Candidate Name	Centre Number					Candidate Number				

GCSE PHYSICS

COMPONENT 1

Concepts in Physics

FOUNDATION TIER

SAMPLE PAPER

(2 hours 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**8**	
3.	**12**	
4.	**5**	
5.	**7**	
6.	**5**	
7.	**8**	
8.	**7**	
9.	**7**	
10.	**12**	
11.	**9**	
12.	**6**	
13.	**17**	
14.	**13**	
Total	**120**	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

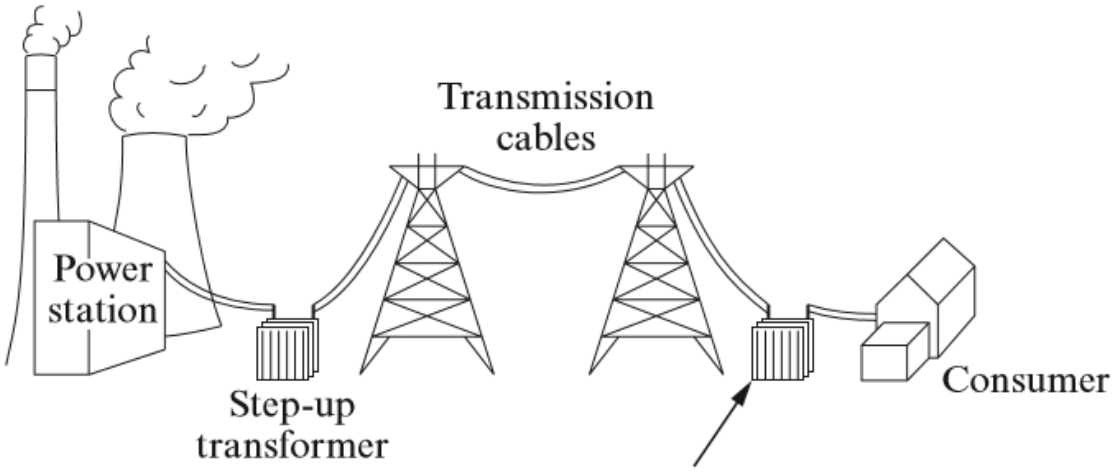
The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in question **12.**

EQUATION LIST

final velocity = initial velocity + acceleration × time	$v = u + at$
distance = ½ (initial velocity + final velocity) × time	$x = \frac{1}{2}(u + v)t$
(final velocity)^2 = (initial velocity)^2 + 2 × acceleration × distance	$v^2 = u^2 + 2ax$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = mc\Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = mL$
energy transferred in stretching = 0.5 × spring constant × (extension)^2	$E = \frac{1}{2}kx^2$
for gases: pressure × volume = constant (for a given mass of gas at a constant temperature)	pV = constant
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_1I_1 = V_2I_2$

Answer **all** *questions*.

1. The diagram shows how electricity is distributed from a power station to consumers.



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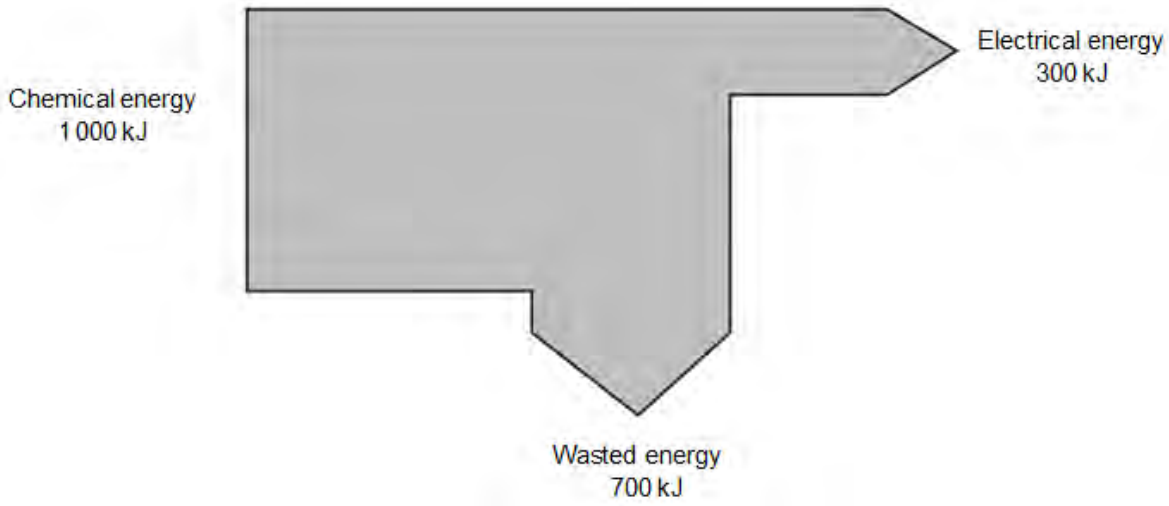
(a) (i) Fill in the missing label **on the diagram**. [1]

(ii) Place a tick (✓) in the boxes next to the **two** correct statements about the step-up transformer. [2]

It allows the electricity to travel further	☐
It increases the voltage	☐
It increases the speed of the electricity through the cables	☐
It reduces energy losses from the cables	☐
It decreases the voltage	☐

(b) The Sankey diagram shows the energy transfers for this power station.



Circle the efficiency of the power station. [1]

0%	30%	70%	100%

4

2. Students are investigating magnetism.

(a) Draw the magnetic field pattern around the bar magnet shown below. [2]

(b) (i) Describe how induced magnets are different from permanent magnets. [2]

.....

