OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
General Certificate of Secondary Education

SCIENCE: DOUBLE AWARD	PAPER 6	**1794/6**
SCIENCE: PHYSICS	PAPER 2	**1782/2**
SCIENCE: PHYSICS (NUFFIELD)	PAPER 2	**1787/2**

HIGHER TIER

Monday	**18 JUNE 2001**	Morning	1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
 Pencil
 Ruler (cm/mm)

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

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 on the question paper.

INFORMATION FOR CANDIDATES

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

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	10	
2	12	
3	10	
4	11	
5	10	
6	17	
7	10	
8	12	
9	13	
TOTAL	**105**	

This question paper consists of 20 printed pages and 4 blank pages.

[Turn over

1 Four groups of students investigate how the heat loss from a model house can be reduced.

Each group has the same type of model house.
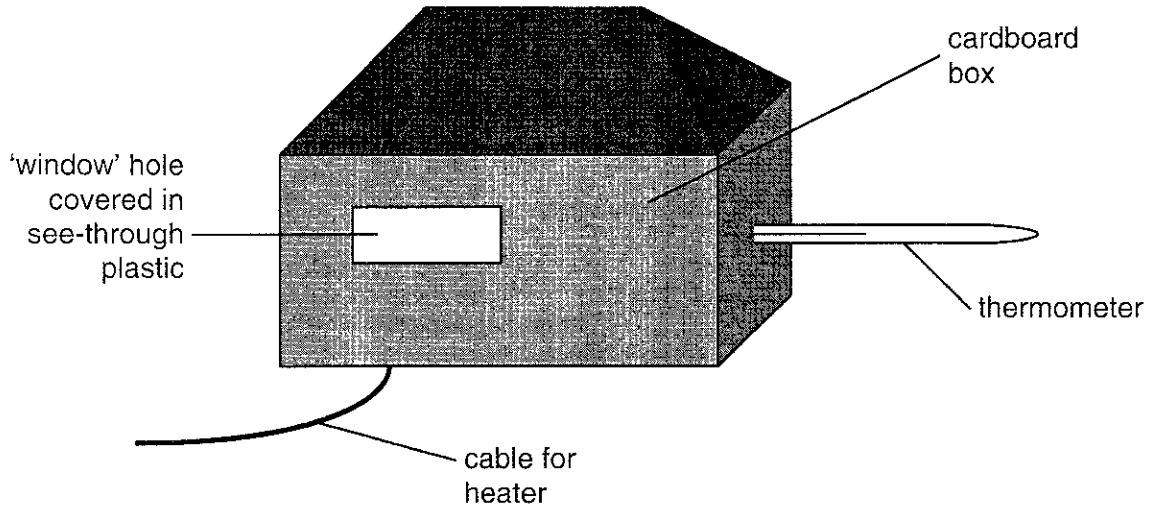
The 'house' is a cardboard box with a roof and hole for the window.

The hole is covered with a see-through plastic window.

An electric heater is used to warm the house.

A thermometer shows the temperature inside the house.

After twenty minutes, the heater is switched off.

The students record the temperature for another twenty minutes.

(a) Group 1 wrote this report.

	GROUP 1
	Our house was used as the 'control' for the other groups, so we did
	not change our house in any way.
	The temperature fell when we turned the heater off.

Why did this group not make any changes to their 'house'?

....[1]

(b) Each of the other three groups changed the basic model house in a different way.

Energy may be transferred by **conduction**, **convection** and **radiation**.

Use the words **conduction**, **convection** and **radiation** in your explanations of the students' observations.

(i) Group 2 wrote this report.

GROUP 2
We covered the roof of our house with silver foil.
The temperature did not fall as quickly as Group 1's house.

Explain the observations of Group 2.

....

....

....[2]

(ii) Group 3 wrote this report.

GROUP 3
We lined the inside of the roof of our house with cotton wool.
The temperature did not fall as quickly as Group 2's house.

Explain the observations of Group 3.

....

....

....[2]

(iii) Group 4 wrote this report.

GROUP 4
We took the polythene away from the window of our house.
The temperature fell more quickly than the temperature of any other
group's house.

Explain the observations of Group 4.

....

....

....[2]

[Turn over for remainder of Question 1

(c) A small, 21 W light bulb is used as the electrical heater.
When it is switched on, the glass surface of the bulb becomes hot.

Use your ideas about energy transfer to explain how all the inside of the model house now becomes warm.

....

....

....

....

....[3]
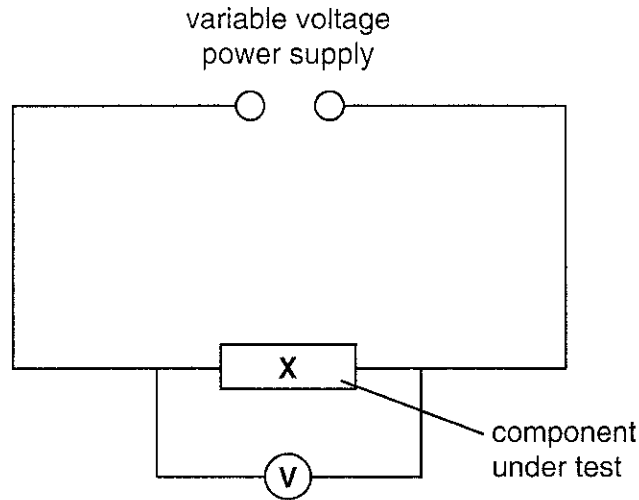
[Total : 10]

