**OCR**

RECOGNISING ACHIEVEMENT

## OXFORD CAMBRIDGE AND RSA EXAMINATIONS
### General Certificate of Secondary Education

**SCIENCE: DOUBLE AWARD A**  PAPER 6  **1983/6**

**SCIENCE: PHYSICS (OPTIONS A & B)** PAPER 2  **1982/2**

HIGHER TIER

Tuesday  **17 JUNE 2003**  Morning  1 hour 30 minutes

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

*IME*  1 hour 30 minutes

## INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and candidate number in the spaces at the top of this page.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

## 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.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.

This means, for example, you should
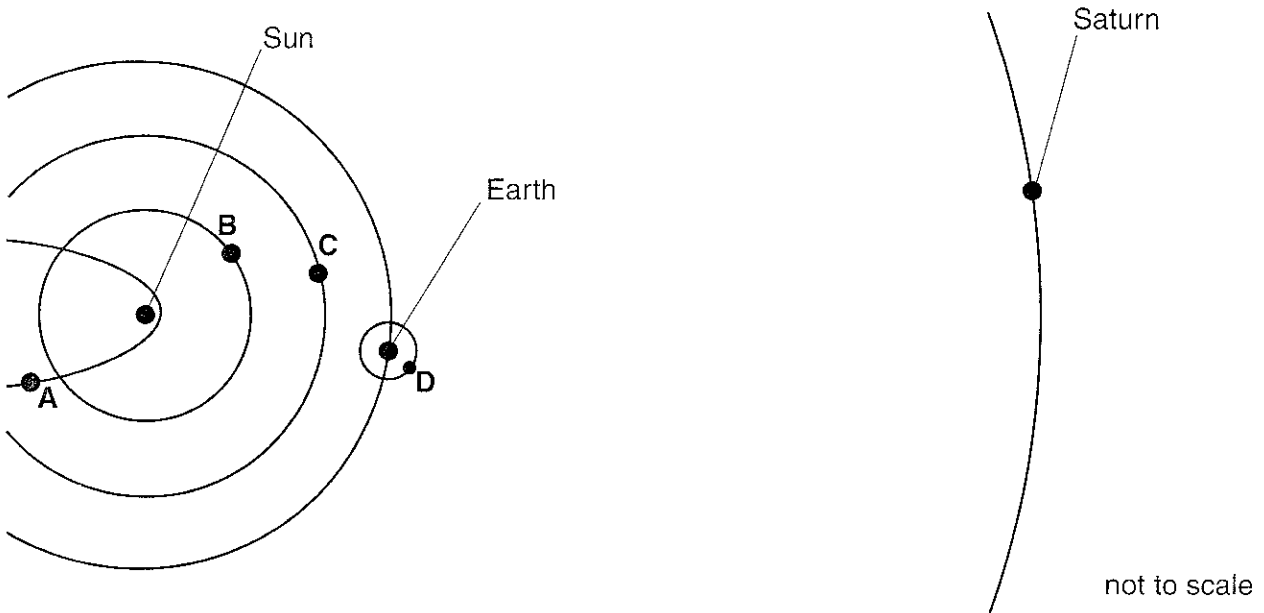- write in sentences,
- use correct spelling, punctuation and grammar,
- use correct scientific terms.

| FOR EXAMINER'S USE | | |
|---|---|---|
| Qu. | Max. | Mark |
| 1 | 16 | |
| 2 | 10 | |
| 3 | 5 | |
| 4 | 15 | |
| 5 | 12 | |
| 6 | 10 | |
| 7 | 14 | |
| 8 | 5 | |
| 9 | 6 | |
| 10 | 7 | |
| TOTAL | 100 | |

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**This question paper consists of 24 printed pages.**

**[Turn over**

2080

Answer **all** the questions.

1    The diagram represents the orbits of several bodies in our solar system.



not to scale

(a)  Which body is a **comet**? Choose **A**, **B**, **C** or **D**. ...............                    [1]

Explain your choice.

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(b)  Gravity is the force which keeps bodies in orbit around planets and stars.

(i)    Two artificial satellites, not shown on the diagram, are in orbit around the Earth.

One of the satellites takes longer to orbit the Earth than the other.

Explain why.

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(ii)   The speed of a comet varies as it orbits the Sun.

Where will it be travelling quickest? Explain why.

