Candidate Name ______________________________

Centre Number ______________________________

Candidate Number ______________________________

CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge Ordinary Level

5054/22
PHYSICS
Paper 2 Theory

May/June 2018
TIME: 1 hour 45 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the Question Paper.
No Additional Materials are required.

READ INSTRUCTIONS OVERLEAF

DC (LK/TP) 166923/1

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided on the Question Paper.

SECTION B

Answer any TWO questions.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

SECTION A

Answer ALL the questions in this section.
Answer in the spaces provided.

1 A student drops a small metal object into a cylinder of oil. The object falls alongside a vertical ruler and a camera records its position at 1.0 s intervals, as shown in Fig. 1.1.

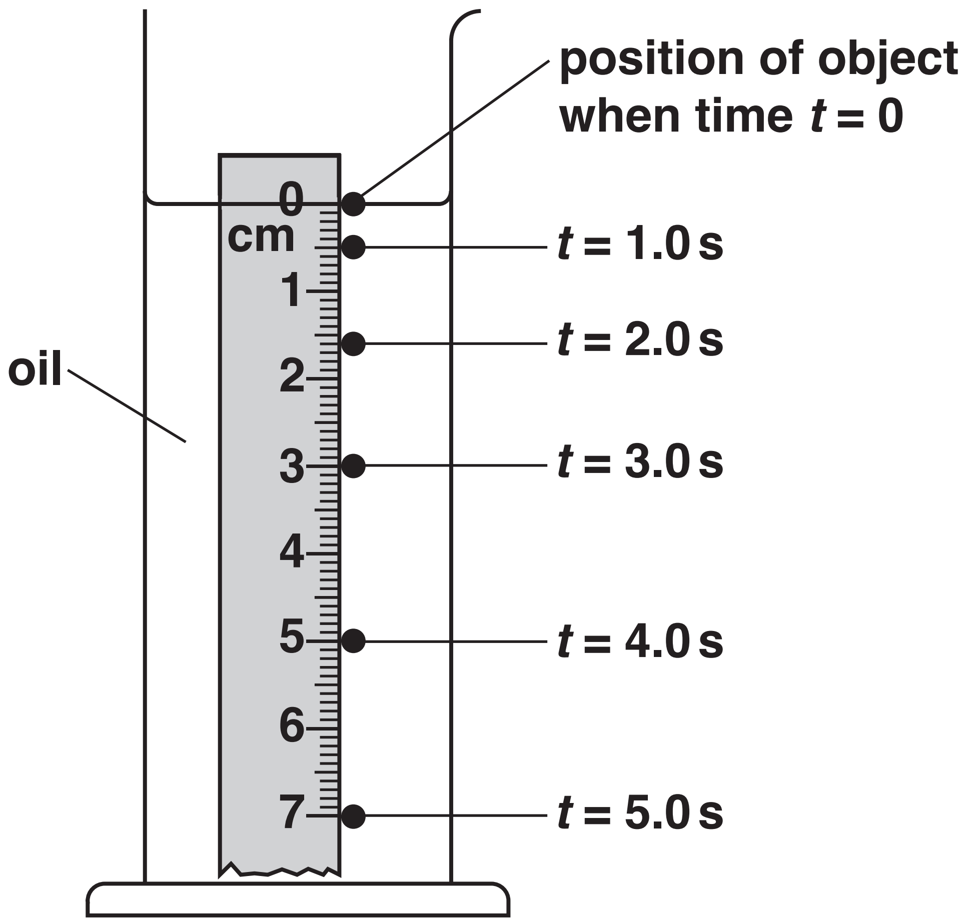

FIG. 1.1

(a) On the grid in Fig. 1.2, plot a distance-time graph for the object.