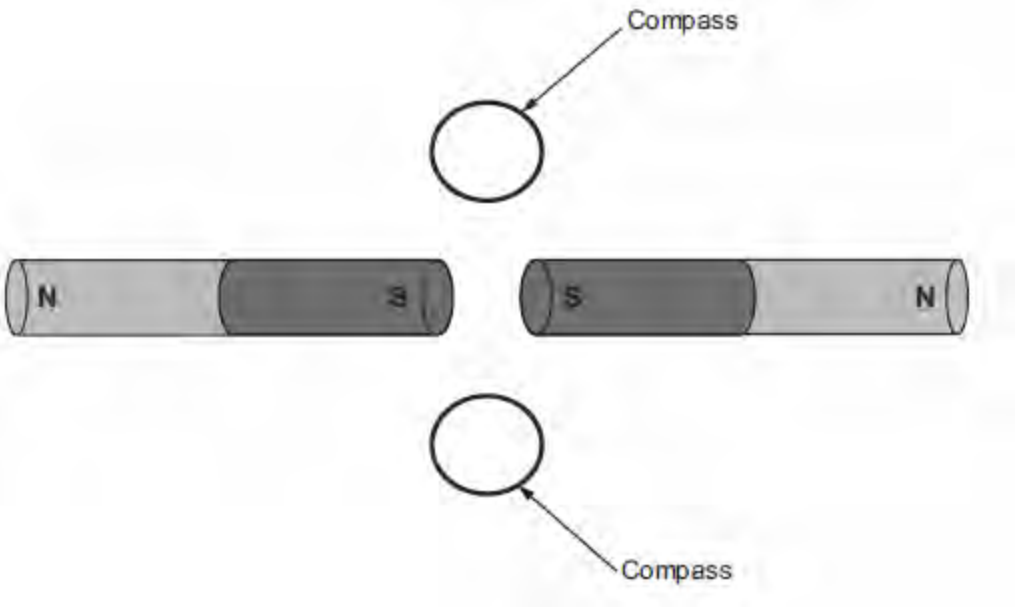
.....

(ii) An unmagnetised iron bar is placed near a bar magnet.

Place a tick (✓) alongside **two** correct statements below. [2]

The bar is not magnetised	☐
The magnet induces a N pole at the nearest end of the bar	☐
The iron bar and magnet attract each other	☐
Like poles face each other	☐
The magnet repels the iron bar	☐

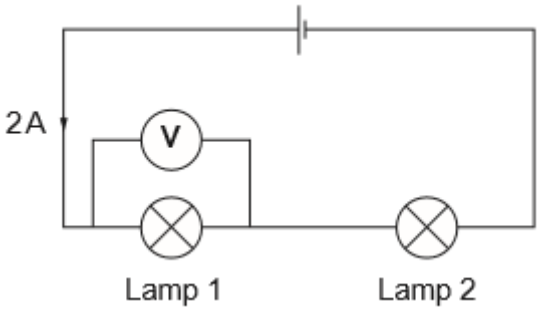
(c) Two magnetic compasses are placed by a pair of magnets as shown in the diagram below.



Draw compass needles in the circles to show in which direction they point. [2]

8

3. Lisa sets up the following circuit:



(a) The current through **lamp 1** is 2A and the voltmeter reading is 4V.

(i) Circle the current flowing through **lamp 2.** [1]

0.5A 1A 2A 4A

(ii) Calculate the resistance of **lamp 1** by using the information above and the equation: [2]

voltage = current × resistance or $V = IR$

resistance = ... Ω

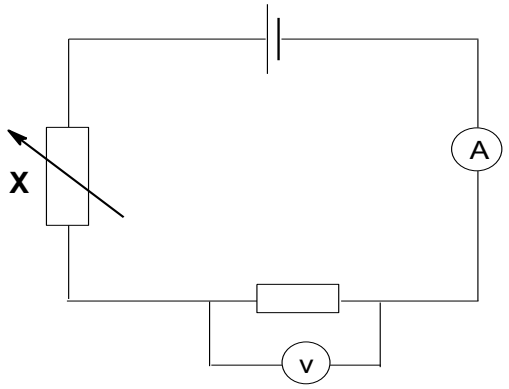
(b) Lisa adds another lamp in series with **lamp 1** and **lamp 2**.
Choose words from the box to complete the following sentences.
Each word or phrase may be used once, more than once or not at all.

increase	decrease	stay the same

(i) When the extra lamp is added, it causes the current through **lamp 1** to ..... and the battery voltage to ..... [2]

(ii) The extra lamp causes the circuit resistance to ..... [1]

(c) Jonathan sets up the following circuit to test Ohm's law. He uses an ammeter set to read between 0 and 10 A and a voltmeter set to read between 0 and 10 V.



(i) What is the component marked **X** and what is its function in the circuit above? [2]

……

……

(ii) Jonathan found it difficult to read the current reading. His results are in the table below.

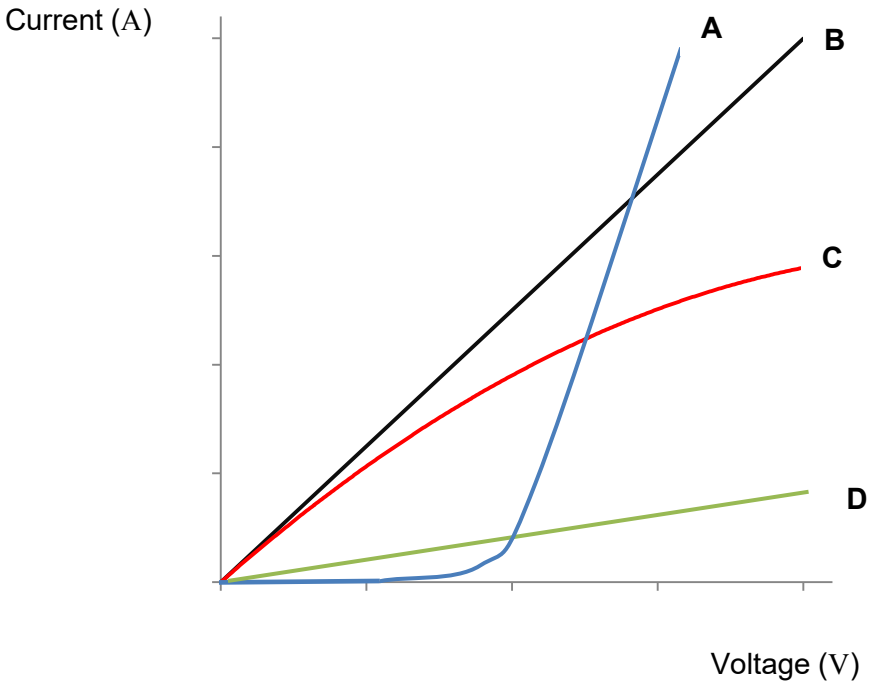
Current (A)	Voltage (V)
0	2.0
0	4.0
0	6.0
1	8.0

Suggest **one** change that Jonathan could make to improve his current readings. [1]

.....

(d) Ibrahim set up an experiment to find out if four different electrical components **A**, **B, C** and **D** obeyed Ohm's law.

A graph showing his results from the investigation is shown below.