2 Zena sets up this circuit to test an electrical component.

She wants to know how the current through the component changes when the voltage across it changes.

variable voltage
power supply

X

component
under test

V

(a) The table shows her results.

						power supply reversed	
voltage in volts	0.5	1.0	1.5	2.0	2.5	−0.5	−1.0
current in milliamps	0	1	5	13	25	0	0

(i) Plot the points on the grid below. Three have been done for you. [2]

current in
milliamps

voltage in volts
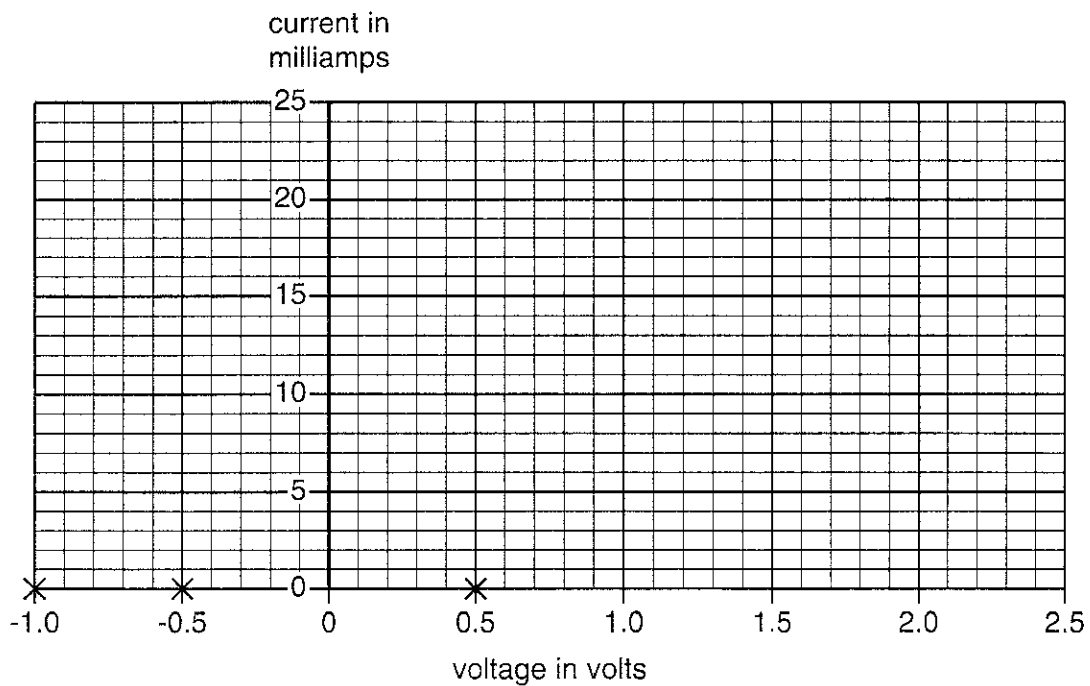
(ii) Finish the graph by drawing the best line through the points. [1]

(b) **(i)** What is the current through component **X** when the voltage across it is 1.8 V?

You **must** show clearly, **on the graph**, how you got your answer.

current = ...milliamps [2]

(ii) Calculate the resistance of component **X** when the voltage across it is 1.8 V.

You **must** show how you work out your answer.

resistance = ...ohms [4]

(iii) Describe how the resistance of component **X** changes as the voltage is increased from 0 to 2.5 V.

....

....

....[2]

(iv) Suggest what component **X** could be.

....[1]

[Total : 12]

[Turn over

3   This question is about cars travelling at speed.

This graph can be used to convert speed in metres per second to miles per hour.

You will need to look at the graph to answer this question.
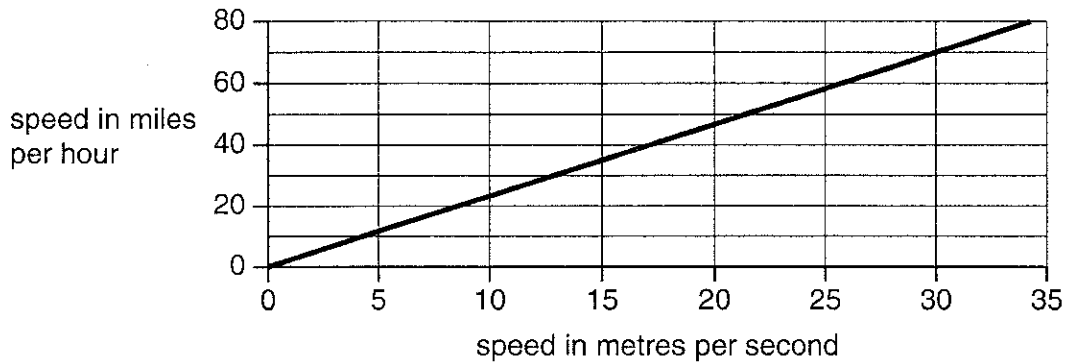
Police are now using a new method of measuring the speed of cars on roads.

Two overhead cameras are placed 1600 metres (one mile) apart.

As cars pass each camera, the exact time of day and the car registration number are recorded.