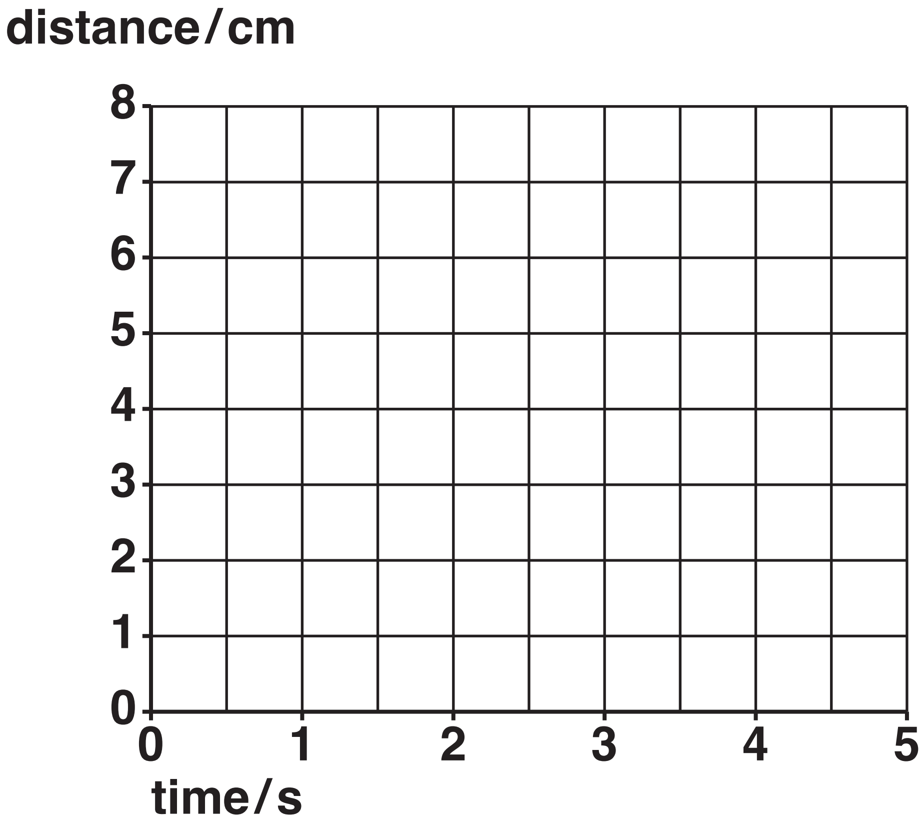

FIG. 1.2

[2]

(b) The object has a constant speed for some of the time.

(i) State and explain how a distance-time graph shows that speed is constant.

____

____

____

____ [2]

(ii) Explain, in terms of the forces acting on the object, how it is able to fall at a constant speed.

____

____

____

____ [2]

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2 In an experiment, a student takes measurements and determines the extension of a spring for different loads. The apparatus is shown in Fig. 2.1.

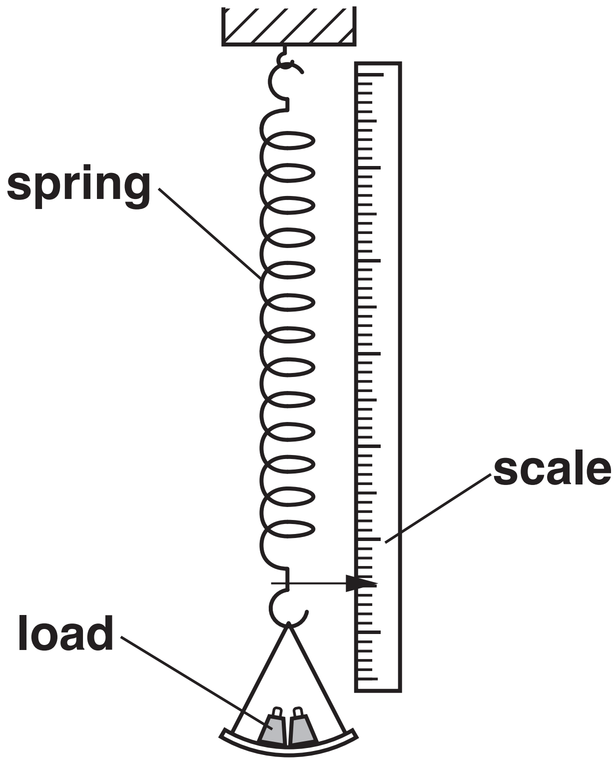

FIG. 2.1

The table in Fig. 2.2 shows the results.

load/N	length of spring/mm	extension/mm
0	200	0
1.0	235	35
2.0	270	70
3.0	305	105
4.0	350	
5.0	420	

FIG. 2.2

(a) **Only some of the extensions are shown in the table.**

Complete the table to show all of the extensions. There are two spaces to fill. **[1]**

(b) **Calculate the load that produces an extension of 49 mm.**

load = ____________________ **[2]**

(c) **The student pulls a load downwards from position A to position B and holds it fixed at position B, as shown in Fig. 2.3.**