(i) Ibrahim is told that the resistance of one component increases with voltage and he should identify it in his conclusion.
Which component behaves in this way? [1]

……

(ii) Ibrahim needs to identify any components that obey Ohm's law in his conclusion.
Which components (if any) obey Ohm's law? Give an explanation for your answer. [2]

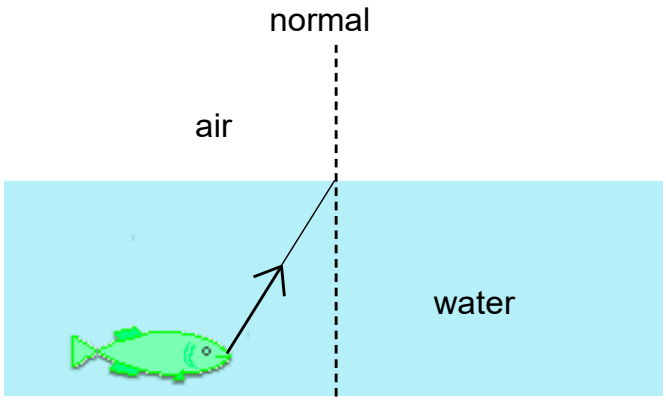
.....

……

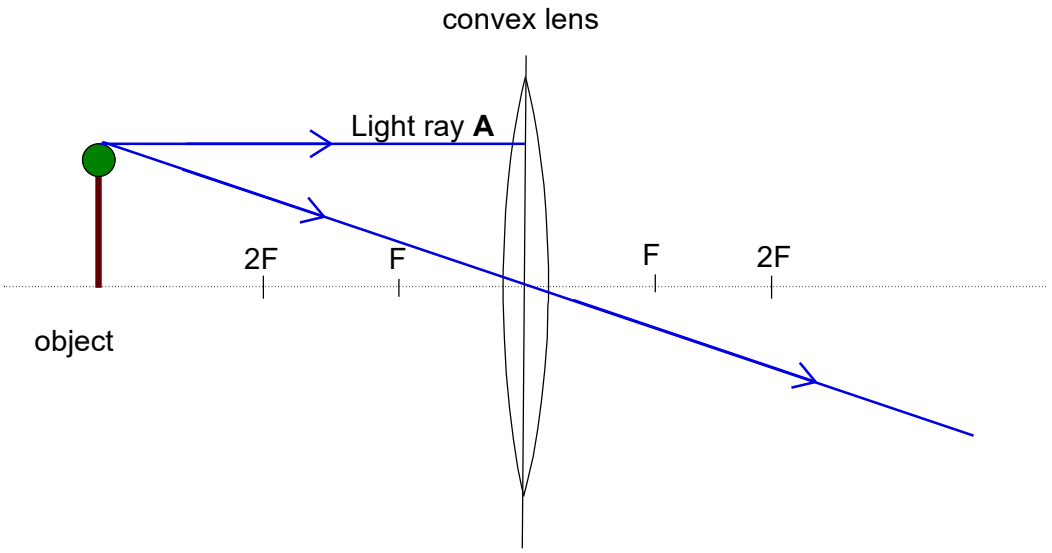
.....

12

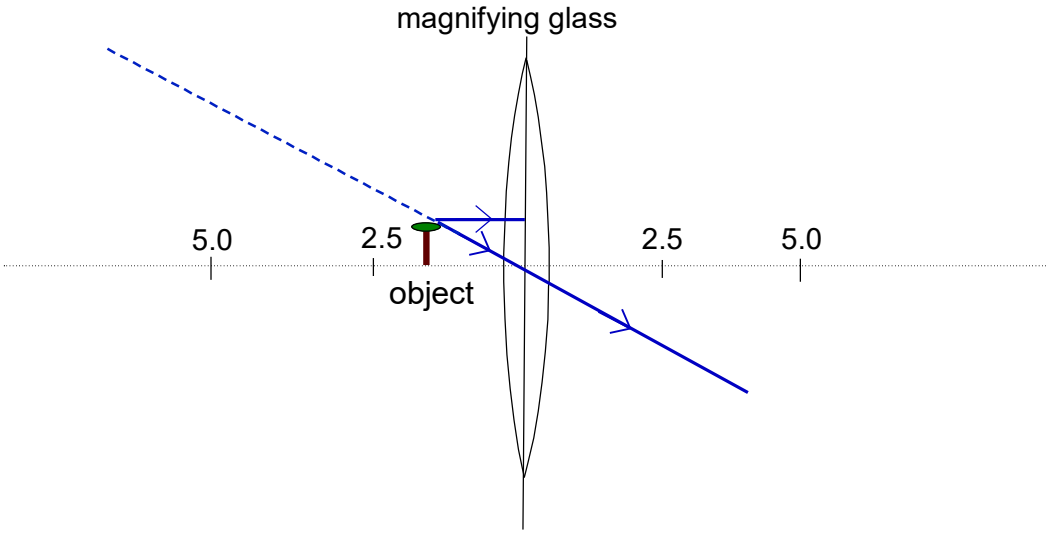
4. (a) Complete the diagram below to show the path the light ray takes in air. [1]



(b) Janine examines an object through a convex image with focal length, F. Complete the path of **light ray A** through the lens below to show the position of the image. [2]

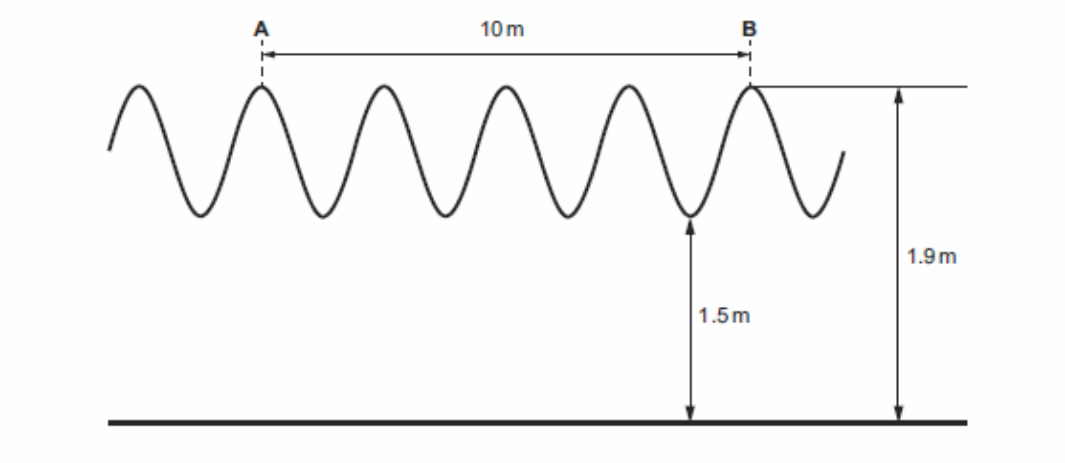


(c) John uses a magnifying glass made from a convex lens with a focal length of **2.5 cm** to look at an object.
Complete the ray diagram below to show the position of the image. [2]



5

5. The diagram shows a side view of water waves, produced in a swimming pool by a wave machine.



(a) Use information from the diagram to answer the following questions.