The diagrams show the progress of a car along the road and the times recorded by the two cameras.
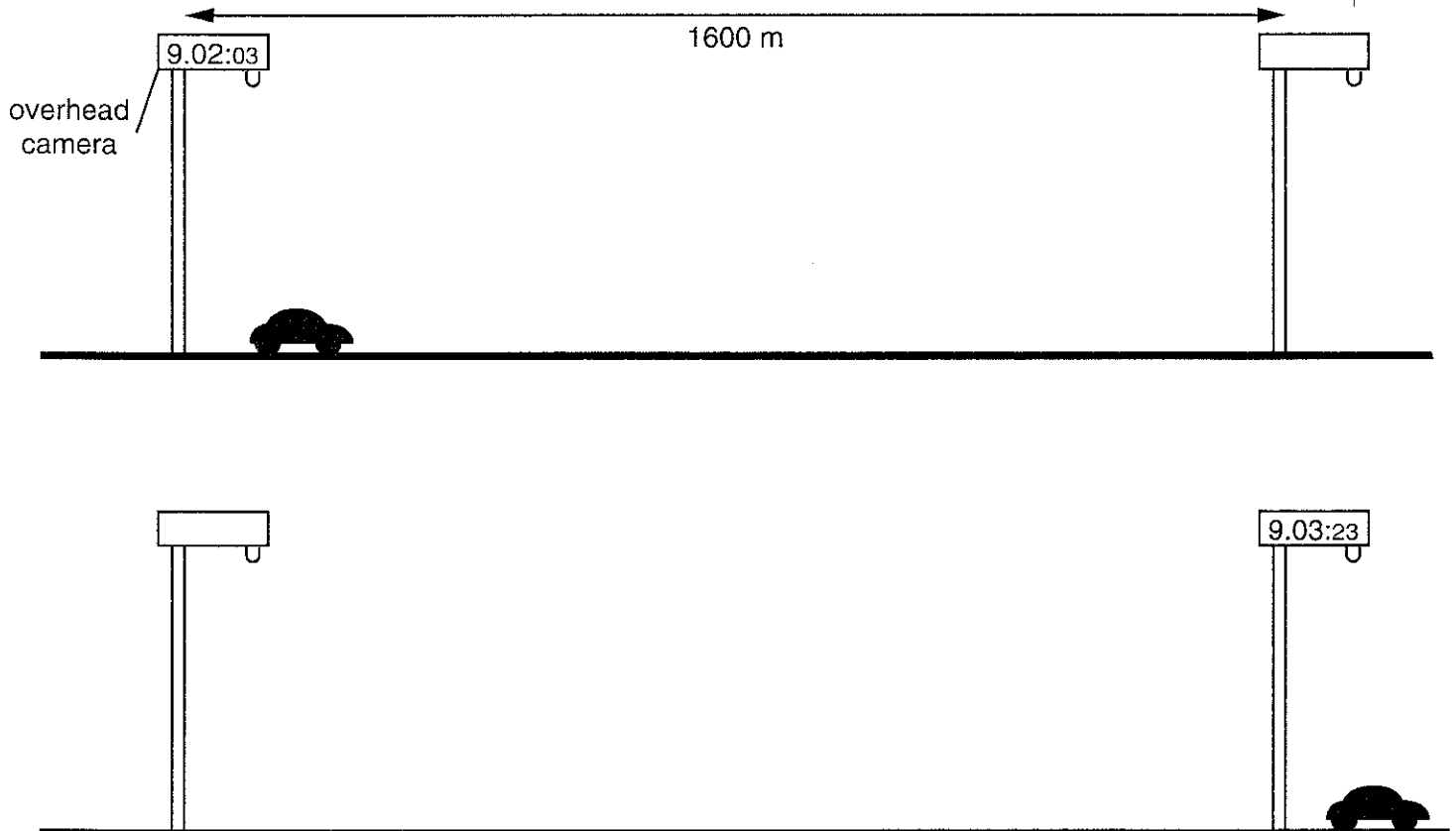
(a) Calculate the average speed of the car.

You **must** show how you work out your answer.

average speed = ...m/s   [3]

(b) Use the graph to explain whether or not the car was breaking the speed limit of 60 miles per hour.

....

....

....[2]

(c) The car is now travelling at 25 m/s.
It takes 5 seconds for the brakes to bring the car from the initial speed of 25 m/s to rest.
The mass of the car and its occupants is 1.1 tonnes (1100 kg)

Calculate the average braking force.
You **must** show how you work out your answer.

braking force = ... unit .... [5]

[Total : 10]