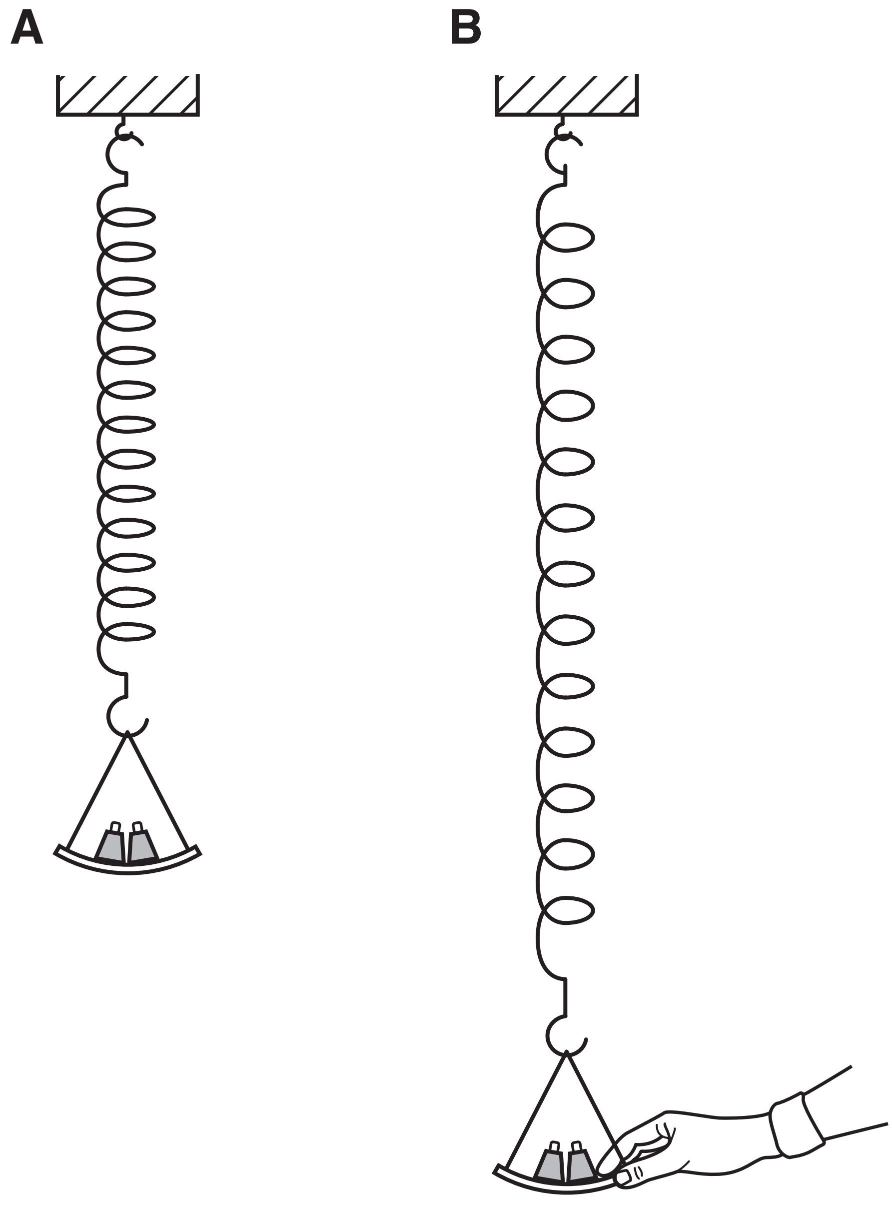

FIG. 2.3

The load is stationary at A and at B. The load has no kinetic energy at either point.

(i) Place ticks (✓) in the boxes to show how the value of each of the forms of energy compares at A and B.

	equal at A and B	larger at A	larger at B
energy stored in spring	☐	☐	☐
gravitational potential energy of load	☐	☐	☐

[1]

(ii) Work is done by the student to pull the load down. The law of conservation of energy states that energy cannot be created and cannot be destroyed.

Explain how this principle applies in this case.

____

____

____

____ [2]

3 Equal volumes of metal, water and air are heated from 20 °C to 80 °C.

(a) State whether the metal, the water or the air expands the most.

____ [1]

(b) Fig. 3.1 is a diagram of the metal at 20 °C. The metal is a large, square sheet with a square hole at its centre. The sheet lies flat on a table.

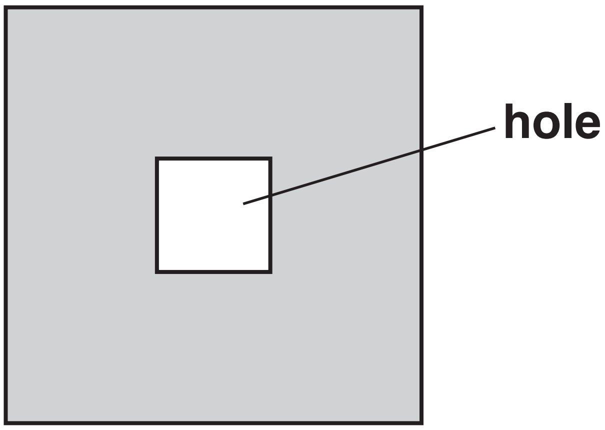

FIG. 3.1

On Fig. 3.1, draw the outline of the sheet and of the hole after the metal is heated. Make sure that the expansion is noticeable. [2]

(c) The metal has a mass of 5.0 kg and a density of 7.5×10^3 kg/m^3.

(i) Define *density*.

____

____ [1]

(ii) Calculate the volume of the metal.

Give your answer to a suitable number of significant figures.

volume = __________________ [2]

4 One form of latent heat is the thermal energy needed to melt a solid.

(a) Define *specific latent heat*.

____

____ [2]

(b) Fig. 4.1 shows one method of measuring the thermal energy needed to melt ice. The ice is contained in a glass funnel and covered with an insulator.