(i) Write down the number of complete waves between **A** and **B** [1]

.....

(ii) Calculate the wavelength of the water waves. [1]

wavelength = ... m

(iii) Calculate the amplitude of the waves. [2]
Show your workings in full.

amplitude = ... m

(b) The wavelength of the waves is affected by the **frequency** of the wave machine.

(i) Using your answer from (a)(ii), calculate the wave speed given that the frequency is 0.3 Hz. [2]

Use the equation:

wave speed = frequency × wavelength or $v = f\lambda$

wave speed = ... m/s

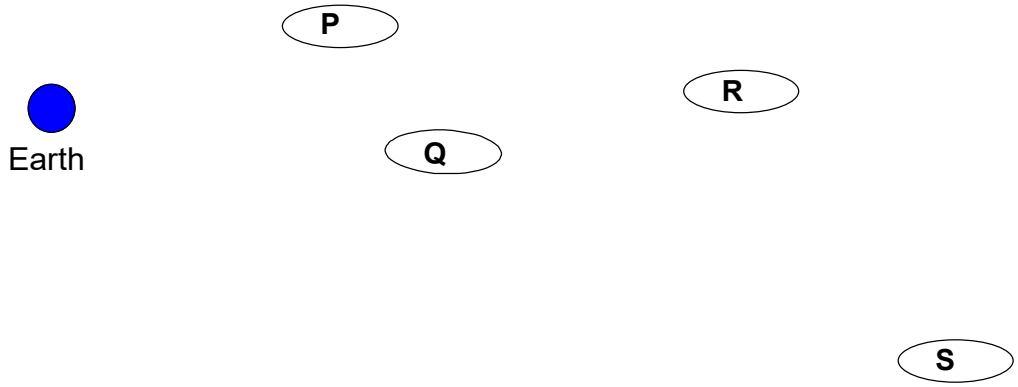
(ii) State how the wavelength is affected when the frequency of the wave machine is **increased**. [1]

.....

7

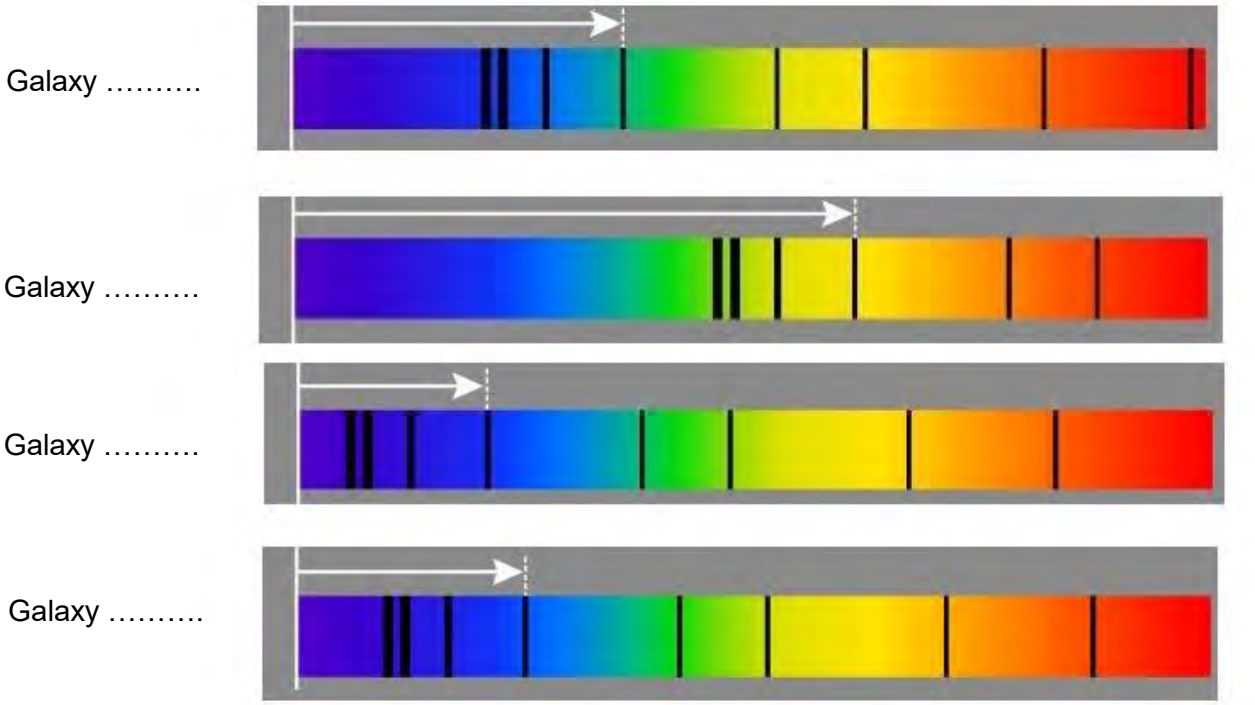
6. **(a)** **Diagram 1** shows four galaxies, **P**, **Q, R** and **S** and their position relative to Earth.

Diagram 1



The spectra from each of these galaxies is shown in **Diagram 2** below.

Diagram 2



Match each spectrum to the galaxies **P**, **Q, R** and **S**. [2]

(b) Complete the following sentences by underlining the correct words in the brackets. [3]

The spectral lines of galaxies give evidence of (**an expanding, a contracting, an unchanging**) Universe.

The spectral lines show evidence of (**red, green, white, blue**) shift.

This means the galaxies are moving (**away from us, towards us, not moving**).

5

7. (a) Cobalt-60 ($^{60}_{27}\mathrm{Co}$) is an unstable isotope which undergoes decay into nickel.

Balance the nuclear equation showing the decay of cobalt-60 into nickel. [2]

$$^{60}_{27}\mathrm{Co} \rightarrow {}^{0}_{-1}\beta + {}^{\cdots}_{\cdots}\mathrm{Ni}$$

(b) The wavelength range of different parts of the electromagnetic spectrum are shown below.