[Turn over

4 The diagram shows a boat and a submarine looking for a sunken wreck on the flat sea bed below.

diver

boat

sea level

shark

submarine

wreck on sea bed

BAR HAM

not to scale
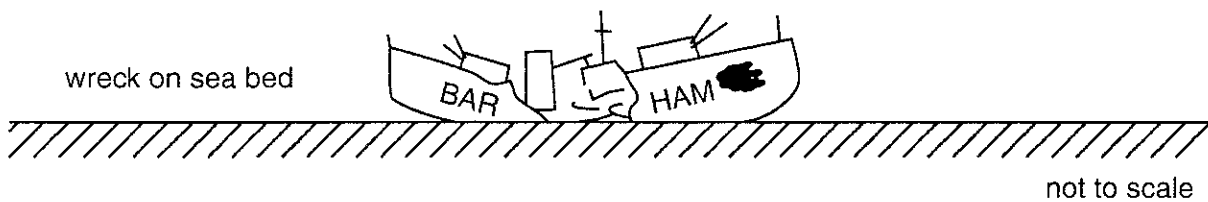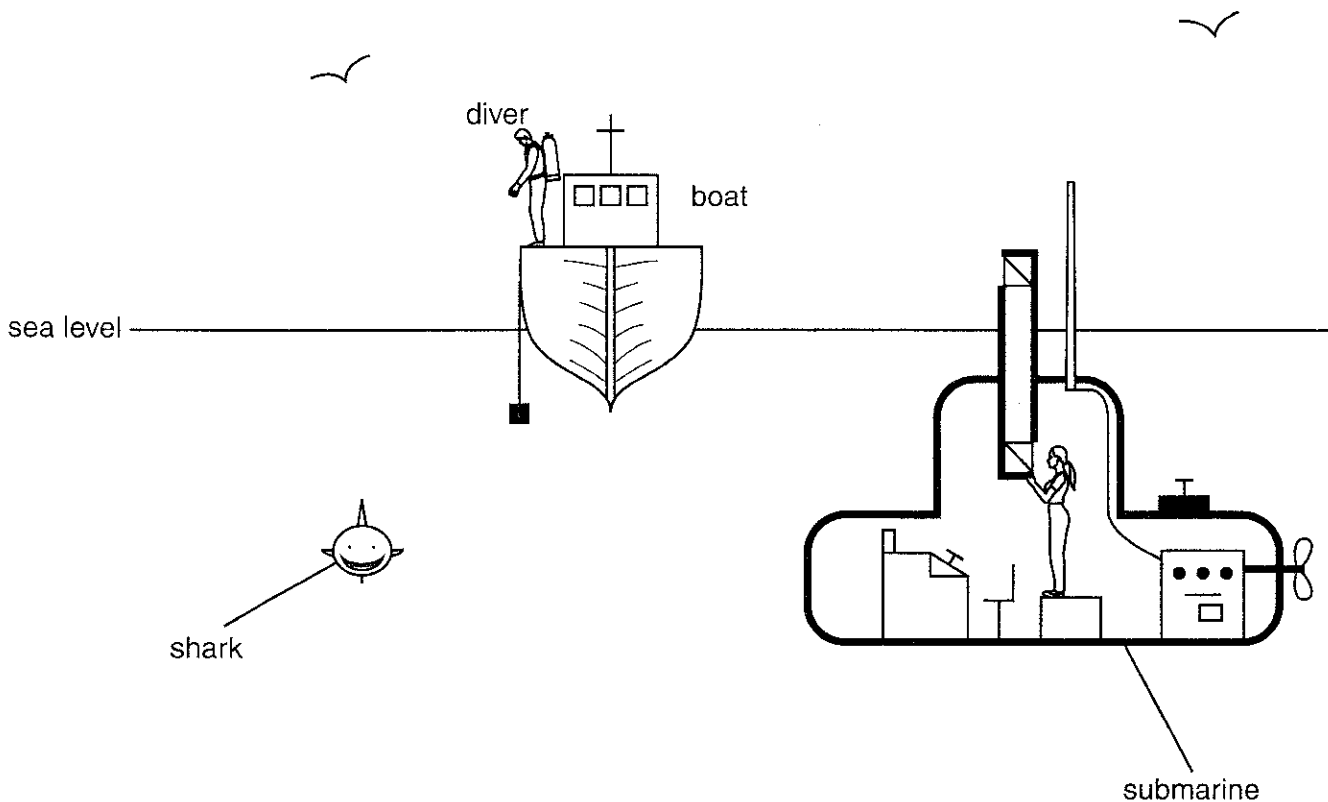
(a) The boat is using echo-sounding to locate the wreck on the sea bed.

(i) What is an echo?

....[1]

(ii) Suggest how the results of the echo-sounding can be used to find **where** the wreck is on the flat sea bed.

....

....

....[2]

(iii) How can the echoes be used to work out how **deep** the wreck is?

....

....

....

....

....[3]

(b) The boat sends out a pulse of sound and receives back other echoes, apart from those from the wreck.

Some echoes are 'stronger' than others. Explain why.

....

....

....[2]

(c) A diver goes down to the sea bed to inspect the wreck.
Bubbles of gas rise from the diver to the surface.

Use the relationship **pV = constant** to explain why the volume of the bubbles change as they rise to the surface.

....

....

....

....[3]

[Total : 11]

[Turn over

5 This question is about waves.

The waves made by earthquakes are recorded by an instrument called a seismometer.
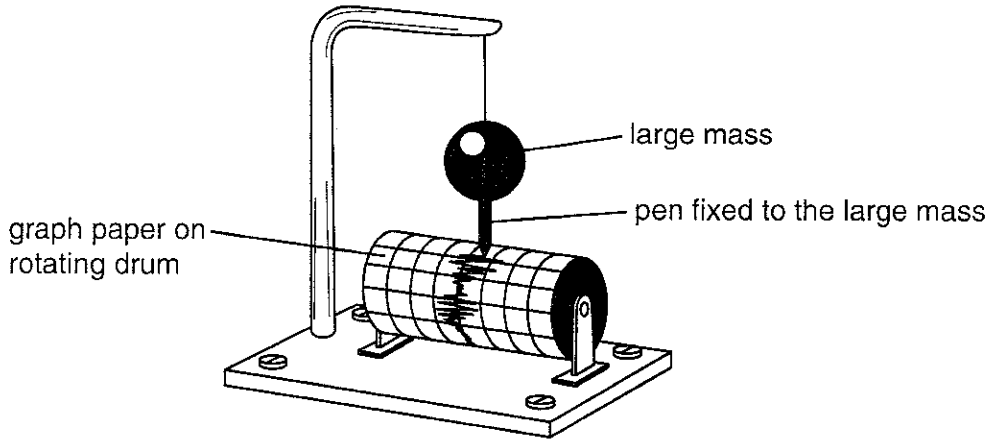
Here is a trace of the waves recorded by the seismometer after an earthquake.

