

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
June 2003



**PHYSICS
FOUNDATION TIER**

3451/F

F

Tuesday 17 June 2003 9.00 am to 11.15 am

In addition to this paper you will require:
a ruler.
You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8			
9			
10			
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 2 hours 15 minutes

Instructions

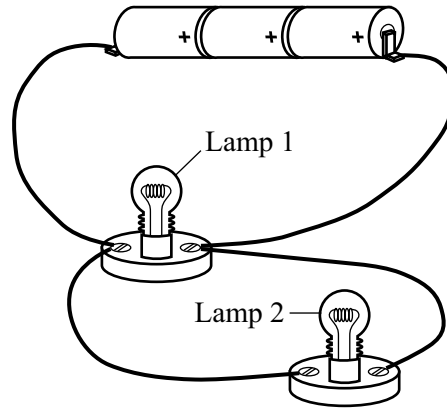
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 135.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

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

- 1 The drawing shows three identical cells and two identical lamps joined in a circuit.



- (a) Use the correct symbols to draw a circuit diagram for this circuit.

(3 marks)

- (b) Each of the cells provides a potential difference (voltage) of 1.5 volts. What is the total potential difference (voltage) provided by all three cells?

.....volts
(1 mark)

- (c) Complete this sentence by crossing out the **two** lines in the box that are wrong.

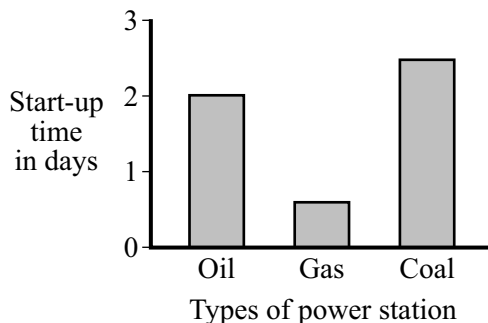
The current through lamp 2 will be

smaller than
the same as
bigger than

 the current through lamp 1.

(1 mark)

2 (a) The bar chart shows the start-up time for different types of fuel-burning power stations.



Which type of power station would be the quickest to start producing electricity?

.....
(1 mark)

(b) A fuel-burning power station is more reliable than a wind generator at producing electricity. Explain why.

.....
.....
.....
.....
(2 marks)

(c) Fuel-burning power stations may produce air pollution. Why does a wind generator not produce any air pollution?

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

4

TURN OVER FOR THE NEXT QUESTION

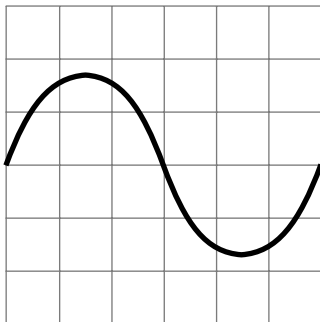
Turn over ►

- 3 (a) In the box are the names of five waves.

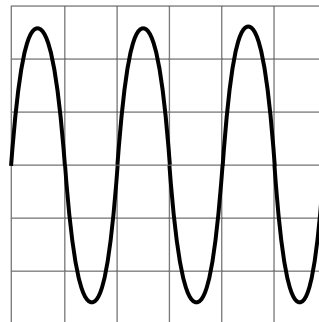
infra red	microwaves	ultrasonic	ultraviolet	X-rays
-----------	------------	------------	-------------	--------

Which wave is used to:

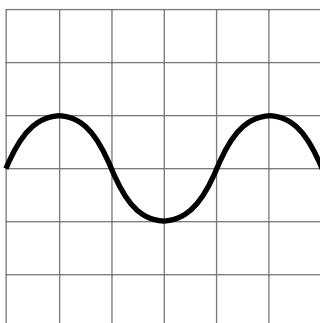
- (i) send information to a satellite, (1 mark)
- (ii) toast bread, (1 mark)
- (iii) clean a valuable ring? (1 mark)
- (b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



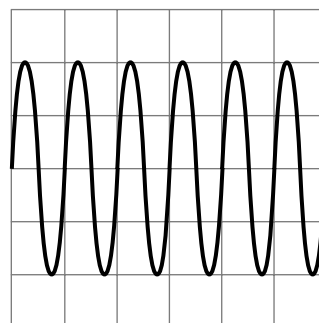
A



B



C

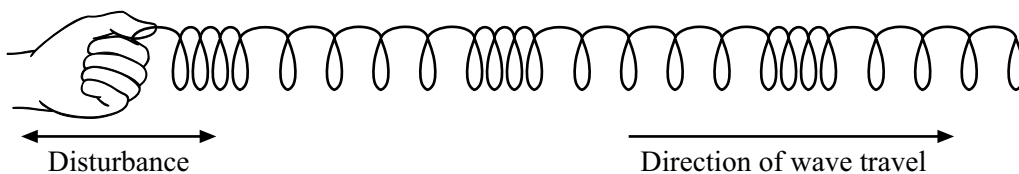


D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

- (i) the largest amplitude, (1 mark)
- (ii) the lowest frequency? (1 mark)

- (c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the causing the wave is in the same as that in which the wave moves.

(2 marks)

- (d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave

sound wave

water wave

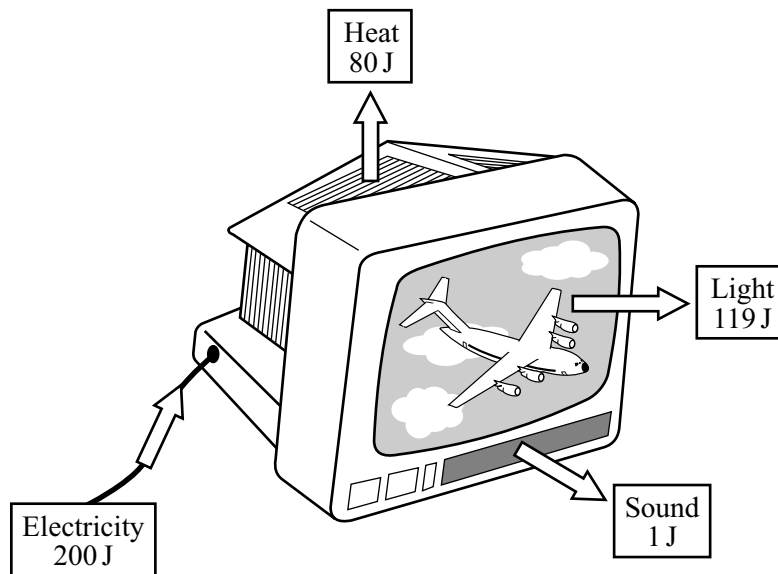
(1 mark)



TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 4 (a) The drawing shows the energy transferred each second by a television set.