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

**(c)** Stars evolve in different ways depending on their mass. Betelgeuse is a red supergiant star many times bigger and more massive than our Sun. It has already used up most of the hydrogen 'fuel' in its core. Betelgeuse is on the way to the 'stellar graveyard'.
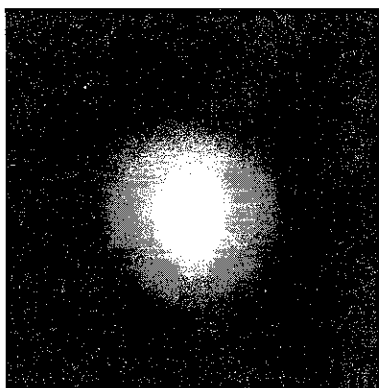


```
└─────────────┘
    size of Star
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        ⊔
size of Earth's orbit
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   └──────┘
size of Jupiter's orbit
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**(i)** Describe how stars like our Sun were initially formed.

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**(ii)** What reaction, occurring in the core of Betelgeuse, is now coming towards an end?

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**(iii)** Suggest **three** further stages Betelgeuse will go through.

1. ................................................................................................................................

2. ................................................................................................................................

3. ............................................................................................................................[3]

**(d)** Most scientists believe that the Universe is expanding.
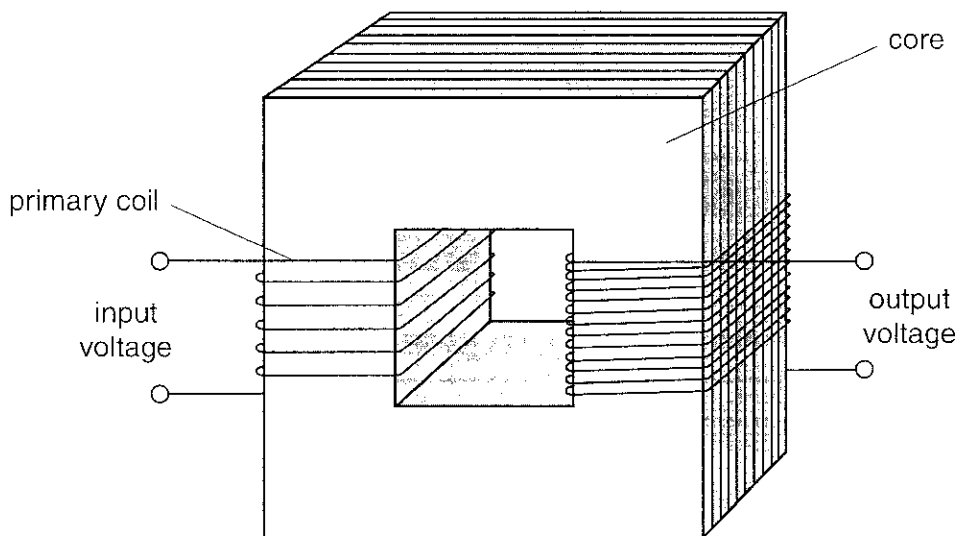What evidence supports this view? Use your ideas about **red shift** and the motion of galaxies in your answer.

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[Total: 16]

**[Turn over**

**2** The diagram shows a simple **step-up** transformer.



**(a)** For safety, a low voltage is needed for a child's train set.

How can this transformer be changed so that a mains voltage can be reduced to a low output voltage?

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**(b)** **Alternating** current must be used for a transformer to work.

**(i)** What is an alternating current?

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**(ii)** Why must an alternating current be used?

