter
checker	battery

[4]

[Total: 4]

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word
meaning of a different word

Dominoes must be put down with the correct word **below** its meaning.

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Write the correct letter in the boxes beside the grey dominoes.

A	**amplitude** / frequency x wavelength			
F	**speed** / a wave bounces from a surface		**B**	**diffraction** / direction of a wave changes as it enters a different medium
			C	**interference** / waves spread out from a narrow gap
			D	**reflection** / two waves meet and their effects add together
			E	**refraction** / the distance from the height of the wave to the undisturbed position
			F	**speed** / a wave bounces from a surface

[4]

[Total: 4]

7 This question is about different scientific models for light.

(a) Which of the following are evidence for the model that light is a wave?

Put ticks (✓) in the boxes next to the correct answers.

light travels at a very high speed ☐

two light beams can produce an interference pattern ☐

light reflects from mirrors ☐

light can be different colours ☐

light is diffracted through small slits ☐

[2]

(b) In the photon model a beam of light is a stream of photons.

The intensity of a beam of light is the energy it delivers per second.

(i) In the photon model which of the following affect the intensity of light?

Put ticks (✓) in the boxes next to the correct answers.

the speed of the photon ☐

the number of photons arriving each second ☐

the amplitude of the photon ☐

the energy carried by each photon ☐

[2]

(ii) In the photon model the energy of an individual photon depends on light wave properties.

To increase the energy of a photon, which light wave property must be increased?

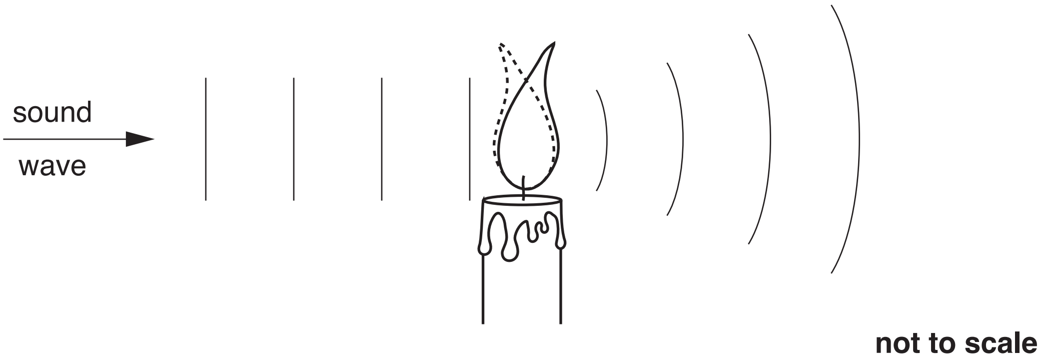
Put a ring around the correct answer.

wave speed **frequency** **wavelength**

[1]

[Total: 5]

8 When a sound wave passes through a candle flame it makes the candle flicker backwards and forwards.



(a) The sound wave has a frequency of 30 Hz and a speed of 300 m/s.

(i) Calculate the wavelength of the wave.

wavelength = ... m **[1]**

(ii) How often will the flame flick backwards and forwards in 4 seconds?

answer = ... **[1]**

(b) The following observations were made during the experiment.

A	The flame acts like a lens for sound waves.
B	The size and brightness of the flame stays the same.
C	The louder the sound the bigger the flicker of the flame.
D	The flame flickers backwards and forwards in the direction the wave is moving.

Some of the observations provide evidence for the statements below.

For each statement write the letter for the observation that provides the best evidence.

the sound wave is a longitudinal wave ☐

the wave speed is greater in the flame than in the air ☐

the energy of the sound wave is related to the amplitude ☐

[3]

[Total: 5]

END OF QUESTION PAPER