- (i) What form of energy is transferred as waste energy by the television set?

.....
(1 mark)

- (ii) What effect will the waste energy have on the air around the television set?

.....
(1 mark)

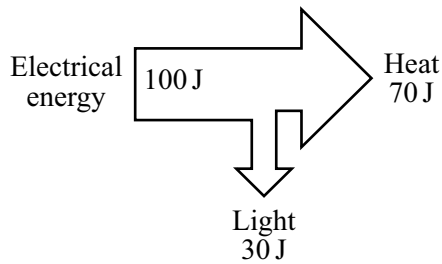
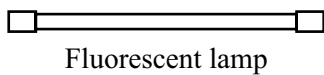
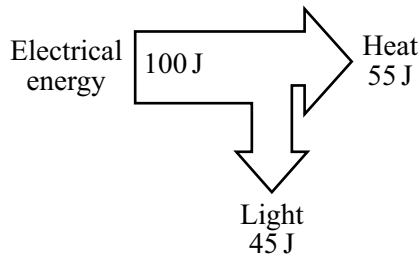
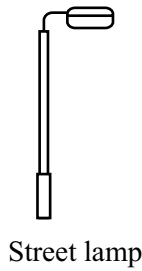
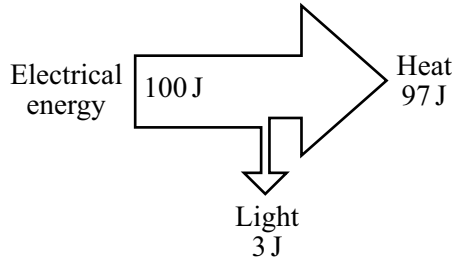
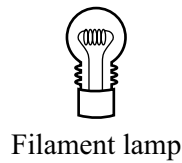
- (iii) Use the following equation to calculate the efficiency of the television set.

$$\text{efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

.....
.....

Efficiency =
(2 marks)

(b) The diagrams show the energy transferred each second for three different types of lamp. For each lamp the electrical energy input each second is 100 joules.



Which type of lamp is the most efficient?

.....

Give a reason for your choice.

.....

.....

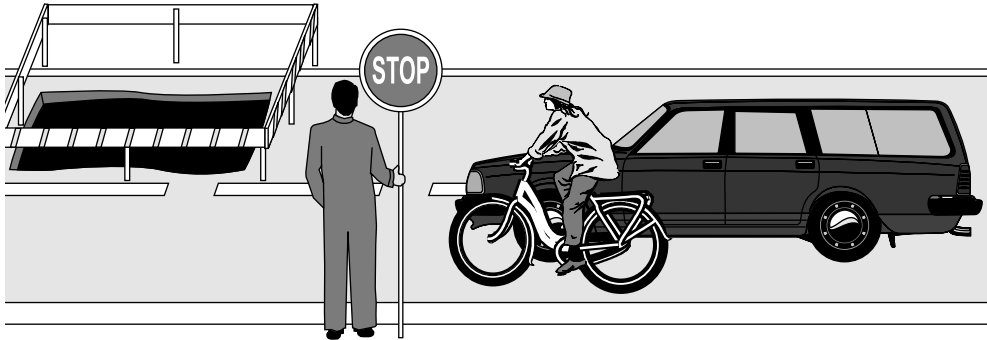
(2 marks)

6

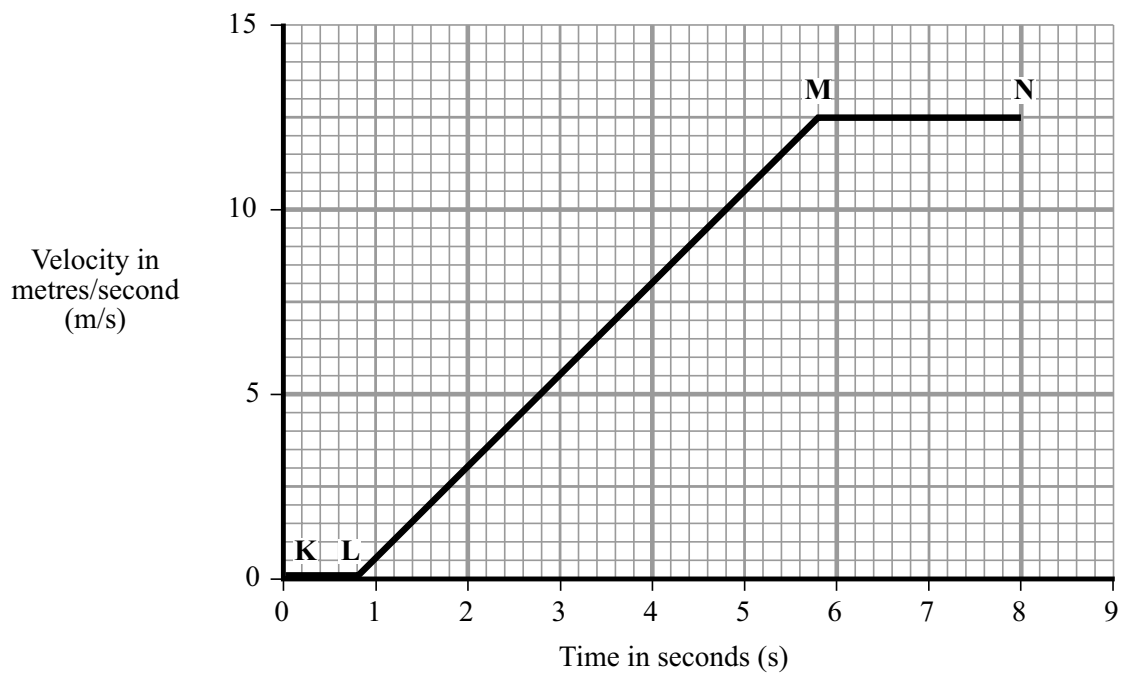
TURN OVER FOR THE NEXT QUESTION

Turn over ▶

- 5 A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



- (a) Between which two points on the graph is the car moving at constant velocity?