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.........................................................................................................................[1]

**(c)** **(i)** Another transformer is being used to step down the voltage from 240 V to 12 V.

The primary coil of this transformer has 4000 turns.

Calculate how many turns are needed on the secondary coil.

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

number of turns on secondary coil = ............... [2]

**(ii)** The output of this transformer is connected to a radio.

State and explain how the output current to the radio compares with the input current to the transformer.

Assume the transformer is 100% efficient.

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...............................................................................................................................[3]

[Total: 10]

**[Turn over**

3   The diagram shows a coal fired power station connected to part of the National Grid.

It provides businesses and homes with electricity.



**(a)** Explain why power is transmitted at high voltage.

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**(b)** The large generators in power stations are different in structure and operation from the simple model generator shown in the diagram.



rotating
coil

magnet
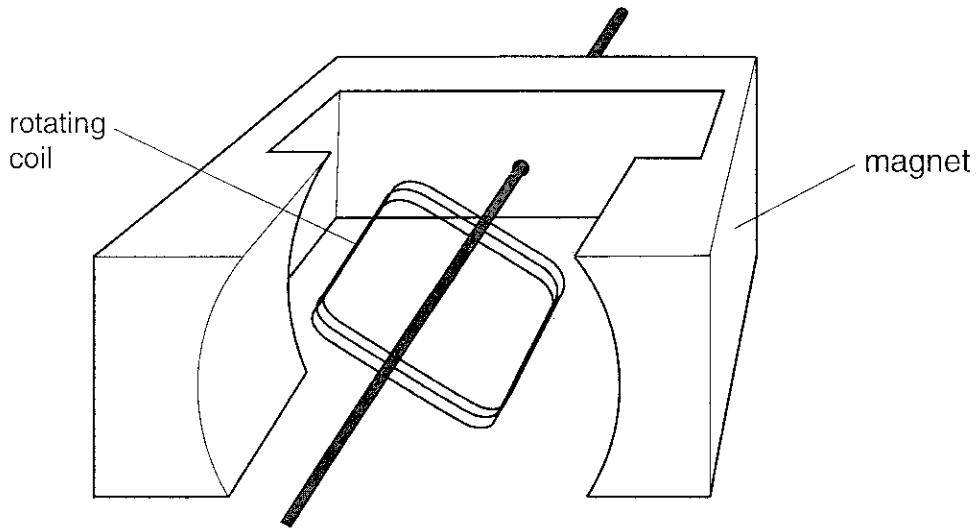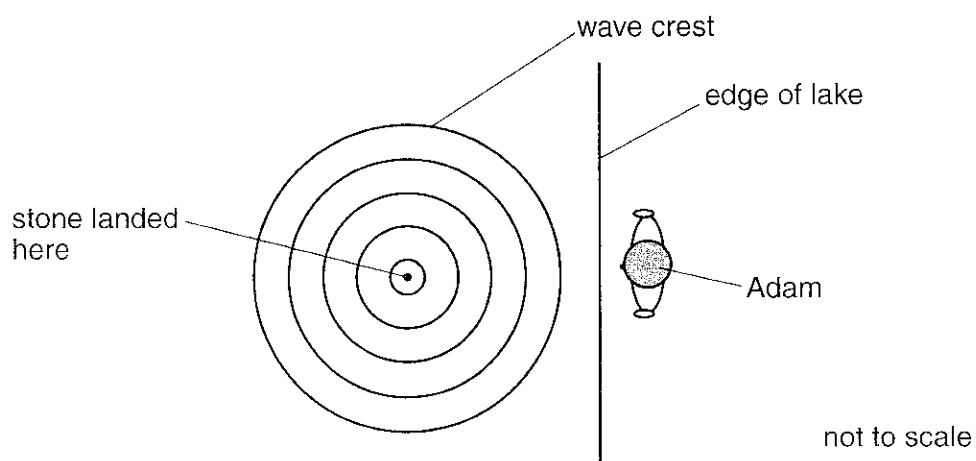
Describe **three** ways in which the large generators are different.

1. .......................................................................................................................................

2. .......................................................................................................................................

3. ...............................................................................................................................[3]

[Total: 5]

**[Turn over**

**4** This question is about transverse waves.

Adam throws a stone into a lake.

He watches the waves move towards the edge.



The distance between each wave is 10 cm.

Adam counts two complete waves reaching the edge in each second.

**(a)** Calculate the speed of the wave.

You **must** show how you work out your answer, including any equation used.