20 seconds
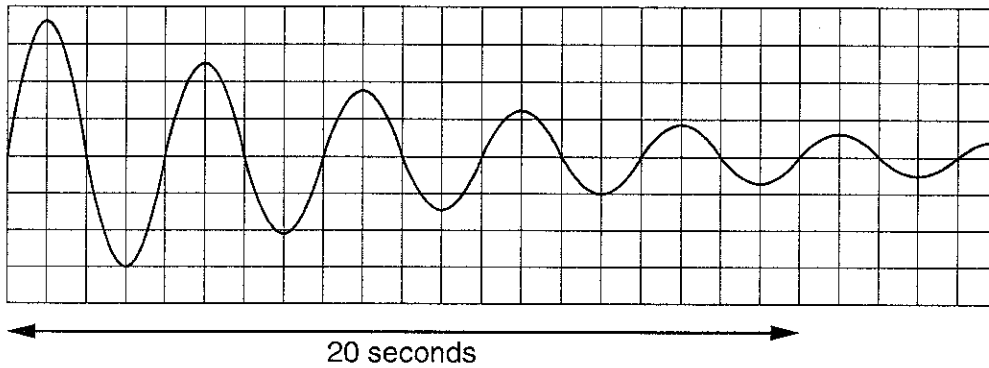
(a) Use the information on the diagram to calculate the **frequency** of the recorded wave.
You **must** show how you work out your answer.

frequency = ...Hz [2]

(b) Another wave recorded during an earthquake had an average wavelength of 800 m inside the Earth and a frequency of 5 Hz. Calculate the average speed of this wave through the Earth.
You **must** show how you work out your answer.

speed = ...m/s [2]

(c) Earthquakes produce **transverse** and **longitudinal** waves.

Describe **one** way in which a transverse wave is different from a longitudinal wave.

You may draw diagrams to help your answer.

....

....

....[2]

(d) In an earthquake, P waves and S waves travel through the Earth.

P waves are different from S waves. Explain how the differences between these waves help geologists to understand more about the internal structure of the Earth.

Drawing and labelling on the diagram may help you answer.

....

....   source of
earthquake

....

....   recording
                                                                                            station A

....

....

....   recording
                                                                                        station B

....

....

....

....[4]

[Total : 10]

[Turn over
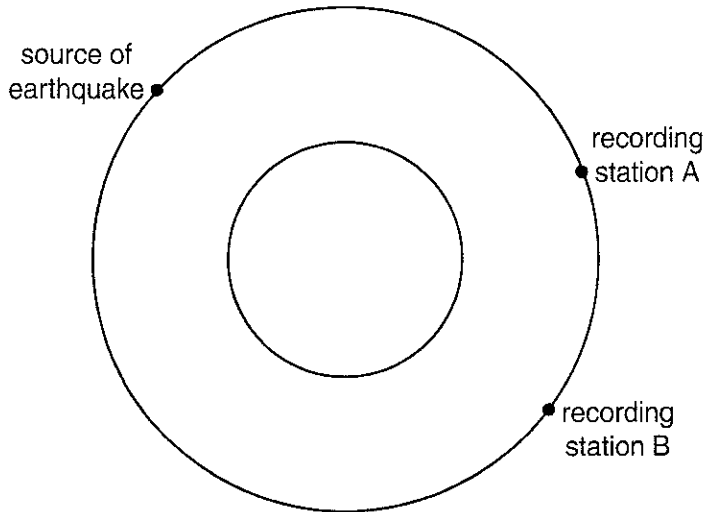
6 The diagram shows two circuits that can make a simple burglar alarm.

(a) When switch 1 is closed, current passes through the battery circuit. The pivoted metal strip moves to the right and stretches the spring.

Explain why.

....