..... (1 mark)

- (b) Between which two points on the graph is the car accelerating?

..... (1 mark)

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time =seconds
(1 mark)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol

Wet roads

Worn car brakes

(1 mark)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

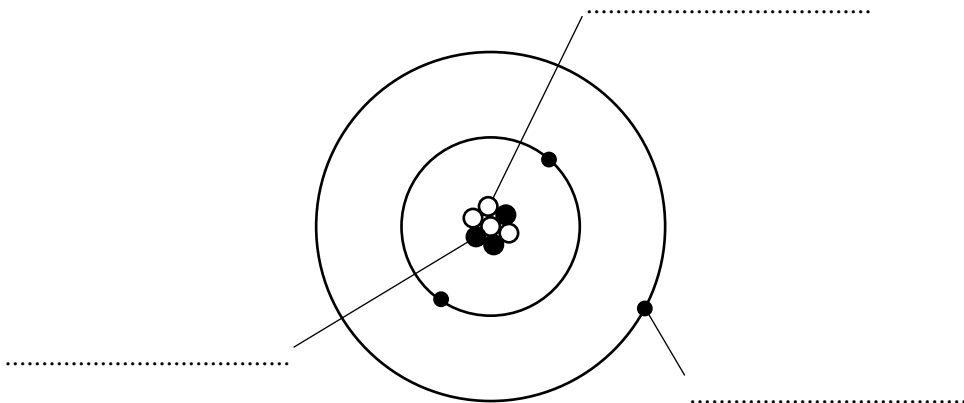
(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 6 (a) The diagram represents an atom of lithium.



- (i) Complete the diagram by writing in the spaces the name of each type of particle. Use only words given in the box. Each word may be used once or not at all.

electron	neutron	nucleus	proton
----------	---------	---------	--------

(3 marks)

- (ii) Which type of particle found inside the atom is uncharged?

.....
(1 mark)

- (iii) What is the mass number of this atom, 3, 4, 7 or 10?

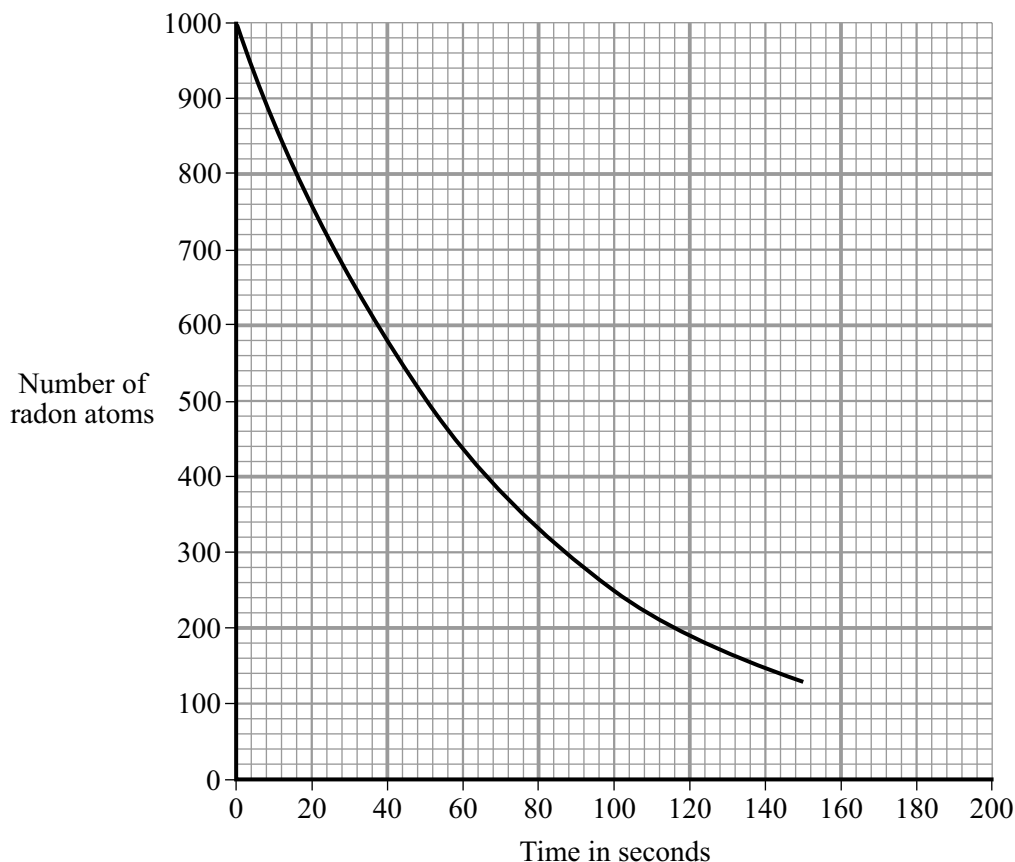
.....

Give a reason for your choice.

.....

.....
(2 marks)

- (b) Radon is a radioactive element. The graph shows how the number of radon atoms in a sample of air changes with time.



- (i) How long did it take the number of radon atoms in the sample of air to fall from 1000 to 500?

Time =seconds
(1 mark)

- (ii) How long is the half-life of radon?

Half-life =seconds
(1 mark)

- (iii) Complete this sentence by crossing out the **two** lines in the box that are wrong.

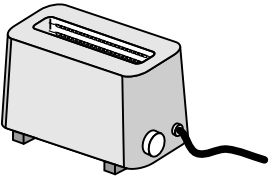
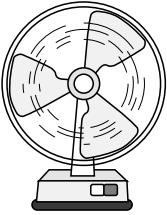

As a radioactive material gets older, it emits

less
a constant level of
more

 radiation per second.

(1 mark)

- 7 (a) List A shows three electrical devices. List B gives different forms of useful energy. Draw a straight line from each of the devices in List A to the useful energy form it produces in List B. Draw only **three** lines.

List A Device	List B Useful energy
Toaster 	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Light</div>
Fan 	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Kinetic</div>
Personal stereo 	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Sound</div>
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Heat</div>

(3 marks)

- (b) The power of each device is given in the table.