wave speed = ..................... unit .............. [4]

(b) The waves travelling towards the edge of the lake are reflected.

Finish this diagram to show how these **three** waves are reflected from the edge.



edge of lake

stone
landed
here

[3]

**[Turn over for remainder of Question 4**
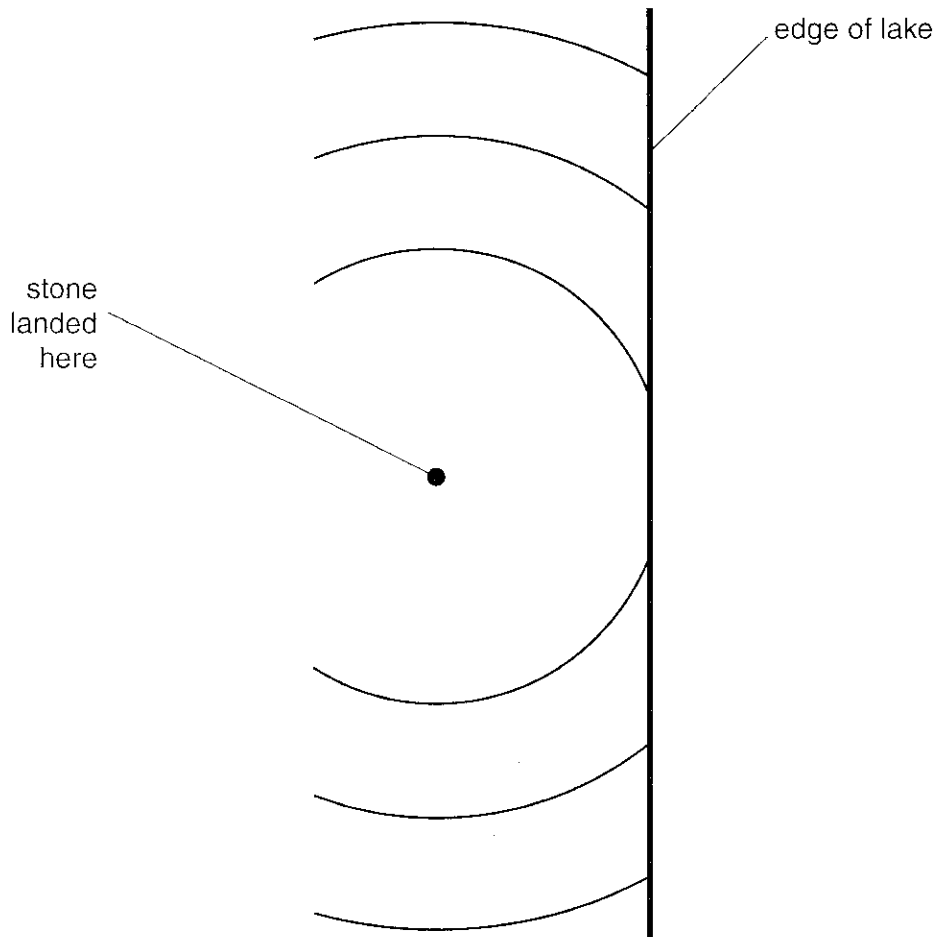
(c) Adam goes to another part of the lake where there is a beach.

He throws in a stone. This is what he sees.

edge of lake

stone landed here
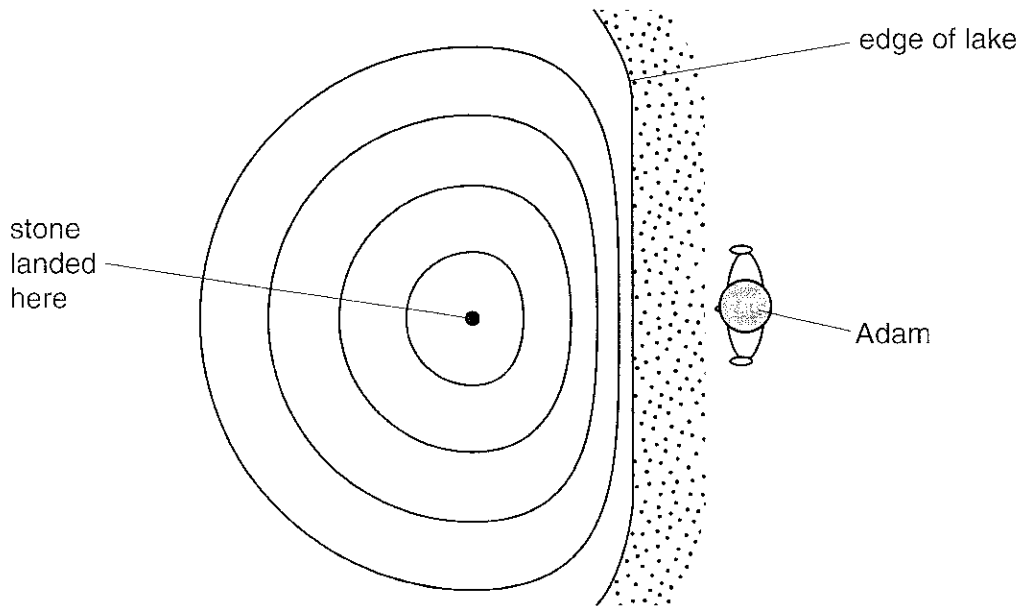
Adam

(i) Suggest why the waves are getting closer together as they move towards the beach.

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(ii) Adam notices that the waves get more difficult to see as they spread out across the water.

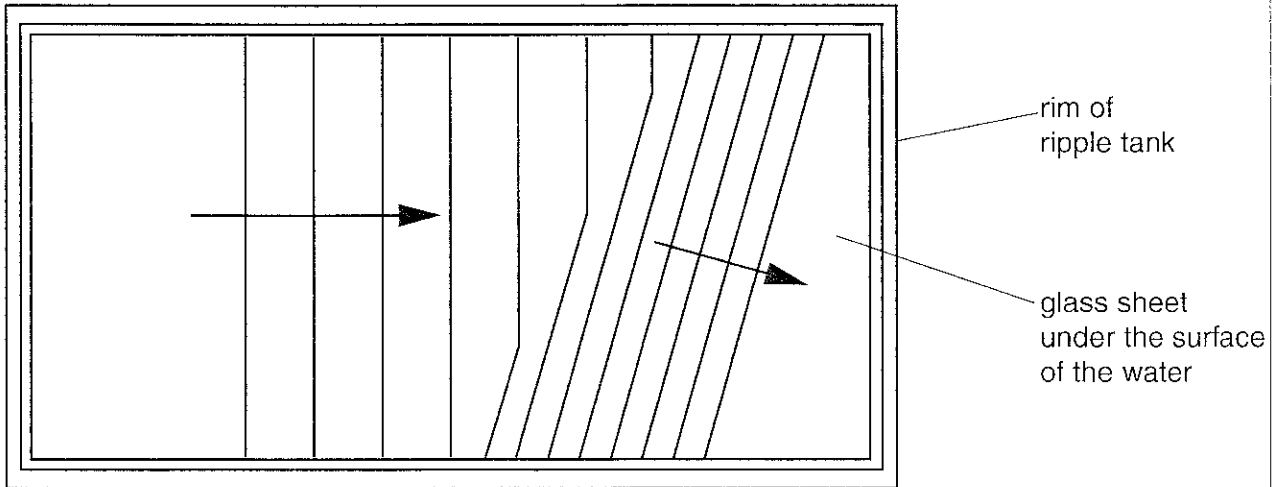What happens to the amplitude of the waves as they spread out?

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Explain why.

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.....................................................................................................................................................[1]

**(d)** Adam uses a ripple tank to try to reproduce the effect he saw in the lake.

He places a sheet of glass under the water on the right hand side of the tank.

rim of
ripple tank

glass sheet
under the surface
of the water

**(i)** State what happens to each of the following as the ripples change direction in the tank.

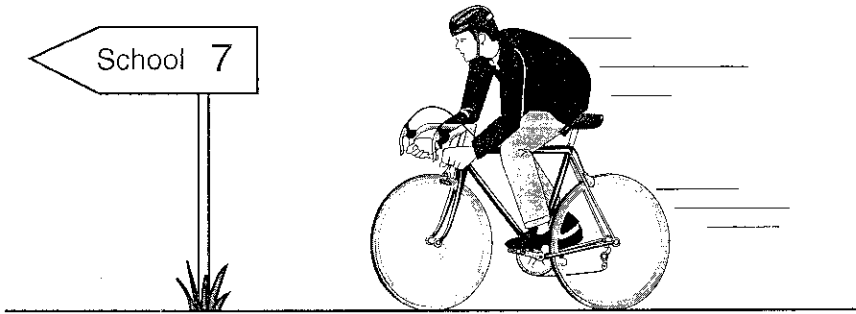wavelength ............................................................................................[1]

speed ...................................................................................................[1]

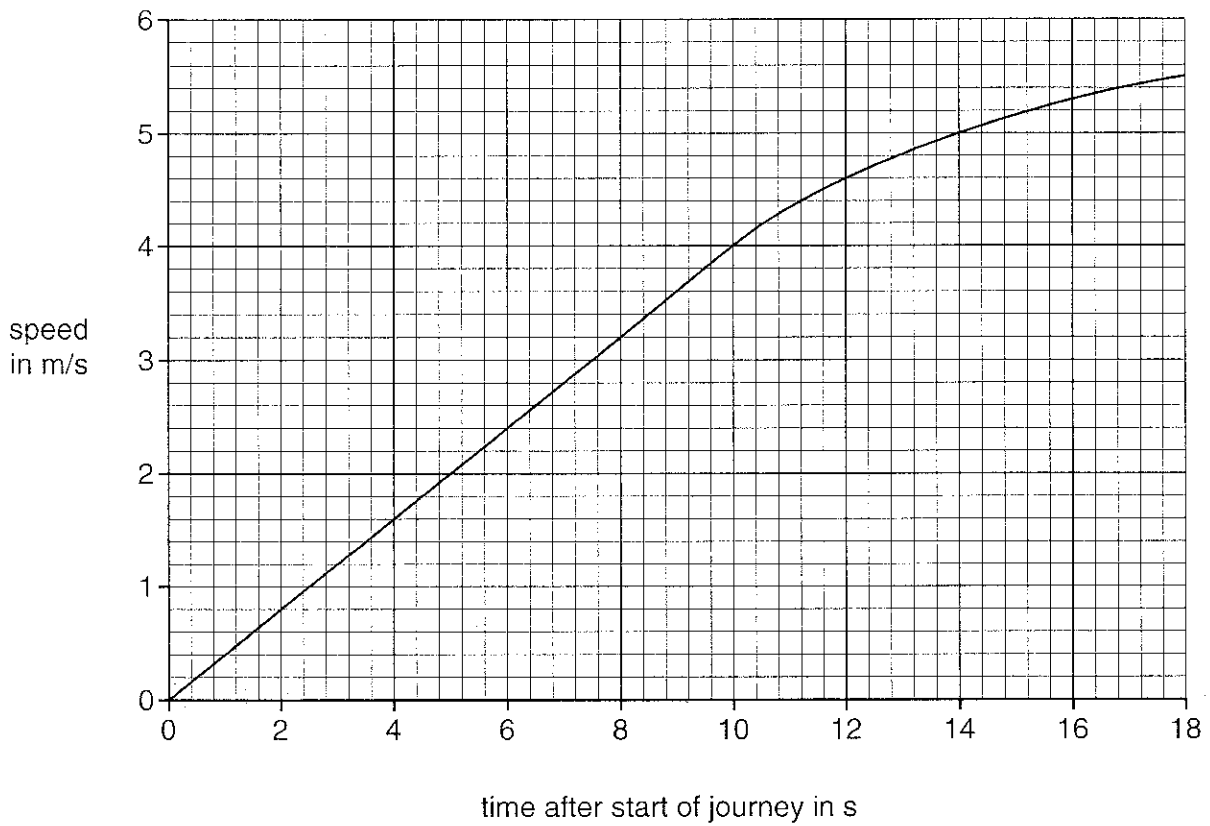frequency .............................................................................................[1]

**(ii)** On the diagram, carefully draw a line to show the edge of the glass sheet that causes the ripples to change direction. [1]

[Total: 15]

**[Turn over**

**5**  Tom cycles to school each morning along a straight flat road.



The graph shows his speed for the first 18 seconds of his journey to school.