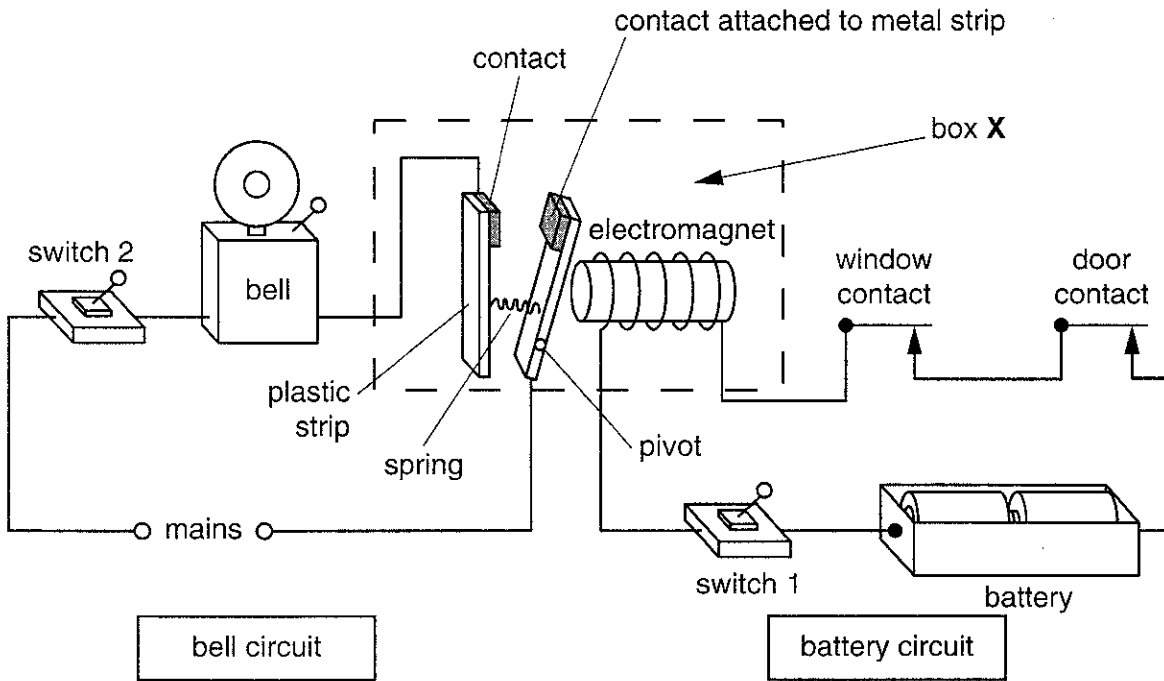...

....[2]

(b) The alarm is now set ready by closing switch 2.

Explain carefully, in a series of steps, why the bell now rings if either the window or the door is opened.

....

....

....

....

....

....[5]

(c) The electromagnet works best when the voltage across it is 6 V, but the battery in the circuit has a voltage of 3 V only. It is suggested that a step-up transformer could be used in the circuit containing a battery to increase the voltage across the electromagnet to 6 V.

Explain carefully why a transformer would not work in this circuit.

....

....[2]

(d) The diagram shows a step-up transformer designed to double the voltage.

input coil   100 turns   output coil

diagram not to scale
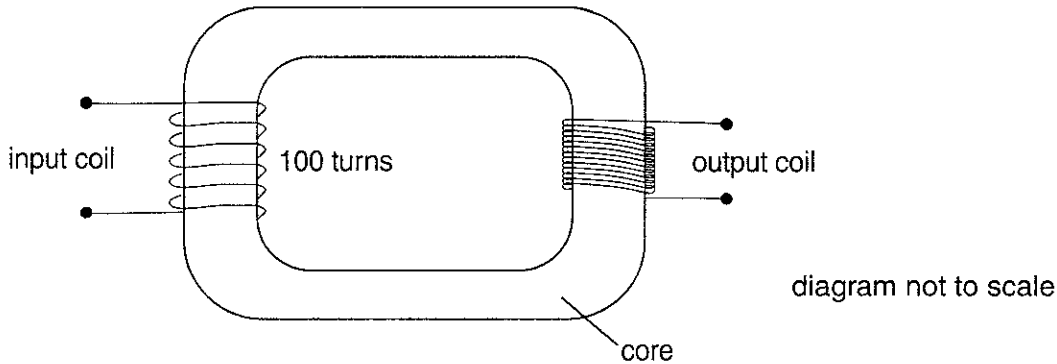
core

(i) State the number of turns on the output coil.   number of turns = ...   [1]

(ii) Name the material used for the core of a transformer. Explain why this material is suitable.

....

....

....[3]

(iii) The voltage output (V_s) of the transformer is double the input voltage (V_p). Use your ideas about power input and power output of transformers to suggest how the output current of the transformer compares with the input current.

....

....

....[2]

(iv) Suggest and explain why copper wire is used for the coils of a transformer.

....

....

....[2]

[Total : 17]

[Turn over

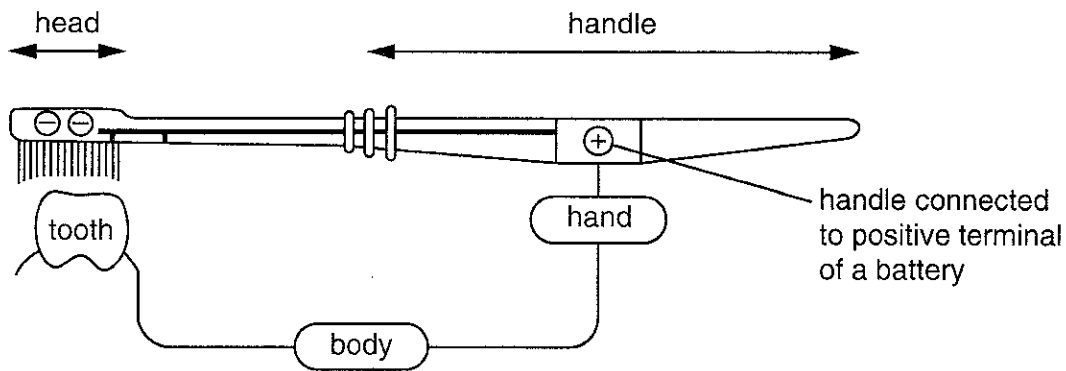**7** This question is about electrostatics and its uses.