Electromagnetic radiation	Wavelength (nm)
gamma radiation	$<10^{-3}$
X-rays	1 - 0.001
ultraviolet	……
visible	750 - 400
infra-red	2 500 - 750
microwave	10^{6} – 2 500
radio waves	$>10^{6}$

Information about units:

$1\ \text{pm} = 1 \times 10^{-12}\ \text{m}$
$1\ \text{pm} = 1 \times 10^{-3}\ \text{nm}$

(i) **Complete** the table by adding the wavelength range for ultraviolet radiation. [1]

(ii) When cobalt-60 decays into nickel, it also emits electromagnetic radiation with a wavelength of **0.93 pm.**

I Use the information above to state which part of the electromagnetic spectrum it is from. **Show your reasoning.** [2]

.....

.....

.....

II Calculate the frequency of the emitted radiation using the equation: [2]

$$\text{frequency} = \frac{\text{speed of light}}{\text{wavelength}} \quad \text{or} \quad f = \frac{v}{\lambda}$$

(Speed of light, v = 300 000 000 m/s)

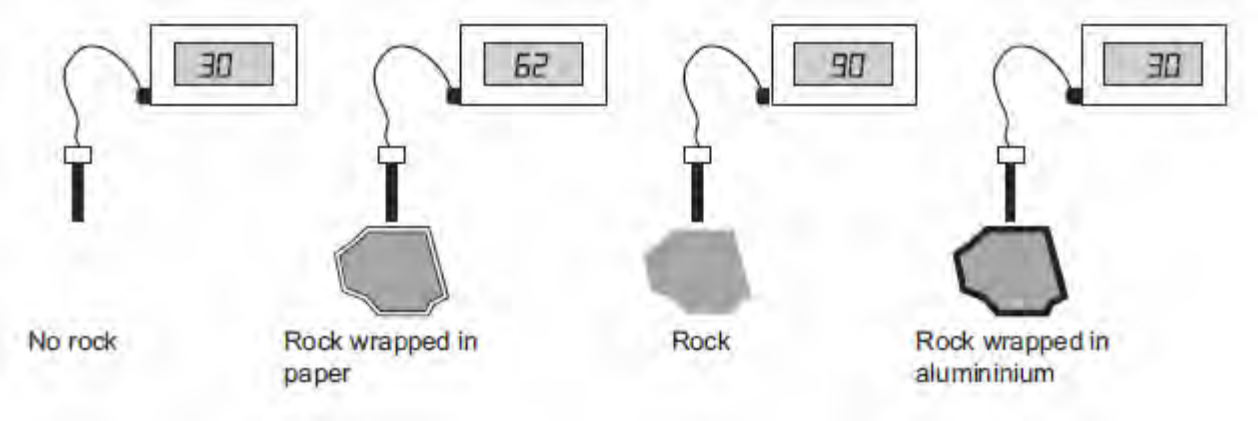
…….…….. Hz

III The electromagnetic radiation emitted by cobalt-60 is used in hospitals. State **one** medical use of this radiation. [1]

.....

8

8. A piece of rock gives a reading on a counter which is connected to a radiation detector. The rock is wrapped in various materials and different readings in counts per minute (cpm) are observed.



(a) (i) What causes the reading of 30 cpm in the first diagram? [1]

……

(ii) State the type, or types of radiation that the rock emits. [2]

.....

(iii) Explain your choice. [2]

.....

.....

.....

(b) The rock is now wrapped in lead. Explain what you would expect the reading on the counter to be. [2]

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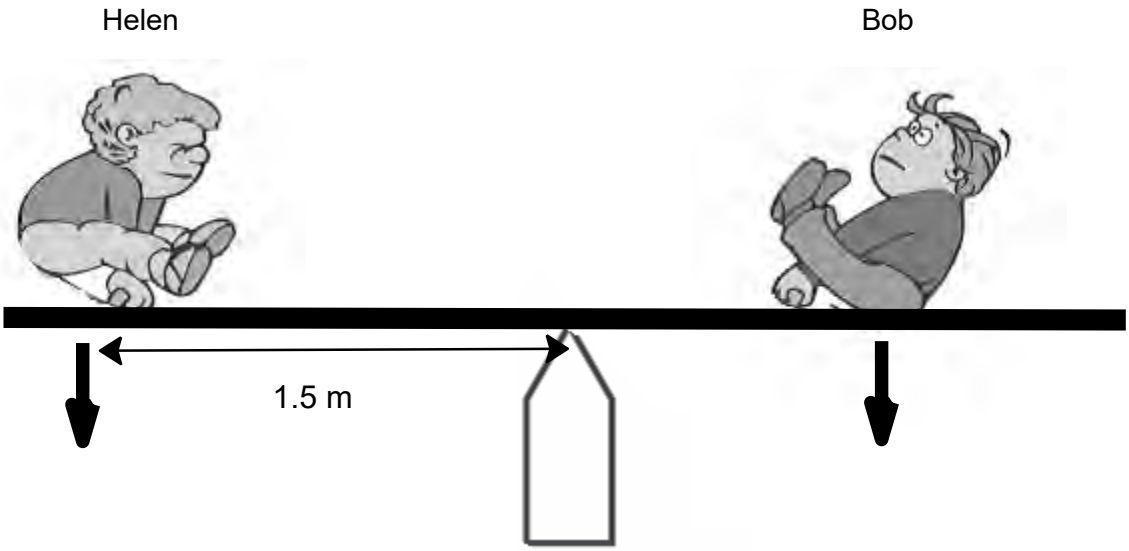
7

9. (a) Two children, Helen and Bob, are playing on a see-saw as shown below.
Helen has a mass of **28 kg**.



(i) Underline the word or phrase that correctly completes the sentence below.

[1]

The moment of a force is a measure of its **(pushing, pulling, turning)** effect.

(ii) The gravitational field strength on Earth is 10 N/kg.
Calculate Helen's weight force. [2]

weight force = ... N

(iii) The children want to sit on the see-saw so that it is exactly balanced.
Helen sits 1.5 m from the centre.
Bob is heavier than Helen and has a weight force of **400 N**.

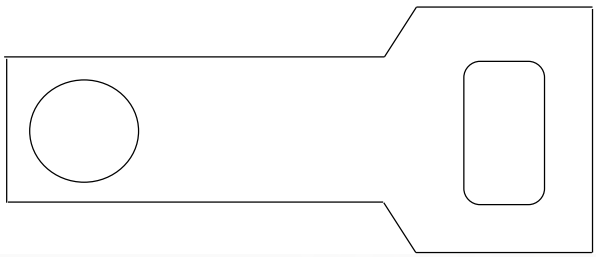
Calculate how far Bob needs to sit from the pivot of the see-saw.
You can calculate the children's moments using:

moment = force × distance or $M = F\,d$ [3]

Distance from pivot =..... m

(b) Explain which of the two bottle openers shown below, **A** or **B**, would be best to use to open a bottle.
The two bottle openers are shown to the same scale. [1]

Bottle opener **A**



Bottle opener **B**

.....