time after start of journey in s

**(a)** During the first 8 seconds of the journey, Tom's acceleration was **constant**.

    **(i)** How can you tell this from the graph?

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

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

    ...........................................................................................................................[1]

    **(ii)** Calculate his acceleration during this 8 s period.

    You **must** show how you work out your answer, including any equation used.

                               acceleration = ................... unit ............... [4]

    **(iii)** In the first 8 seconds, Tom travelled about 13 m.

    Describe how this could be worked out using the graph.

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

    ...........................................................................................................................[1]

**(b)** Tom and his bicycle have a combined mass of 60 kg.

    **(i)** Calculate the total kinetic energy of Tom and his bicycle after 10 s.

    You **must** show how you work out your answer and any equation used.

                               kinetic energy = ..................... J [3]

    **(ii)** On another morning, Tom reaches a speed of 1.5 m/s after only 1 second of his journey.
    Calculate the average force needed for Tom to reach this speed after 1 second.

    You **must** show how you work out your answer, including any equation used.
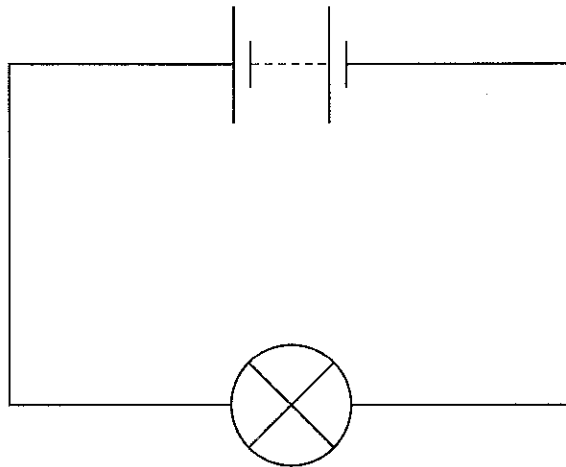
                               force = ..................... N [3]

                                      [Total: 12]

**[Turn over**

**6** This question is about using electricity.

This simple circuit can be used to light a bulb.



**(a)** The current from a battery is **direct current**.

The current from the mains supply is **alternating current**.

Use your ideas about electron movement to explain the **difference** between direct current and alternating current.

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**(b)** The voltage of the battery is 12 V. The current through the bulb is 0.5 A.

Calculate the power transferred to the bulb.