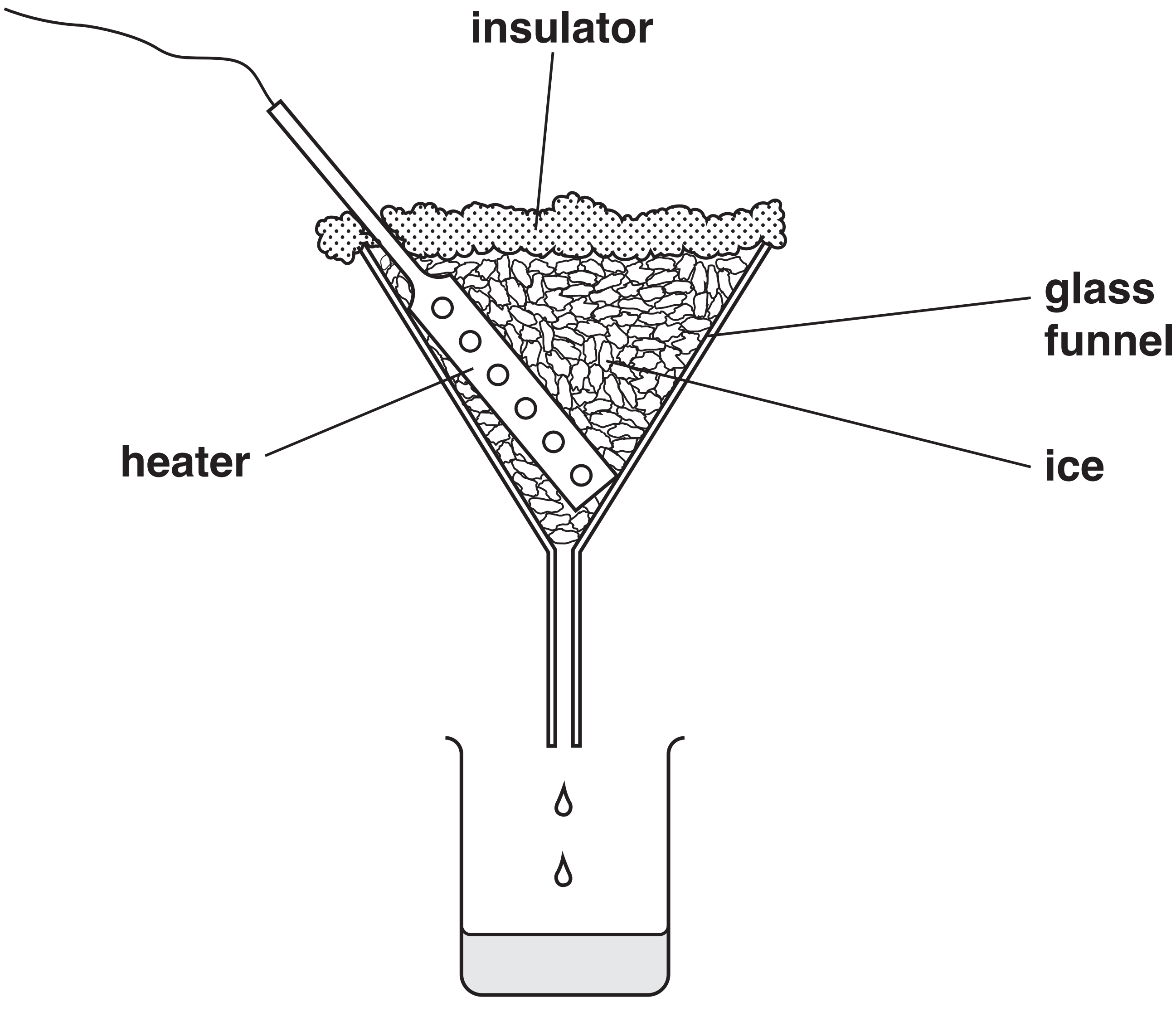

FIG. 4.1

(i) The heater is switched on and the ice melts.

The specific latent heat of fusion of ice is 3.3×10^5 J/kg.

Calculate the energy needed to melt 5.0 g of ice.

energy = ____________________ [2]

(ii) Before the heater is switched on, thermal energy from the room causes some of the ice to melt.

Describe the process by which the ice gains thermal energy from the air.

____

____ [1]

5 A microwave signal from a transmitter on the Earth's surface is sent up to a satellite in orbit and is then immediately transmitted back to Earth.

(a) A pulse of microwaves from the transmitter is received back at the transmitter 0.24 s later.

The speed of microwaves is 3.0×10^8 m/s.

Calculate the distance from the transmitter on the Earth to the satellite.

distance = ____________________ [2]

(b) The microwave signal is used in a telephone system that produces sound.

Waves are described as longitudinal or transverse. Some waves are also electromagnetic.

(i) Place ticks (✓) in the table in Fig. 5.1 to show whether microwaves and sound waves are longitudinal or transverse and to show whether they are electromagnetic.

	microwaves	sound
longitudinal		
transverse		
electromagnetic		

[2]

FIG. 5.1

(ii) A longitudinal wave contains a compression.

Describe what is meant by a *compression*.

____

____

______________________________ [1]

6 A converging lens has a focal length of 3.0 cm. An object of height 2.0 cm is placed 5.0 cm from the centre of the lens. Fig. 6.1 shows the arrangement of the object and the lens.