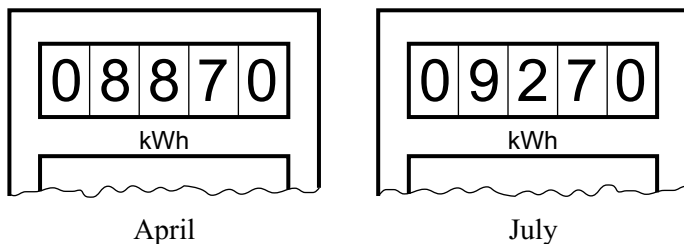
Device	Power
Toaster	1.2kW
Fan	30W
Personal Stereo	10W

Which **one** of the devices will transfer the most energy in 10 minutes?

.....

(1 mark)

(c) The diagrams show the readings on a domestic electricity meter in April and July.



(i) How many Units (kWh) of electricity were used between the two meter readings?

.....
.....

Number of Units =
(1 mark)

(ii) One Unit costs 6p.

Use the following equation to calculate the cost of the electrical energy used between the two meter readings. Show clearly how you work out your answer.

$$\text{total cost} = \text{number of Units} \times \text{cost per Unit}$$

.....
.....

Cost =
(2 marks)

(d) A 3000 watt electric cooker is switched on for 2 hours.

Use the following equation to calculate the number of Units of energy transferred by the cooker. Show clearly how you work out your answer.

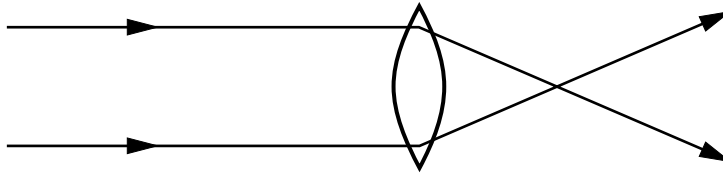
$$\begin{array}{l} \text{energy transferred} \\ \text{(kilowatt-hour, kWh)} \end{array} = \begin{array}{l} \text{power} \\ \text{(kilowatt, kW)} \end{array} \times \begin{array}{l} \text{time} \\ \text{(hour, h)} \end{array}$$

.....
.....

Energy transferred =kWh
(2 marks)

8 (a) The diagram shows how parallel rays of light pass through a convex lens.

(i) Mark the position of the focus.



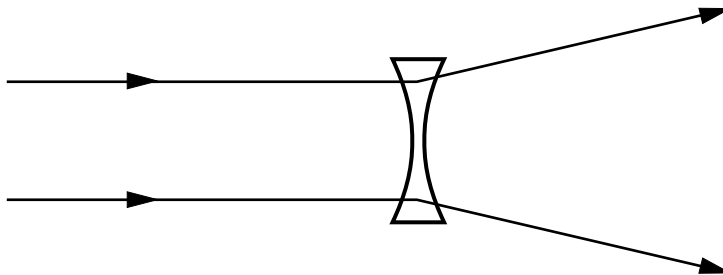
(1 mark)

(ii) Is this a **converging** lens, a **diverging** lens, **both** or **neither**?

..... (1 mark)

(b) The diagram shows how parallel rays of light pass through a concave lens.

(i) Mark the position of the focus.



(1 mark)

(ii) Is this a **converging** lens, a **diverging** lens, **both** or **neither**?

..... (1 mark)

(c) Complete these sentences by crossing out the **two** lines in each box that are wrong.

In a camera, a

converging
diverging
parallel

 lens is used to produce an image of an
object on a

film
lens
screen

. The image is

larger than
smaller than
the same size as

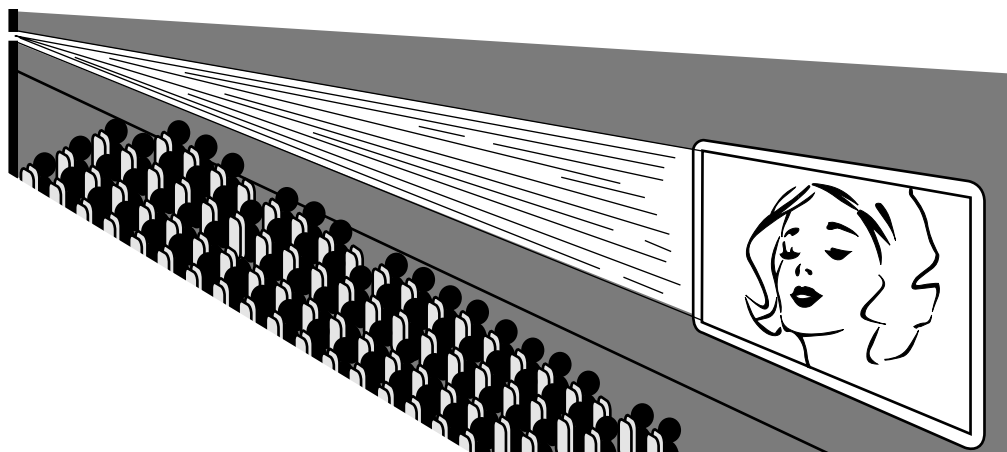
 the object.
The image is

further from
nearer to
the same distance from

 the lens, compared to the distance
of the object from the lens.

(4 marks)

(d) In a cinema projector, a convex lens is used to produce a *magnified, real* image.



(i) What does *magnified* mean?

.....

 (1 mark)

(ii) What is a *real* image?

.....

 (1 mark)

(e) You are in a dark room. You have a box containing some lenses. Only **one** of them is a converging lens.

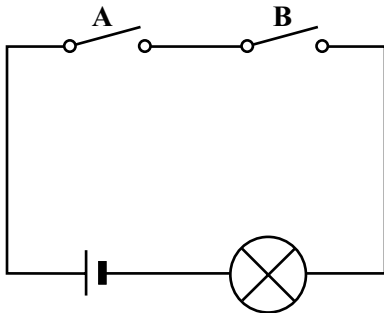
Describe how, by just feeling the lenses, you can pick out the converging lens.

.....

 (2 marks)

- 9 (a) The diagrams show circuits in which a lamp can be controlled by two switches. The switches are shown in the off position.

(i) Complete the Output column in the table.