You **must** show how you work out your answer, including any equation used.

power = ........................... unit ............... [4]

**(c)** The circuit is switched on.

Calculate the charge which flows through the bulb in 5 minutes.

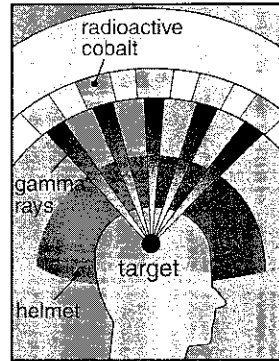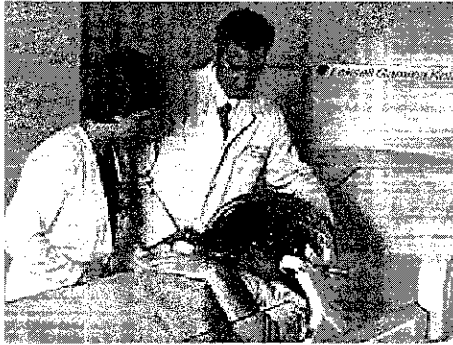You **must** show how you work out your answer, including any equation used.

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

[Total: 10]

**[Turn over**

**7** Jane is being treated for brain cancer.

The equipment being used is called a gamma knife.

Cobalt-60 is used as a source of gamma radiation.

Jane's head is being treated by over two hundred gamma ray beams, directed on the cancer in her brain.



**(a) (i)** What are gamma rays?

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

**(ii)** Alpha radiation and beta radiation are not suitable to use when treating brain cancers.

Why are gamma rays suitable?

..............................................................................................................[1]

**(iii)** Suggest why low intensity beams from all directions around the head are used instead of one intense beam of gamma radiation.

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**(b)** Strontium-90 emits beta particles.

**(i)** Strontium-90 is used to treat cancer in the eye.

Suggest why strontium-90 is used instead of cobalt-60.
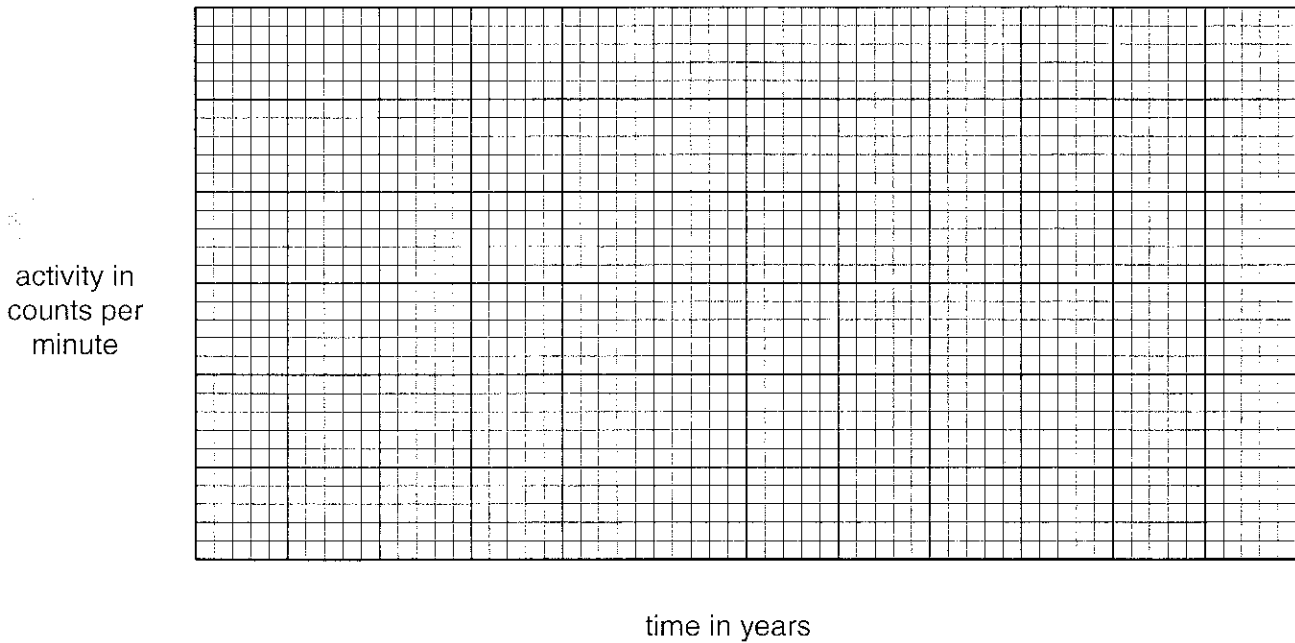
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(ii) The half-life of strontium-90 is 28 years.

Explain what is meant by the term **half-life**.

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(iii) The activity of a sample of strontium-90 is measured as 220 counts per minute.

Plot a graph to show how the activity will change over a period of 90 years.     [4]

activity in
counts per
minute



time in years

(iv) After how many years will the activity be 50 counts per minute?

You **must** show clearly on the graph how you work out your answer.

time = ...................... years  [2]

[Total: 14]

**[Turn over**

**8** This question is about electric motors.

The diagram shows a simple d.c. electric motor.



split ring
commutator

switch