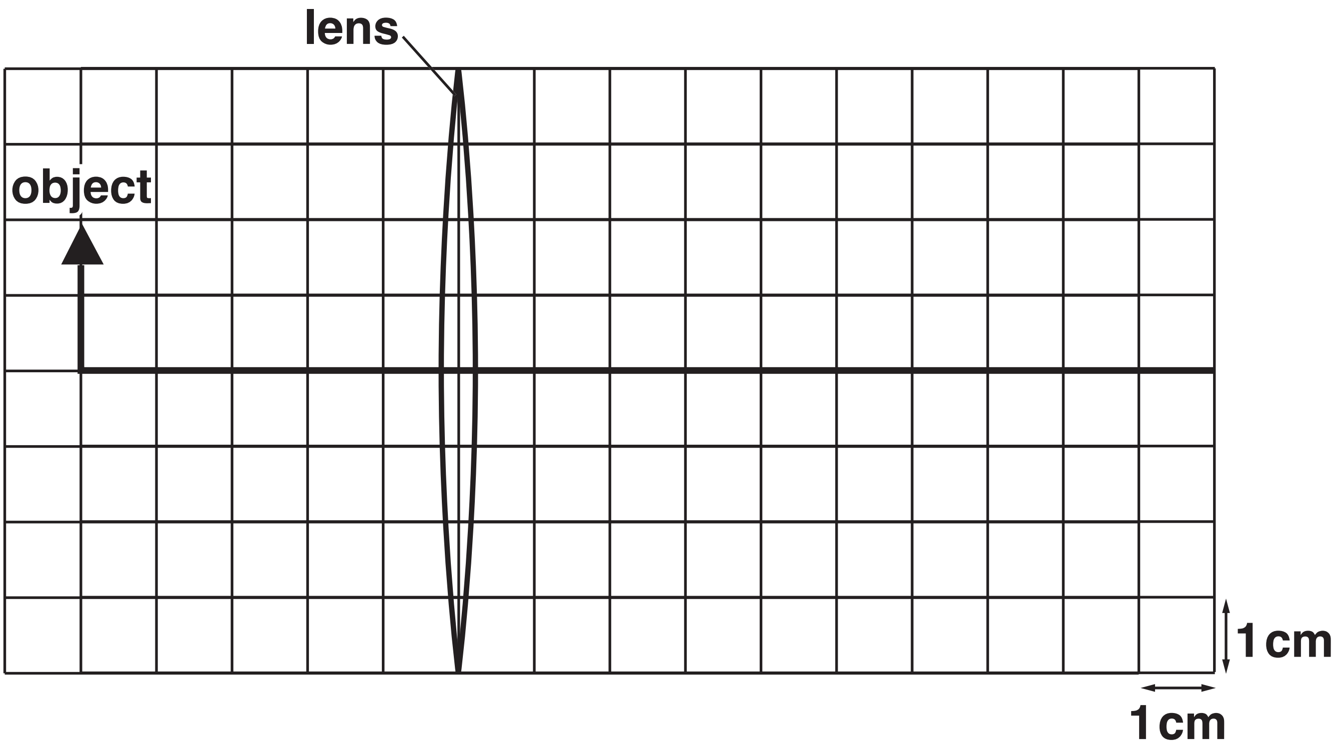

FIG. 6.1 (to scale)

(a) On Fig. 6.1, draw rays from the top of the object to show how the lens forms an image of the object. Mark the image clearly. [2]

(b) The image is magnified. State ONE other feature of the image.

____ [1]

(c) **Calculate the linear magnification produced by the lens in this case.**

magnification = ____________________ **[2]**

(d) **State the name of ONE optical device that produces a magnified image as shown by Fig. 6.1.**

____ **[1]**

7 A computer hard disk contains a layer of a magnetic material.

(a) Describe how a magnet is used to find out if a sample of material is magnetic or non-magnetic.

____

____

____ [1]

(b) Data is stored on the disk as a series of N-poles and S-poles.

Fig. 7.1 on page 21 shows part of the hard disk. The thin layer of magnetic material contains small regions. Each region has an N-pole and an S-pole. Some magnetic field lines are shown on Fig. 7.1.

(i) Region 2 causes a magnetic force on region 1.

State the direction of the magnetic force on region 1 and explain why it acts.

____

____

____ [2]

(ii) On Fig. 7.1, draw arrows on the field lines to show the direction of the magnetic field near the boundary between region 1 and region 2. [1]

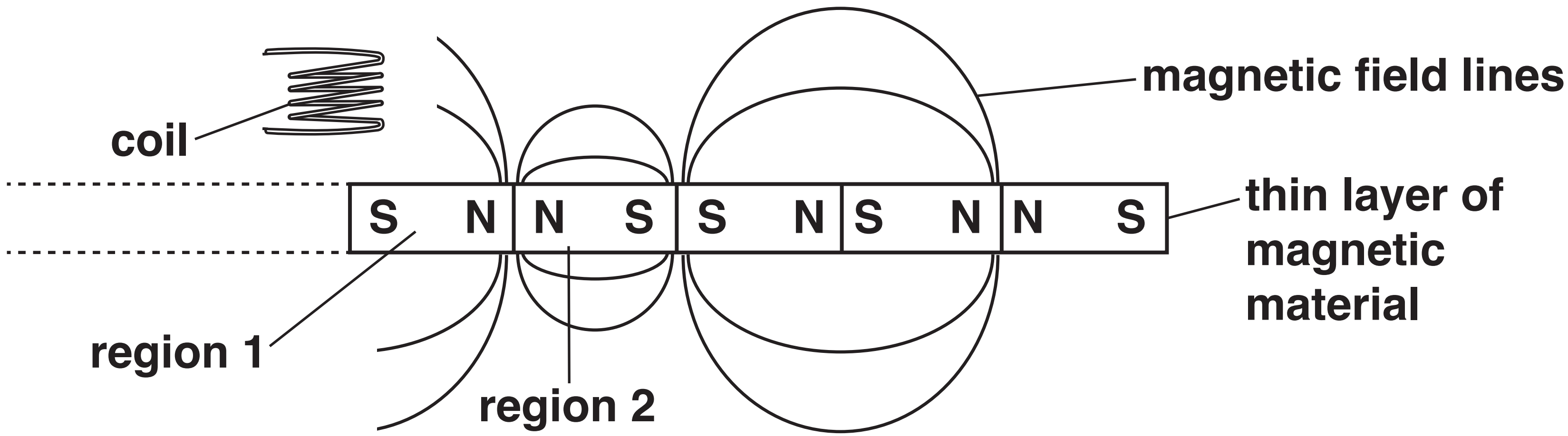

FIG. 7.1 (not to scale)