Inputs		Output
Switch A	Switch B	Lamp
off	off	off
off	on	
on	off	
on	on	

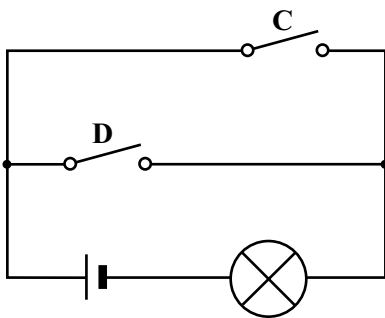
(1 mark)

(ii) What is the name of the logic gate which behaves like the two switches in this circuit?

.....

(1 mark)

(iii) Complete the Output column in the table.



Inputs		Output
Switch C	Switch D	Lamp
off	off	off
off	on	
on	off	
on	on	

(1 mark)

(iv) What is the name of the logic gate which behaves like the two switches in this circuit?

.....

(1 mark)

- (b) (i) Complete the truth table for a NOT gate by writing either **1** or **0** in each of the four boxes.

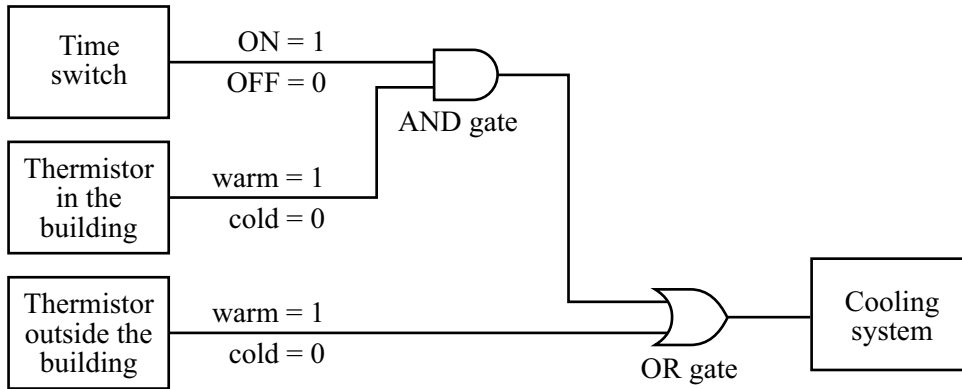
Input	Output

(1 mark)

(ii) Draw the symbol for a NOT gate.

(1 mark)

(c) The diagram shows a system which can switch a cooling system either ON (1) or OFF (0).



Complete the Output to cooling system column in the truth table by writing either 1 or 0 in each box.

Inputs to AND gate		Inputs to OR gate		Output to cooling system
Time switch	Thermistor in the building	Output from AND gate	Thermistor outside the building	
0	0	0	0	
0	1	0	0	
1	0	0	0	
1	1	1	0	
0	0	0	1	
0	1	0	1	
1	0	0	1	
1	1	1	1	

(4 marks)

(d) (i) Draw the symbol for a thermistor.

(1 mark)

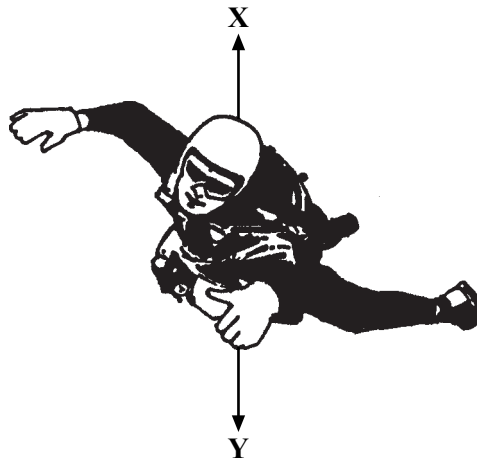
(ii) What property of a thermistor enables it to detect a change in temperature?

.....

(2 marks)

Turn over ►

10 The diagram shows a sky-diver in free fall. Two forces, **X** and **Y**, act on the sky-diver.



(a) Complete these sentences by crossing out the **two** lines in each box that are wrong.

(i) Force **X** is caused by

friction
gravity
weight

 . (1 mark)

(ii) Force **Y** is caused by

air resistance
friction
gravity

 . (1 mark)

(b) The size of force **X** changes as the sky-diver falls. Describe the motion of the sky-diver when:

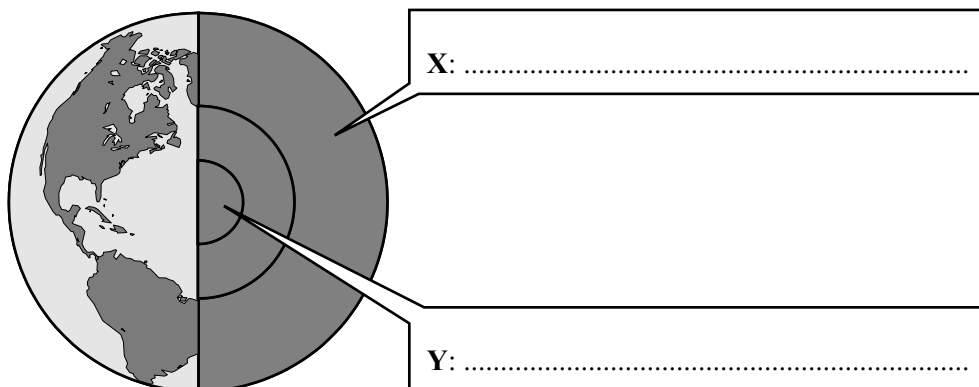
(i) force **X** is smaller than force **Y**,

 (2 marks)

(ii) force **X** is equal to force **Y**.

 (1 mark)

11 (a) The diagram shows the layered structure of the Earth.



(i) Write in the boxes the name of layer **X** and the name of layer **Y**. (2 marks)

(ii) The overall density of the Earth is about 5500 kg/m^3 . The average density of the rocks in the Earth's crust is about 2800 kg/m^3 . What does this suggest about the material that makes up the lower layers of the Earth?