Plaque is a thin layer of bacteria on teeth.

When it is on teeth, the surfaces of the teeth are negatively charged and the plaque is positively charged.

A new type of toothbrush helps to clean teeth using electrostatic charge.

Look at the diagram to help you answer the questions.

If you use an Ionic Toothbrush™, your hand touches the positive terminal of a battery in the handle.

(a) (i) How does this affect the charge on your teeth?

....[1]

(ii) What type of charge is on the bristles of the toothbrush?

....[1]

(iii) Write down **two** reasons why the positively charged plaque leaves the surface of the tooth.

1. ....

2. ....[2]

(b) It is recommended that you brush your teeth for 3 minutes.

Calculate the total charge passing through the brush in this time, when a steady current of 0.0001 A passes.

You **must** show how you work out your answer.

charge = ... unit .... [4]

(c) The instructions say that the toothbrush works best if the hand is **wet**.
Suggest why the toothbrush is less effective when held with a **dry** hand.

....

....

....[2]

[Total : 10]

[Turn over

8 This question is about different types of stars.
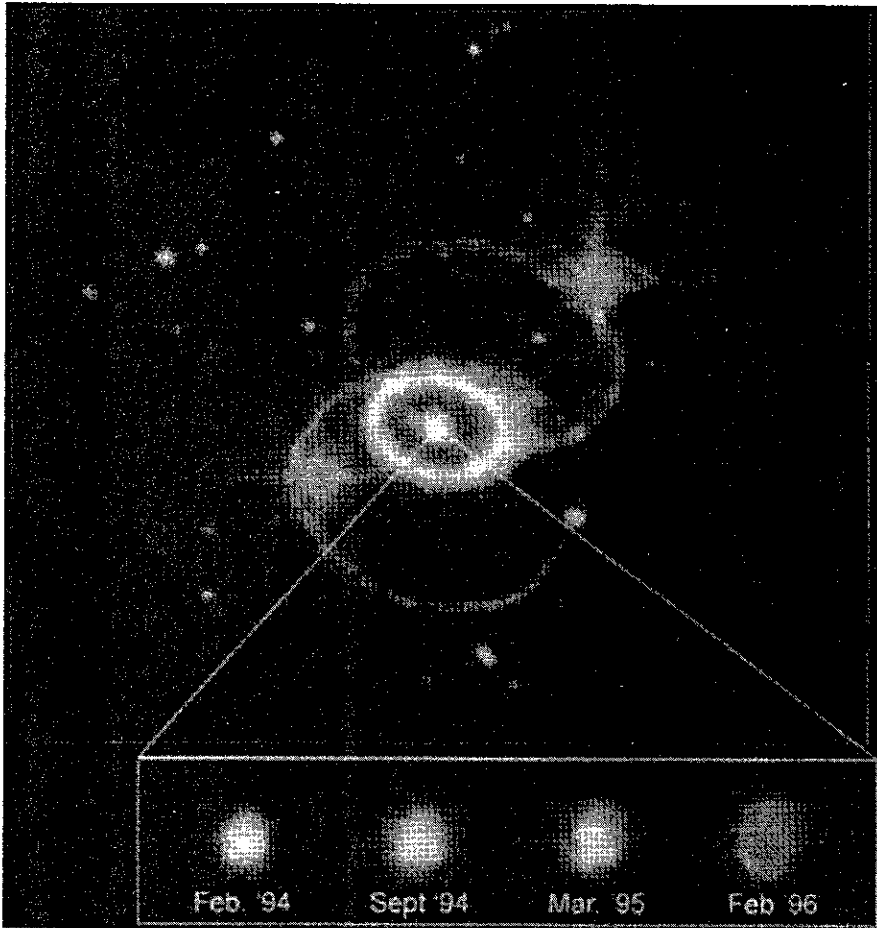
The picture, taken by the Hubble Space Telescope, shows Supernova 1987A and its surroundings. The explosion of the supernova was observed in 1987 and the series of four small pictures show the debris at later times after the explosion. The explosion debris is expanding at 6 million miles per hour! The rings around the supernova are probably composed of materials lost by the pre-supernova star in the last stages of its evolution.

Supernova 1987A is located 167,000 light-years away from the Earth in the Large Magellanic Cloud.

(a) (i) How would the mass of the star that became Supernova 1987A compare with the mass of our Sun?

....[1]

(ii) By looking at the four small pictures of the explosion debris, suggest how the supernova would have appeared just before it exploded.

....

....[1]

(iii) Although these events were observed recently, they actually occurred over 150,000 years ago. Explain this.

....

....[2]

(iv) A series of rings can be seen around the supernova, similar to the ripples seen around a vibrating source in a ripple tank. What do these rings suggest about what happened to the star just before it became a supernova?

....

....[2]

(v) What is the likely fate of the inner core of the supernova?

....[1]

(vi) In what ways is the fate of our Sun likely to be different to that of the star that became Supernova 1987A?

....

....

....[2]

(b) Heavy elements are formed in the core of the supernova whereas only light elements are formed in the core of the Sun.

(i) By what process are these elements formed?

....[1]

(ii) Suggest why heavy elements are found on the Earth.

....