(iii) The coil shown in Fig. 7.1 is fixed in position. The layer of magnetic material passes quickly under the coil.

A voltage is induced in the coil as some of the boundaries between the regions pass under the coil.

1. Explain why a voltage is induced in the coil.

____

____

____ [1]

2. Suggest why the coil must be close to the layer.

____

____

____ [1]

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8 A fuse is one form of protection in an electrical circuit.

(a) State TWO OTHER forms of protection that are included in household electrical circuits.

These may protect the consumer, the circuit or an electrical appliance.

1. ______________________________

2. ______________________________

[2]

(b) Fig. 8.1 shows a fusebox connected to part of a lighting circuit in a house.

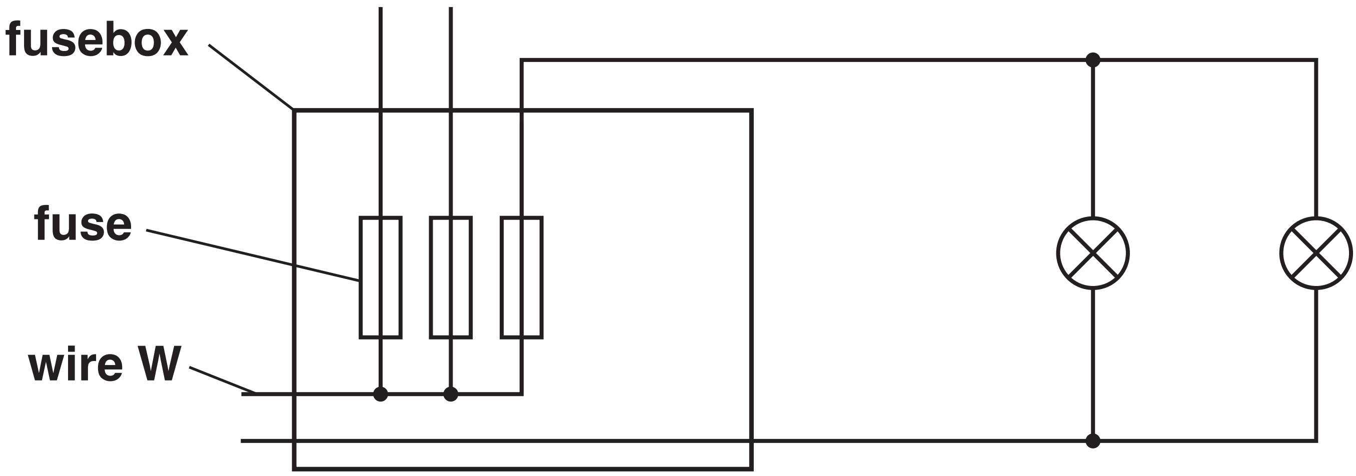

FIG. 8.1

(i) **State how Fig. 8.1 shows that wire W is the live wire.**

____

____ **[1]**

(ii) **On Fig. 8.1, mark with a letter s, the correct position for a switch that controls both lamps.** **[1]**

(iii) **The rating of the fuse in the lighting circuit is 5 A.**

Explain what this means.

____

____

____ **[1]**

SECTION B

Answer TWO questions from this section.
Answer in the spaces provided.

9 **Wind energy is a renewable energy source. A wind turbine and generator convert energy in the wind to electrical energy in a generator. Fig. 9.1 shows some wind turbines.**

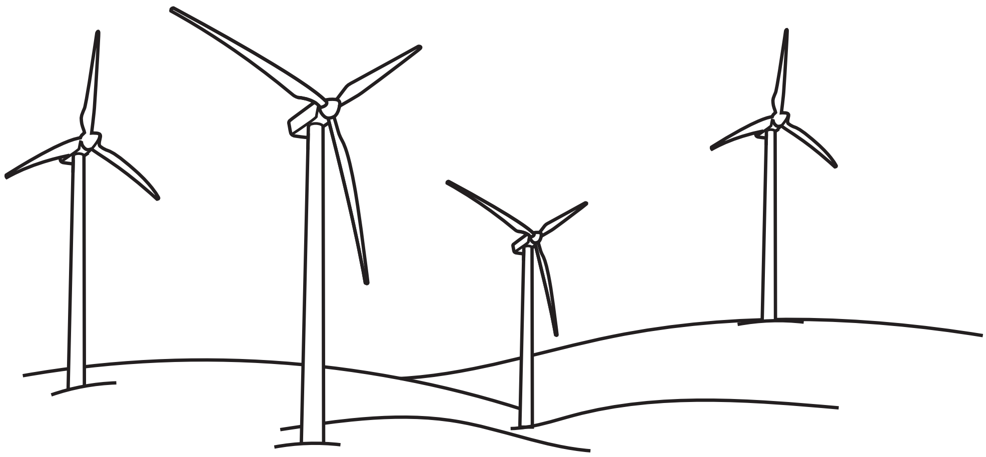

FIG. 9.1

(a) (i) State what is meant by a *renewable energy source*.