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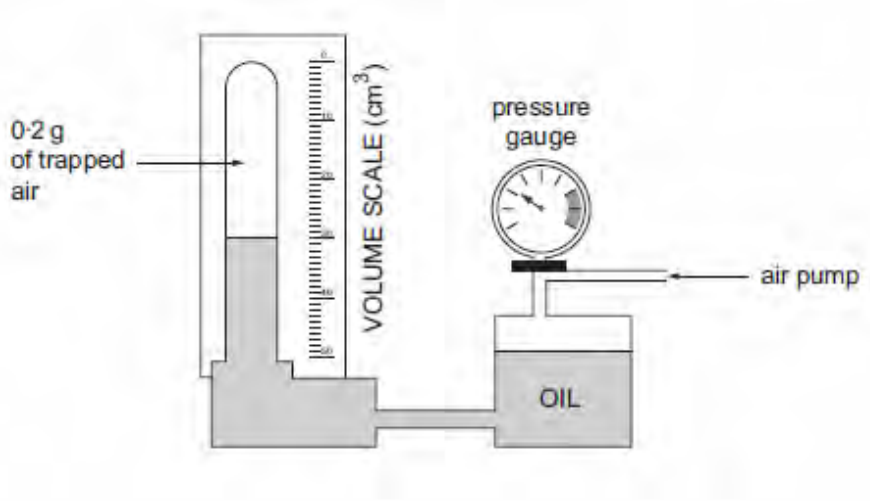
7

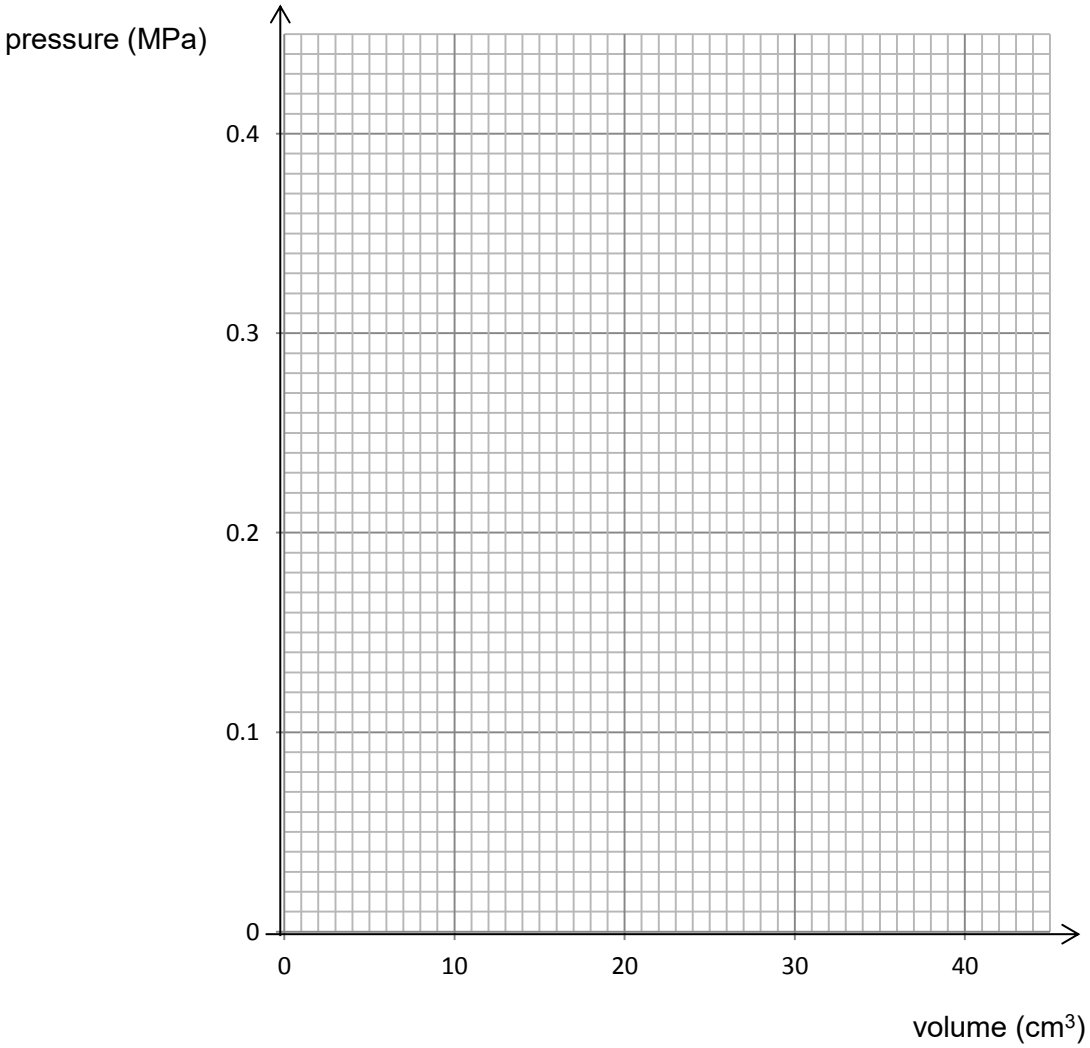
10. A teacher slowly pumps air into the apparatus shown in the diagram.
This causes the oil to squeeze the trapped air in the tube. The teacher stops when the volume of trapped gas is 10 cm^3.



Some results are recorded in the table.

Pressure of trapped air (MPa)	0.10	0.16	0.25	0.40
Volume of trapped air (cm^3)	40	25	16	10

(a) Plot the four points on the grid and draw a suitable line. [3]



(b) (i) The surface area of the inside of the glass tube is 0.002 m^2 when the gas volume is 16 cm^3.

Use the equation below to calculate the force exerted by the air on the inside walls of the glass. [3]

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

force = …… N

(ii) State the danger that arises from this force value and give **one** method of safeguarding the pupils from this danger. [2]

.....

.....

(c) Calculate the pressure when the volume is 80 cm^3.
You should use an equation from page 2 to answer this question. [4]

Answer …….