battery
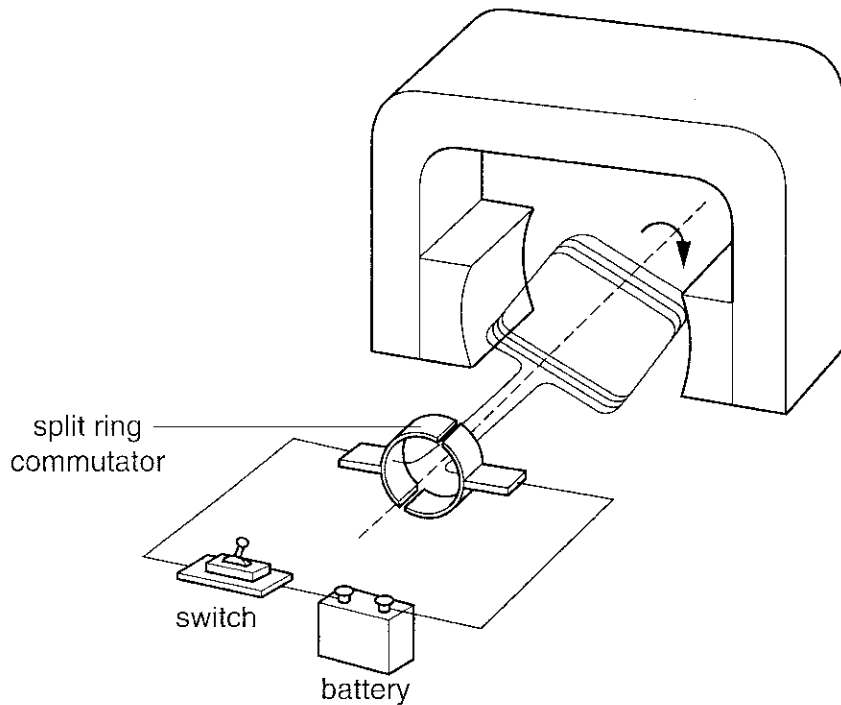
**(a)** What does the **split ring commutator** do to the current flowing in the coil as the motor turns?

How often does this effect happen?

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...............................................................................................................................................[2]
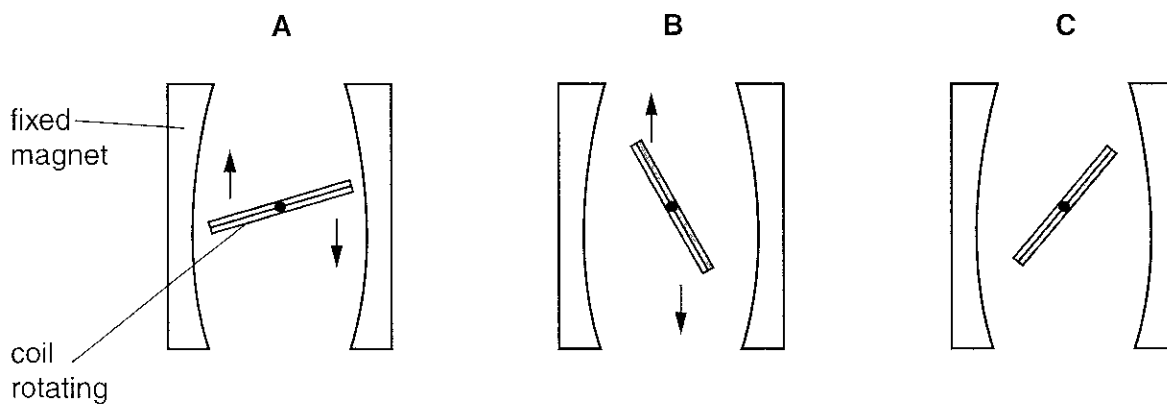
**(b)** The diagrams show the coil in three positions **A**, **B** and **C** as it turns.

**(i)** Draw arrows on diagram **C** to show the direction of the forces on the coil. [1]

A        B        C

fixed magnet

coil rotating

**(ii)** Why do the forces in diagram **A** have more turning effect than the forces in diagram **B**?

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[Total: 5]

**[Turn over**

**9** Here are some recent newspaper headlines about mobile phones.

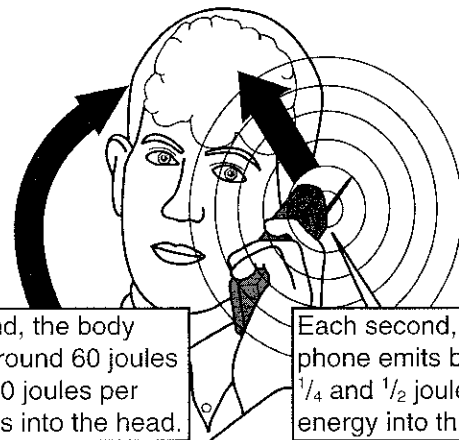| Health risks for children will be investigated | Scientists at a loss to explain unusual symptoms |
| --- | --- |

# Mobile phone kids are on the skids

Read the following passage and look at the diagram carefully. Then use them to help you answer the questions.

There is no conclusive evidence that mobile phones are dangerous. However, some studies suggest that their radiation can have strange effects on the brain. Just like power lines, televisions and computer screens, mobile phones produce electromagnetic radiation. This radiation is in the microwave region of the electromagnetic spectrum.

When microwaves pass into an object, they can excite molecules. This warms up the object. A typical mobile phone transfers between 0.25 and 0.5 joules of energy each second into the head, raising brain temperature by a fraction of a degree.

Each second, the body produces around 60 joules of energy. 20 joules per second pass into the head.

Each second, a mobile phone emits between $1/4$ and $1/2$ joule of energy into the head.

The body produces about 60 joules of energy every second, of which 20 joules passes into the head. The increase in temperature caused by mobile phones is far less than that caused by exercise or sitting in the sun. Headaches while using phones for long periods may, in fact, be caused by bad posture and the heating effect of a warm battery.