____

____

____ **[1]**

(ii) State the name of ONE OTHER renewable energy source.

____

____ [1]

(iii) Some methods of generating electricity cause much more global warming than wind energy.

1. State ONE method of generating electricity that causes a large amount of global warming.

   ____ [1]

2. Describe, in outline, how the method you have chosen causes a significant amount of global warming.

   ____

   ____

   ____ [1]

(b) During a 30 minute period, a mass of 4.2×10^{7} kg of air enters the turbine with a speed of 15 m/s.

(i) Calculate the kinetic energy of the air that enters the turbine in 30 minutes.

energy = ____________________ [2]

(ii) The electrical power output of the generator connected to the turbine is 8.4×10^{5} W.

Calculate the electrical energy output from the turbine in 30 minutes.

energy output = ____________________ [2]

(iii) Calculate the efficiency of the turbine and generator in converting the kinetic energy of the air to electrical energy.

efficiency = ____________________ [2]

(c) The generator contains a coil that rotates between the poles of a magnet.

The coil rotates 50 times in one second and produces an alternating voltage output with a maximum value of 500 V.

(i) On the grid in Fig. 9.2, sketch a voltage–time graph showing the output voltage.

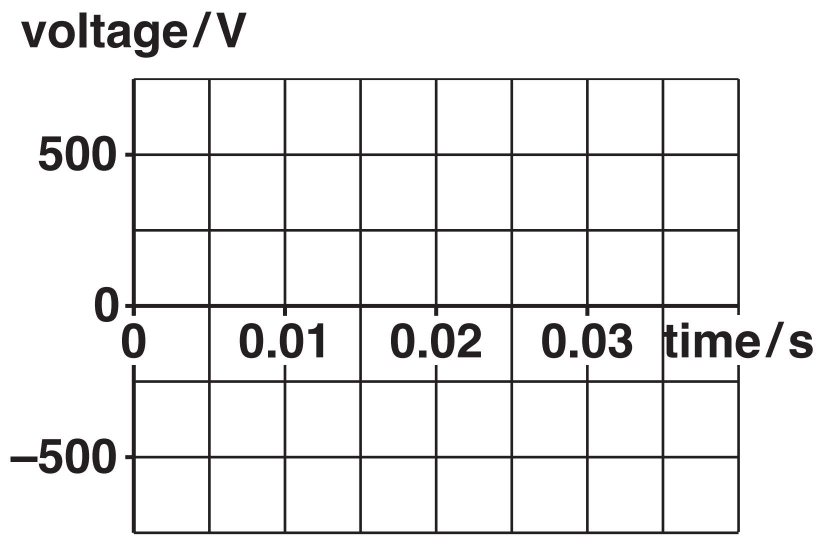

FIG. 9.2

[2]

(ii) The output voltage from the generator is stepped up by a transformer. The electrical energy then passes along a transmission line to a distant house.

Explain why

1. a high voltage is used for the transmission of electrical energy,

____

____

____

____ [2]

2. a transformer is used to connect the transmission line to the house.

____

____

____ [1]

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10 **A student connects a battery to two resistors. The circuit diagram is shown in Fig. 10.1.**

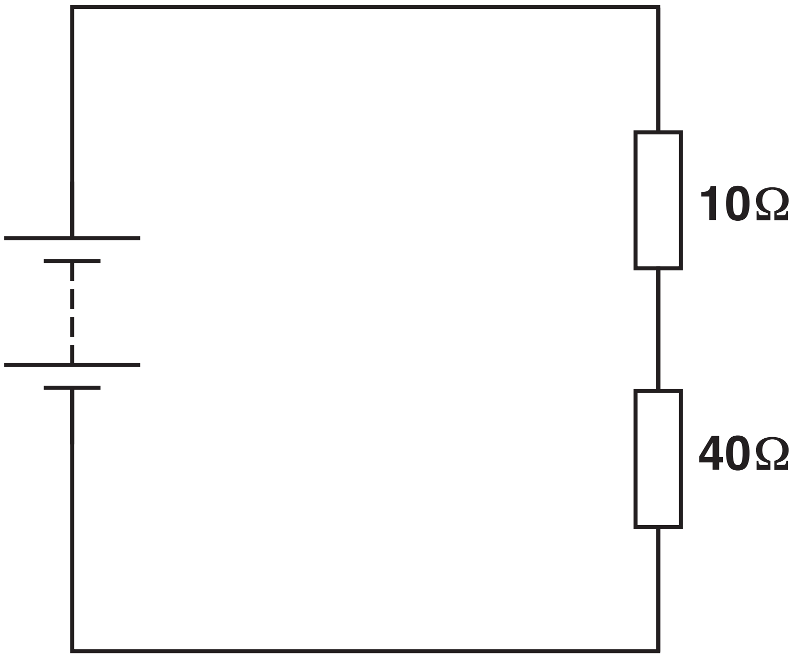

FIG. 10.1

The potential difference (p.d.) across the $40\,\Omega$ resistor is 9.6 V.