12

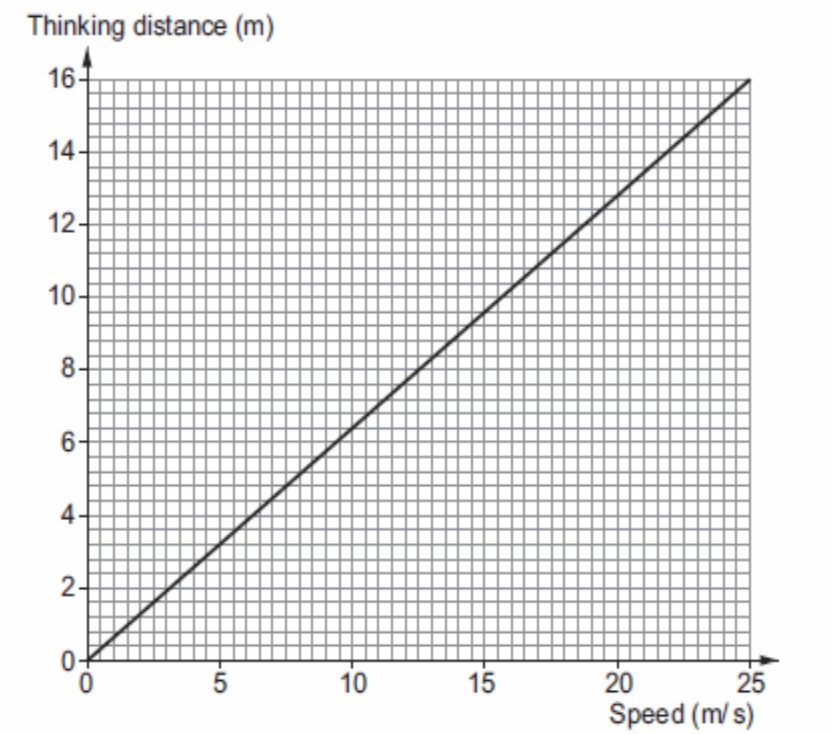
11. (a) **Two** things happen when a car driver does an emergency stop.

- The driver sees a hazard and thinks what to do. The distance travelled by the car in this time is called the **thinking distance**.
- The driver's foot presses the brake to stop the car.

What distance is added to the thinking distance to give the total stopping distance? [1]

.....

(b) The graph shows how thinking distance changes with speed for an alert driver.

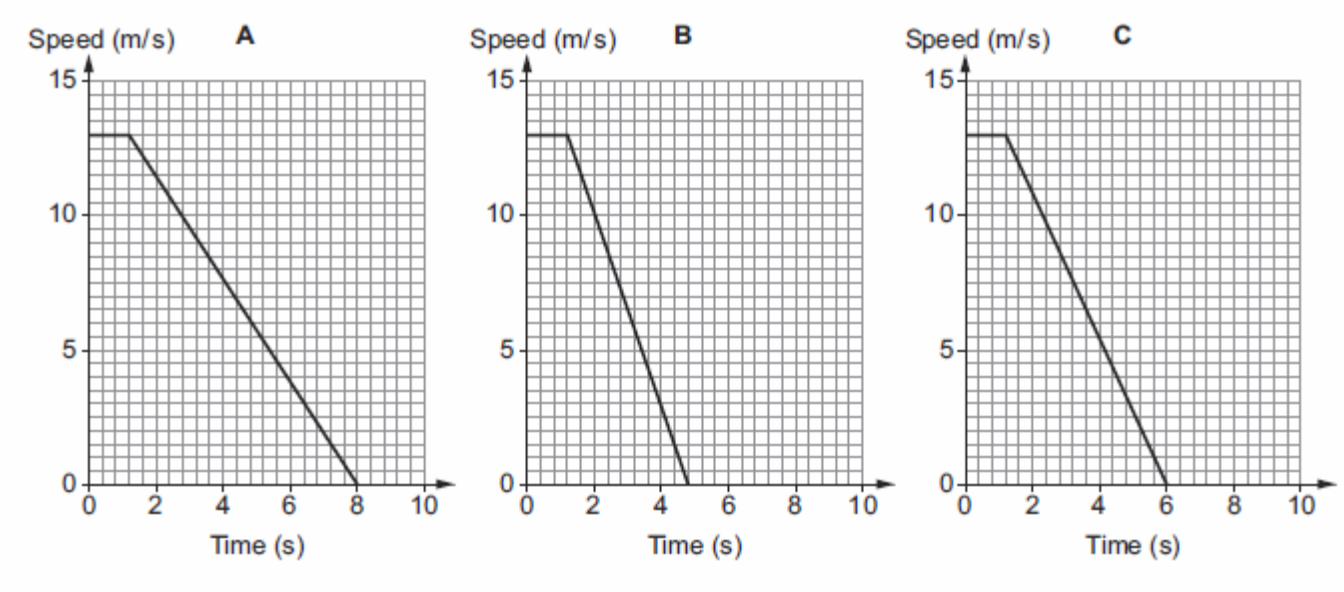


(i) How is tiredness likely to affect the thinking distance? [1]

.....

(ii) **Add a line** to the graph above to show how thinking distance varies with speed for a tired driver. [1]

(c) Three cars, **A**, **B** and **C**, are travelling towards traffic lights. The graphs below show how the speed of each car changes after the drivers see the lights turn to red.



Use information in the graphs to answer the following questions.

(i) Which one of the cars, **A**, **B** or **C** has the biggest deceleration? [1]

.....

How do the graphs show this? [1]

…….....

(ii) Give a reason whether the following statement is a valid conclusion that can be made from the graphs:
"Car **B** travels the smallest distance". [1]

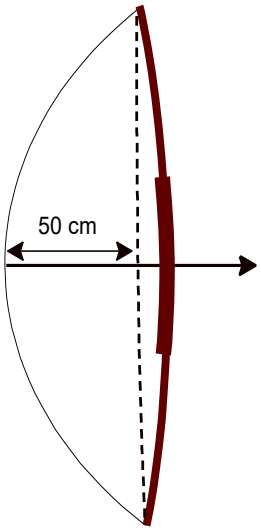
…….....

(d) A car accelerates from rest at a junction to a speed of 13 m/s in 5.2 seconds. Select an equation from page 2 to work out its acceleration. [3]

…….. m/s^2

9

12. A bow obeys Hooke's Law in a similar way to a spring. This allows us to calculate the spring constant and the energy stored in the bow.



It is suggested that most of the energy stored in a bow is transferred to the arrow when it is fired.

A force of 60 N is required to extend the bow 0.5 m.

A bow is extended 50 cm and fires an arrow.

The kinetic energy of the arrow leaving the bow is 7.2 J.

Explain whether this information supports the hypothesis that "most energy in the bow string is transferred to the arrow".

You may use an equation from page 2.