It is suggested that microwaves from **analogue** phones speed up the reaction times of people doing multiple choice questions. Some research has found that rats show signs of stress when exposed to electromagnetic waves from mobile phones. Other research suggested that mobile phone radiation changes the signals in rats' brain cells.

**(a)** What region of the electromagnetic spectrum is used in mobile phone transmission?

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**(b)** Use your ideas about analogue and digital signals to explain what is meant by an **analogue** phone.

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

**(c)** The research has not found conclusive evidence that mobile phones are harmful.

**However**, the scientists who did the research have suggested that it would be sensible for people to avoid over-use of mobile phones.

What evidence is there in the passage to support this suggestion?

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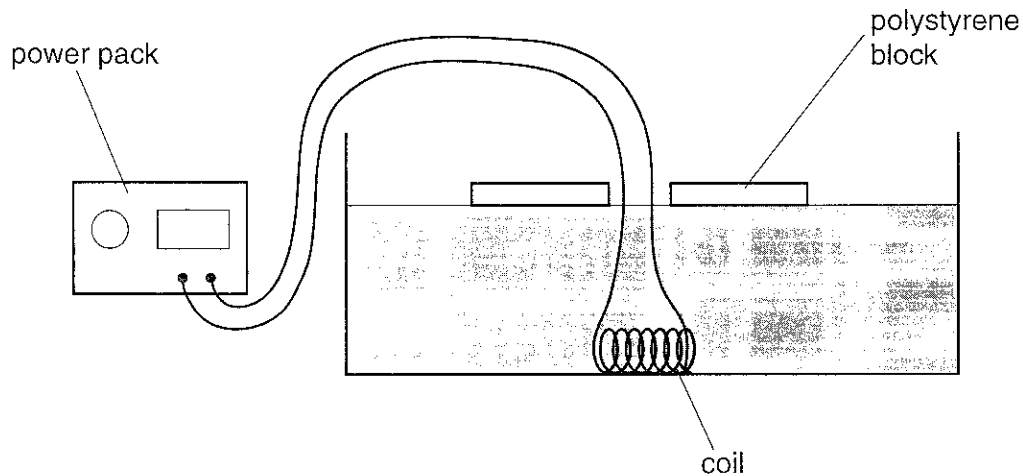
[Total: 6]

**∫Turn over**

**10** This question is about the structure of the Earth.

A science teacher shows her class a demonstration which models the behaviour of the Earth.

She uses a tank of water.

Two blocks of polystyrene are floating on the surface. They are not moving.

An insulated coil of wire at the bottom of the tank is connected to a power pack.



When the power pack is turned on, a current passes through the wire.

Nothing happens for a few moments.

Then, the polystyrene blocks start to move towards the sides of the tank.

**(a)** Use your ideas about convection to explain why this happens.

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**(b)** The diagram shows part of the Earth's structure.

plate

mantle

core

The teacher used the demonstration to help explain ideas about plate tectonics (movement).

In the demonstration, the plates were represented by the polystyrene tiles.

Suggest how the results of the teacher's demonstration support ideas about plate tectonics.

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[Total: 7]