(a) **State what is meant by the *potential difference* across a resistor.**

____

____ **[2]**

(b) **(i)** **Calculate the current in the $40\,\Omega$ resistor.**

current = ____________________ **[2]**

(ii) Calculate the electromotive force (e.m.f.) of the battery.

e.m.f. = ____________________ [2]

(c) The student has three different voltmeters to measure the p.d. across the 40 Ω resistor. These are labelled 0–2 V, 0–20 V and 0–200 V. Each has a pointer that shows the p.d. on a scale.

State and explain which of the three voltmeters is best to measure this p.d.

____

____

____

____ **[2]**

(d) (i) Calculate the power *P* produced in the 10 Ω resistor.

***P* = ______________________ [2]**

(ii) The student has available two 10 Ω resistors, with power ratings of $\frac{1}{2}P$ and $2P$.

Suggest why a resistor with a power rating of $\frac{1}{2}P$ is not suitable for the circuit in Fig. 10.1.

____

____ [1]

(e) The student adds a resistor R to the circuit, to make the circuit shown in Fig. 10.2.

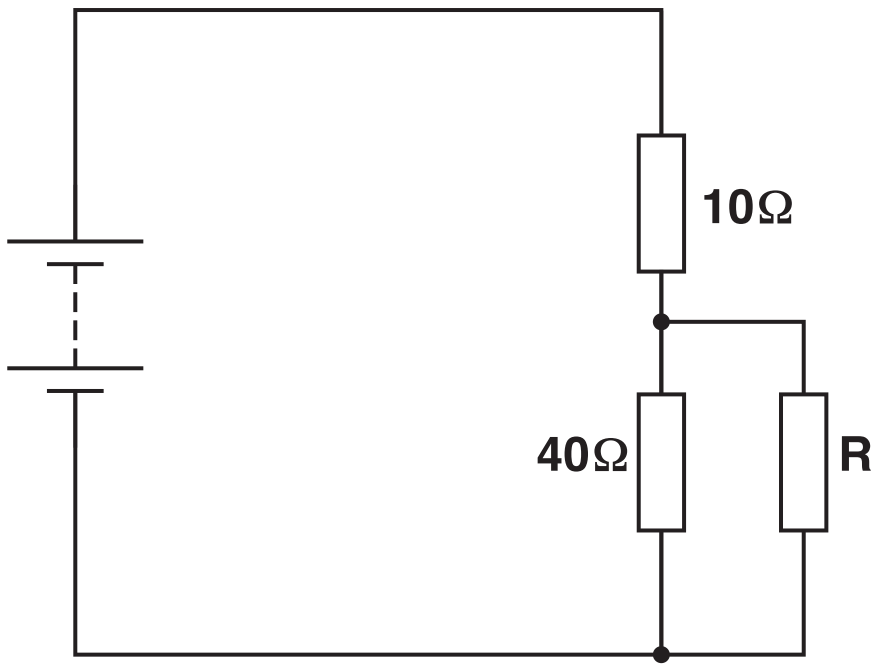

FIG. 10.2

Complete the table in Fig. 10.3 to show what happens as resistor R is connected.
There are five spaces to fill.

You should state whether each quantity increases, decreases or stays the same and give a brief explanation of why any change occurs.
Calculations are not required.

quantity	increases, decreases or stays the same as resistor R is added	brief explanation of why the change occurs
current in 10 Ω resistor	increases	
p.d. across 10 Ω resistor		
p.d. across 40 Ω resistor		

[4]

FIG. 10.3

11 A smoke detector contains a small radioactive source of americium-241. The source emits alpha-particles.

(a) (i) In the space below, draw a diagram of an apparatus that can be used to show that the source emits alpha-particles.

[2]

(ii) Describe how this apparatus is used.

____

____

____

____ [2]

(iii) Explain how the results of the test show that the source emits alpha-particles.

____

____

____

____ [2]

(b) The smoke detector works because alpha-particles from the source ionise the air.

Compare the relative ionising effects and penetrating powers of alpha-particles, beta-particles and gamma rays.

ionising effects ______________________________

____

penetration effects ___________________________

____

[2]

(c) Americium-241 has a half-life of 430 years.

(i) Radium-224 is another element that emits alpha-particles. It has a half-life of 3.6 days.

Explain why americium-241 is more suitable as the radioactive source in a smoke detector than radium-224.

____

____

____ [1]

(ii) A smoke detector contains 8.0×10^{11} atoms of americium-241.

Calculate the time taken for the number of atoms of americium-241 to fall to 1.0×10^{11}.

time = ____________________ [3]

(d) When used correctly, the radioactive source in the smoke detector is less harmful than background radiation.

(i) State one harmful effect of background radiation.

____ [1]

(ii) A radioactive source is picked up using a long-handled tool. Explain why this is safer than using a short-handled tool.

____

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____

____ [2]

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