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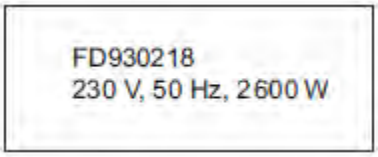
6

13. The following information is found on the base of a kettle.

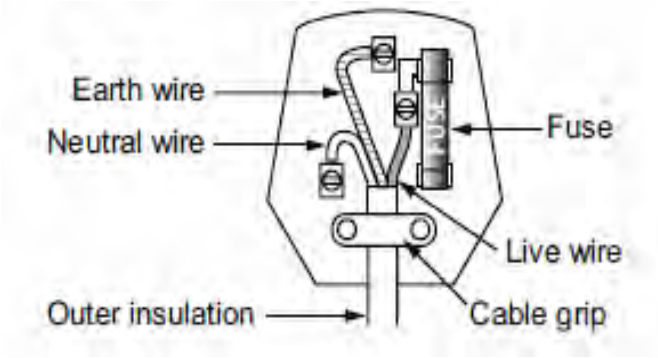


(a) What does this information tell you about the type of **current** the kettle is designed to work with? Explain your reasoning. [2]

.....

.....

(b) The diagram shows the plug connected to the kettle.



(i) The ratings of fuses that are available for use in plugs are 3 A, 5 A, 7 A and 13 A. Determine which fuse should be chosen and state what would happen if the each of the other fuses was used instead. [4]

.....

.....

.....

.....

(ii) Explain the function of the fuse. [2]

.....

.....

(iii) Describe how the earth wire helps to keep consumers safe. [2]

.....

.....

(c) The kettle was tested to check its efficiency. The data collected are given below:

start temperature of water (^{o}C)	20
mass of water boiled (kg)	1.5
time taken for kettle to boil (min : s)	3 : 30
specific heat capacity of water (J / kg ^{o}C)	4 200
power of kettle (W)	2 600

(i) Select an equation from page 2 and use it to calculate the energy transferred to the water. [3]

energy transferred = ... J

(ii) The efficiency of the kettle is calculated to be 0.92; explain in terms of energy transfer what this means. [2]

.....

.....

(d) Another kettle, of similar design, takes longer to boil the same quantity of water. Explain whether this kettle is more or less environmentally friendly. [2]

.....

.....

17

14. Rising moisture within a thundercloud collides with falling ice or sleet. The base of the thundercloud becomes negatively charged and the top becomes positively charged.

(a) Explain how a thundercloud becomes charged with static electricity. [3]

.....

.....

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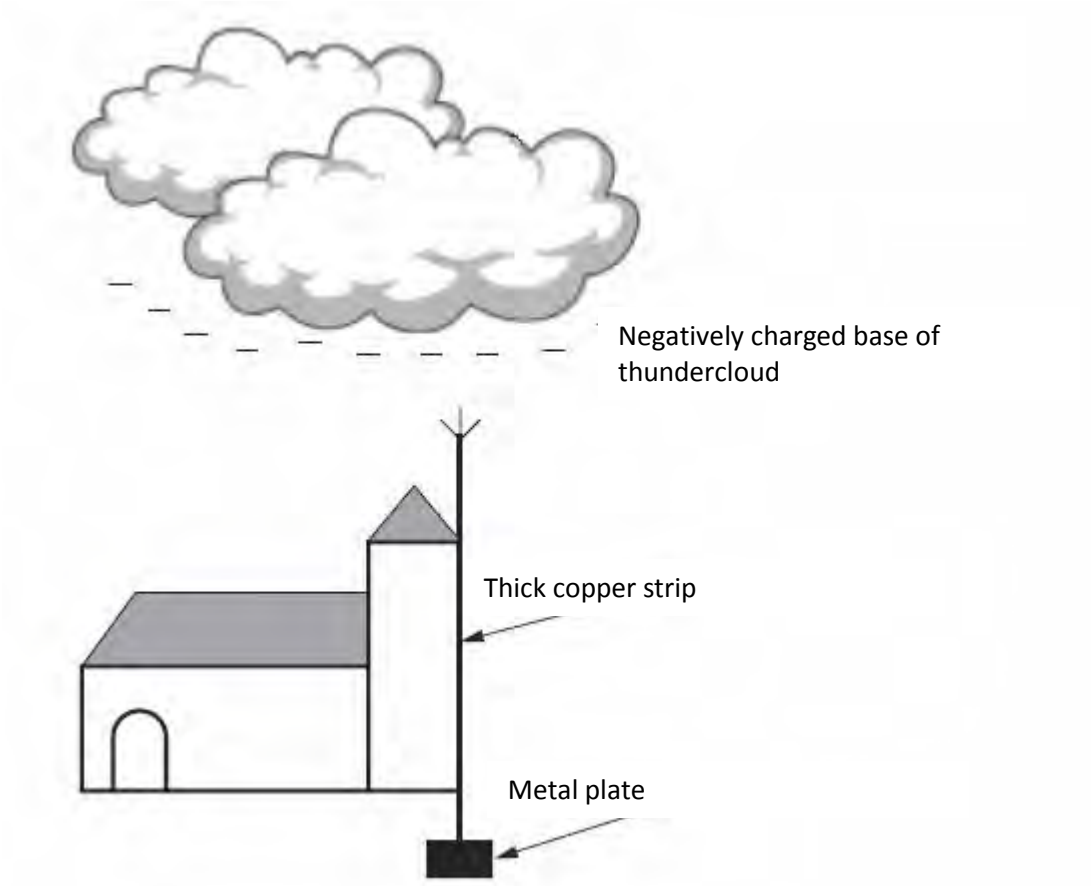
(b) A lightning conductor is a **very thick** strip of **copper**, which connects some sharp points above the top of a building to a metal plate buried deep in the ground.



The negatively charged based of the thundercloud causes a movement of charge in the lightning conductor. Positive and negative ions are produced in the air around the sharp points. The movement of these ions reduces the build-up of charge on the cloud making a lightning strike less likely.

(i) Describe how a positive charge is produced at the points of the lightning conductor. [2]

….....

.....

(ii) Explain how the ions produced in the air around the points help to prevent the build-up of charge in the cloud. [2]

.....

.....

(iii) Give **two** reasons why the lightning conductor, shown in the diagram, minimises the damage to the building by the lightning strike described above. [2]

.....

.....

(c) In a lightning strike, a current of 3 000 A flows through the lightning conductor for 0·005 s. Calculate the amount of charge transferred from the cloud and state its unit. [4]

charge = ...

unit = ...

13