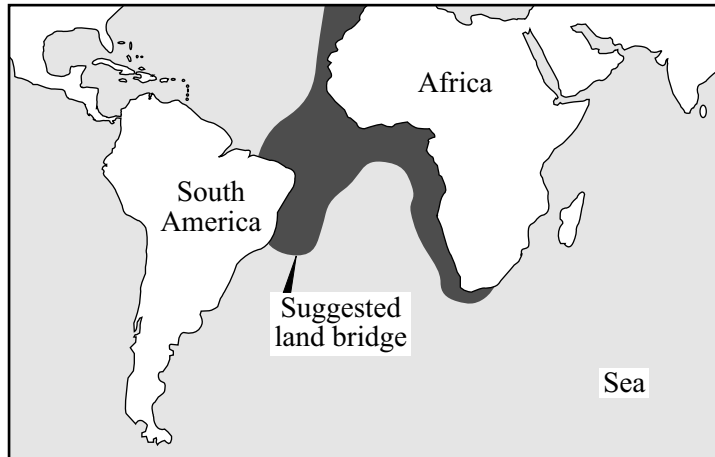
.....
.....
.....
.....

(2 marks)

QUESTION 11 CONTINUES ON THE NEXT PAGE

Turn over ►

- (b) In 1915, the scientist Alfred Wegener suggested that Africa and South America had once been joined but had since drifted apart. Evidence for his theory came from the animal fossils found in the two continents. The fossils are almost the same, although animals now living in Africa and South America are different. Other scientists did not agree with Wegener and suggested that a land bridge had once joined the two continents.



How could scientists use the idea of a land bridge to explain the evidence put forward by Wegener?

.....

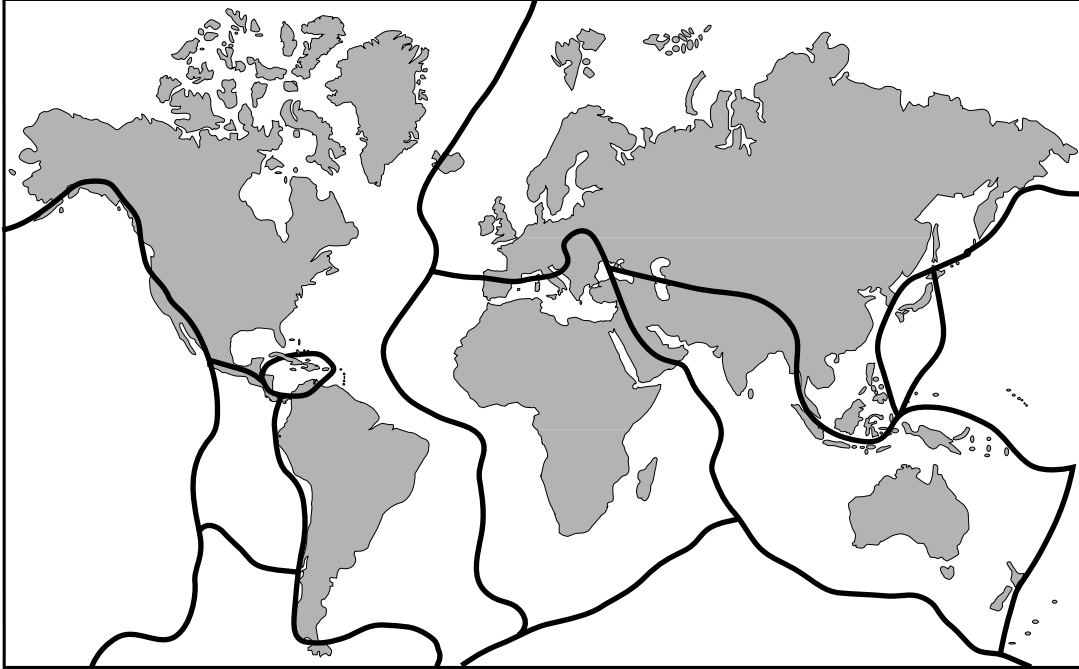
.....

.....

.....

(2 marks)

- (c) Scientists now think that the outer layer of the Earth is cracked into a number of large pieces called tectonic plates. The tectonic plates are moving very slowly. The lines on the diagram show the boundaries between the major tectonic plates.



- (i) Explain why there are no major earthquakes in Britain.

.....

(2 marks)

- (ii) What is causing the tectonic plates to move?

.....

(1 mark)

12 (a) Some scientists are involved in the search for *extra-terrestrial* intelligence (SETI).

(i) What does *extra-terrestrial* mean?

.....
(1 mark)

(ii) What equipment is used to carry out this search?

.....
(1 mark)

(b) In 1967, radio pulses, one every 1.337 seconds, were discovered coming from a point in space. Some scientists thought the pulses were being produced by intelligent life elsewhere in the *Universe*. Later, it was discovered that the pulses were emitted by a *neutron star*.

(i) Complete this sentence.

The *Universe* is made up of at least a billion
(1 mark)

(ii) Suggest **one** reason why scientists might have thought that the pulses were produced by intelligent life.

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

(iii) What is the link between a *neutron star* and a *super nova*?

.....
.....
.....
(2 marks)

(c) In 2001, equipment was carried by balloons to a height of 41 km above the Earth’s surface. The equipment detected the presence of bacteria.

(i) The natural movement of air in the Earth’s atmosphere may have carried the bacteria up **or** the bacteria may have come from outer space.

Suggest **one** other explanation.

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

(ii) Suggest **one** way in which bacteria may have travelled through space to reach the edge of our atmosphere.

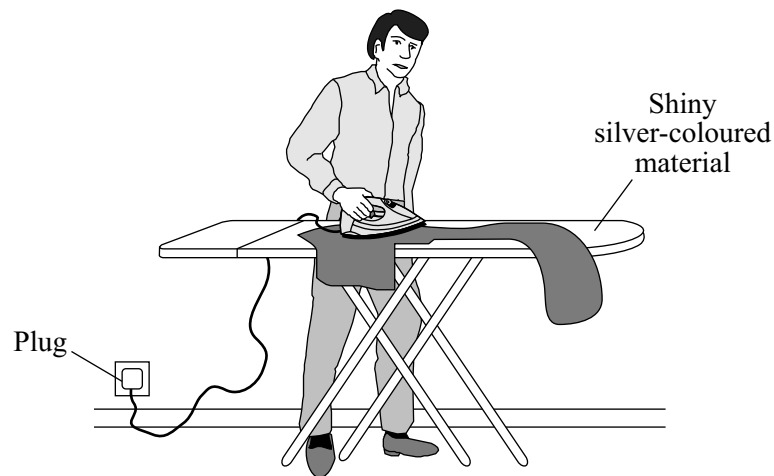
.....
.....
(1 mark)

8

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 13 The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.