....[2]
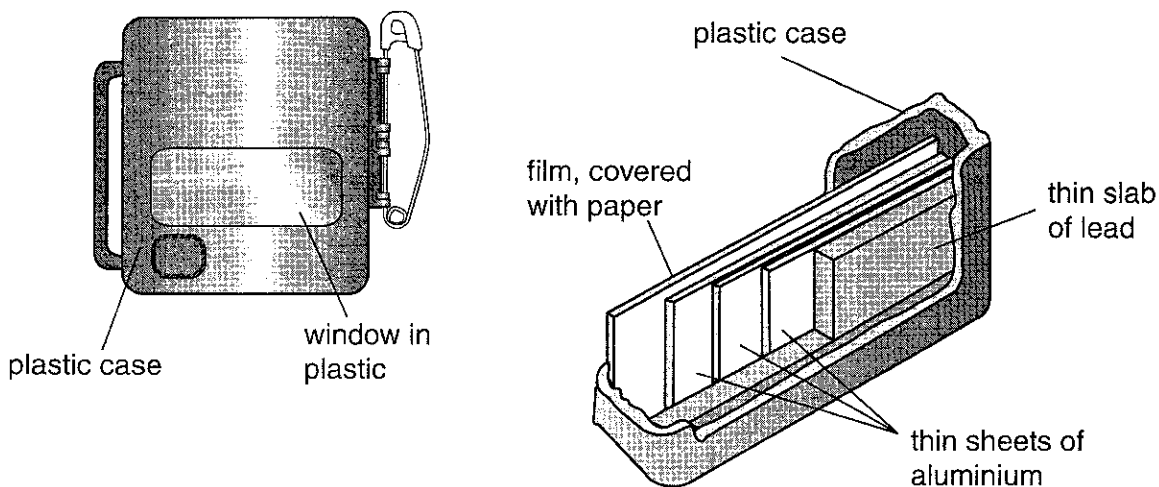
[Total : 12]

[Turn over

9   This question is about the measurement of radioactivity.

When Marie works with radioactive sources she wears a film badge.
After a certain time the film is taken from the badge and developed.
The amount of darkening of the film indicates the amount of radiation to which the film has been exposed.

The diagram shows the badge and the absorbers in front of the film.

plastic case

film, covered
with paper

plastic case

window in
plastic

thin slab
of lead

thin sheets of
aluminium

(a)   Alpha particles **cannot** be detected by the film. Explain why.

....

....[1]

(b)   How would the developed film indicate

(i)   that γ (gamma) rays are present?

....

....[1]

(ii)   that a range of β (beta) particles with different energies are present?

....

....[1]

(c)   The effects of radiation on the human body depend on the type of radiation, its energy and penetration as well as the amount of exposure.

(i)   Explain why an alpha source **inside** the body is the **most** dangerous.

....

....

....[2]

(ii) Explain why a gamma source **inside** the body is the **least** dangerous.

....

....

....[2]

(d) The graph shows how the activity of cobalt-60 changes with time.
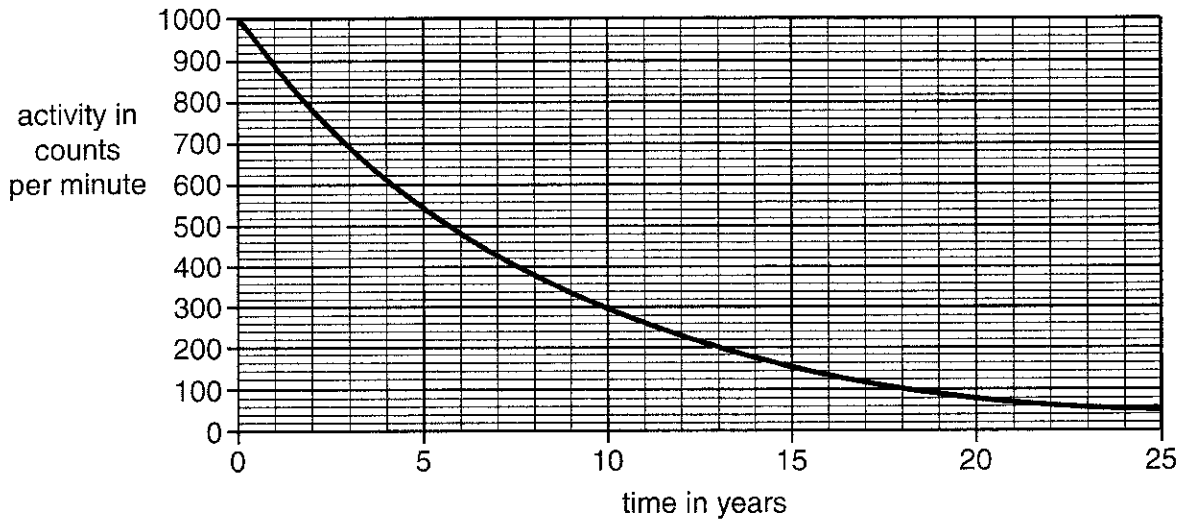
Use the graph to find the half-life of cobalt-60.

You **must** show clearly, **on the graph**, how you got your answer.

half-life = ...years   [2]

(e) Marie has a radioactive isotope which she knows has a half-life of about half an hour. She wishes to measure the half-life accurately. Describe what she would do, and how she would use the results to produce a similar graph to that shown in **(d)**.

....

....

....

....

....

....[4]

[Total : 13]