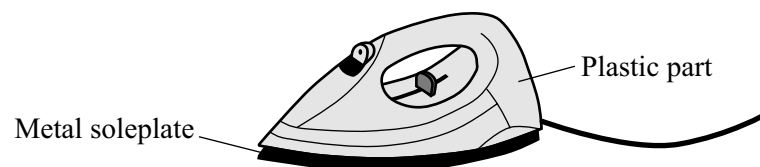


- (a) Explain why the shiny silver-coloured material helps to make ironing easier.

.....

(2 marks)

- (b) The iron must be earthed to make it safe. Which part of the iron is connected to the earth pin of the plug?



.....

(1 mark)

- (c) Name a material that could be used to make the outside case of the plug.

.....

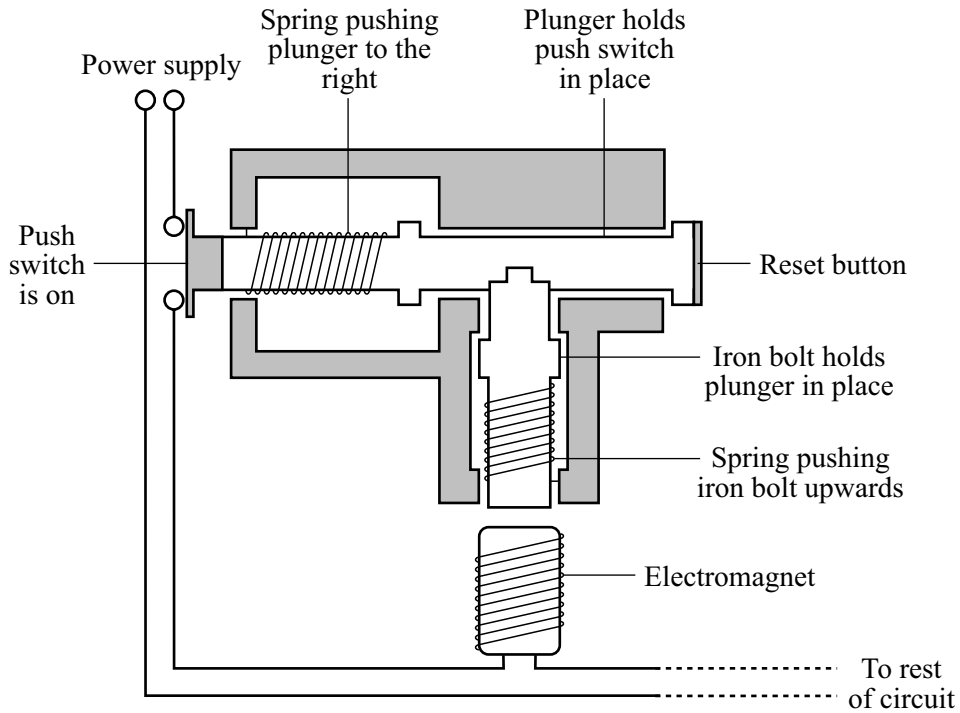
Give a reason for your choice.

.....

(2 marks)

- (d) To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.



Source: adapted from V. PRUDEN and K. HIRST, *AQA GCSE Science*
Reproduced by permission of Hodder and Stoughton Educational Ltd

Explain what happens when a current larger than 15 A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and.....

.....

.....

.....

.....

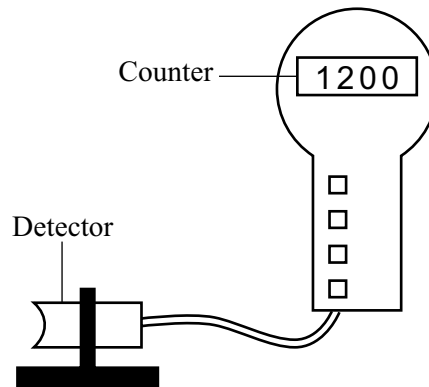
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.....

.....

(3 marks)

- 14 (a) The diagram shows a radiation detector and counter being used to measure background radiation. The number shows the count ten minutes after the counter was reset to zero.



- (i) Name **one** source of background radiation.

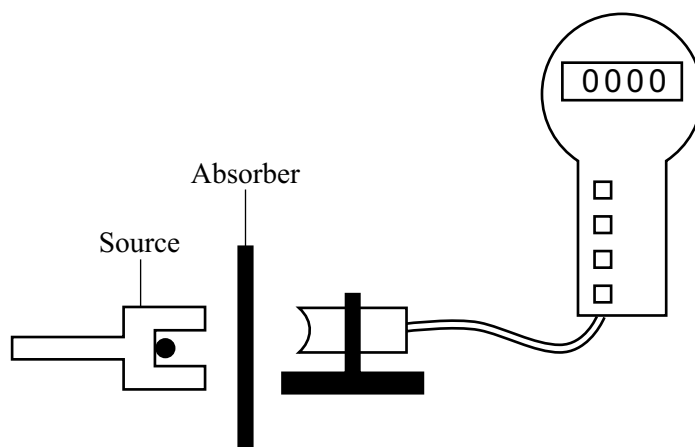
.....
(1 mark)

- (ii) Calculate the average background radiation level, in counts per second. Show clearly how you work out your answer.

.....
.....

Background radiation level =counts per second
(2 marks)

- (b) The detector and counter are used in an experiment to show that a radioactive source gives out alpha and beta radiation only.



Two different types of absorber are placed one at a time between the detector and the source. For each absorber, a count is taken over ten minutes and the average number of counts per second worked out. The results are shown in the table.

Absorber used	Average counts per second
No absorber	33
Card 1 mm thick	20
Metal 3 mm thick	2

Explain how these results show that alpha and beta radiation is being given out, but gamma radiation is **not** being given out.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

6

Turn over ►

- 15 (a) The table gives information about some planets.

Name of planet	Gravitational field strength in N/kg	Diameter of planet in thousands of km	Time for 1 orbit around the sun in years
Mercury	4	4.9	0.2
Venus	9	12.0	0.6
Earth	10	12.8	1.0
Jupiter	26	143.0	12.0

- (i) Write down the equation that links gravitational field strength, mass and weight.

.....
(1 mark)

- (ii) An astronaut has a mass of 75 kg. Calculate the weight of the astronaut on Venus. Show clearly how you work out your answer.

.....
.....

Weight of astronaut =newtons
(2 marks)

- (iii) Why would the astronaut weigh more on the Earth than on Venus?

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

- (iv) The radius of the orbit of Jupiter is greater than the radius of the orbit of Mercury, Venus or the Earth. What evidence is given in the table to show this?

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

- (b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Explain briefly how stars like the Sun are thought to have been formed.

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(2 marks)

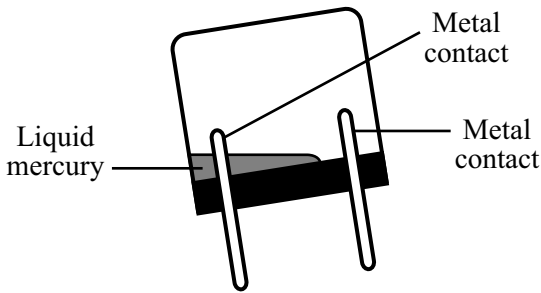


TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 16 (a) In one design of tilt switch, two metal contacts are sealed inside a small plastic container. There is some mercury inside the container. Mercury is a metal which is a liquid at room temperature.

The switch is shown in an OFF position. Next to it, draw the same switch in an ON position.

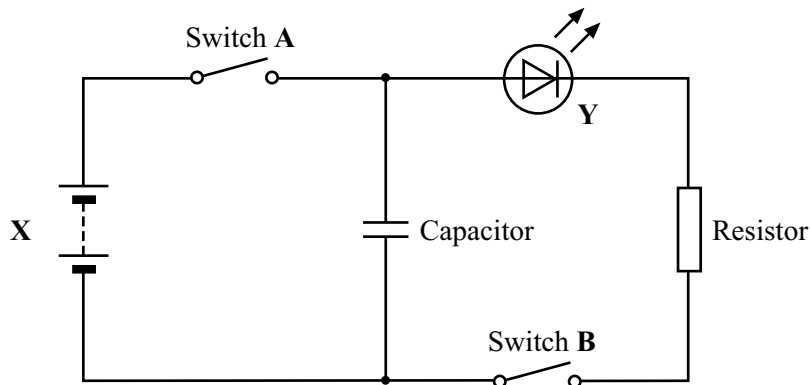


OFF

ON

(2 marks)

- (b) The diagram shows the circuit used in an experiment. Both switches are shown in the open (off) position.



- (i) Name component **X** and component **Y**.

X is a **Y** is a.....
(2 marks)

- (ii) Switch **A** was closed for three minutes. Switch **A** was then opened. Switch **B** was then closed and the time, t , was measured for how long component **Y** stayed on.

The experiment was then repeated, using a resistor of greater resistance.

How would this change affect the time, t ?

.....
(1 mark)

(iii) Explain the reason for your answer to part (b) (ii).

.....

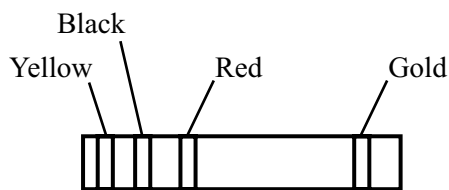
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(2 marks)

(c) The diagram shows the coloured bands on a resistor.



The gold band tells you that the tolerance is $\pm 5\%$.

The colour code for resistors is given in the table.

Figure	Colour
0	black
1	brown
2	red
3	orange
4	yellow
5	green
6	blue
7	violet
8	grey
9	white

What is the **maximum** value of the resistance of the resistor shown in the diagram?

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

.....

.....

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Maximum resistance =

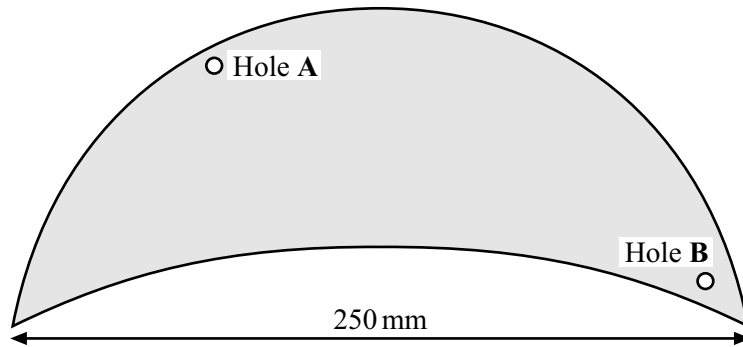
(3 marks)

17 (a) Every object has a *centre of mass*. What is meant by the *centre of mass*?

.....
.....

(1 mark)

(b) The drawing shows a thin sheet of plastic. The sheet is 250 mm wide. Two holes, each with a radius of 2 mm, have been drilled through the sheet.



Describe how you could use:

- a clamp and stand
- a steel rod 100 mm long and with a radius of 1 mm
- a weight on a thin piece of string (= a plumb line)
- a ruler
- a pen which will write on the plastic sheet

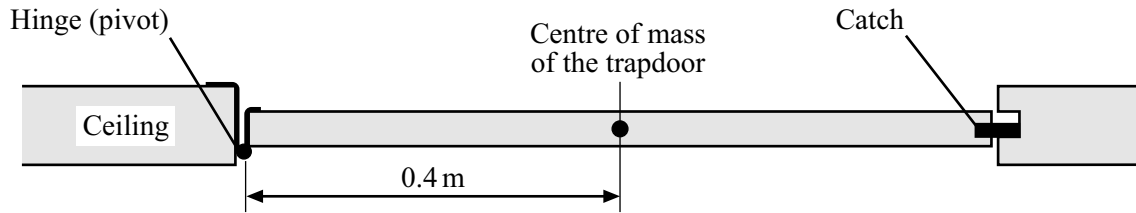
to find the centre of mass of the plastic sheet.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(5 marks)

- (c) There is a trapdoor in the ceiling of a house.
The trapdoor weighs 44 N.
The drawing shows a side view of the trapdoor.



- (i) Complete the **three** spaces to give the equation which is used to calculate the turning effect of a force.

..... = × perpendicular
between line of action and pivot
(1 mark)

- (ii) Calculate the turning effect, about the hinge, due to the weight of the trapdoor.

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

.....
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Turning effect =
(3 marks)

END OF QUESTIONS