

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
June 2004



**PHYSICS (MODULAR) SPECIFICATION A
HIGHER TIER**

3453/H

Tuesday 22 June 2004 9.00 am to 10.30 am

H

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

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

Time allowed: 1 hour 30 minutes

Instructions

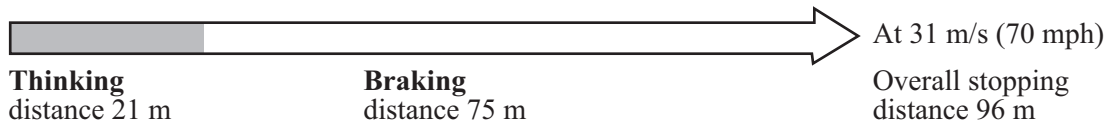
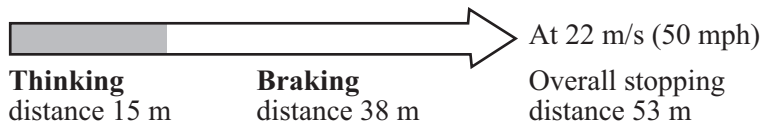
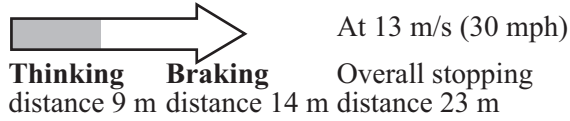
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show all your working in calculations.

Information

- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

FORCES

1 The diagrams below show the total stopping distance of a motorcyclist travelling at different speeds.



(a) Describe how the thinking distance and the braking distance change with the speed of the motorcyclist.

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(2 marks)

(b) (i) Name **two** factors, other than the speed of the motorcycle, which would increase the thinking distance of the motorcyclist.

1.....

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2.....

.....

(2 marks)

(ii) Name **two** factors which would increase the braking distance of the motorcyclist on a wet road.

1.....

.....

2.....

.....

(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 2 A space probe, Beagle 2, was launched in 2003 by the European Space Agency. It is part of the *Mars Express* programme.

The project leader, Professor Colin Pillinger, commented: "Britain has a history of exploring our planet. It is about time we started exploring the other planets as well".

Space probes are designed to send pictures back to Earth, and collect samples of soil and rock.

- (a) Complete the sentence by choosing the correct words from the box.

fossils	hydrogen	iron	sulphur	water
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If scientists found or on Mars, it would indicate that there may be, or once was, life there. (2 marks)

- (b) The sending of probes deep into space is very expensive, and the space flights would take too long. For over forty years, a *SETI* team in the USA has been monitoring signals coming from space.

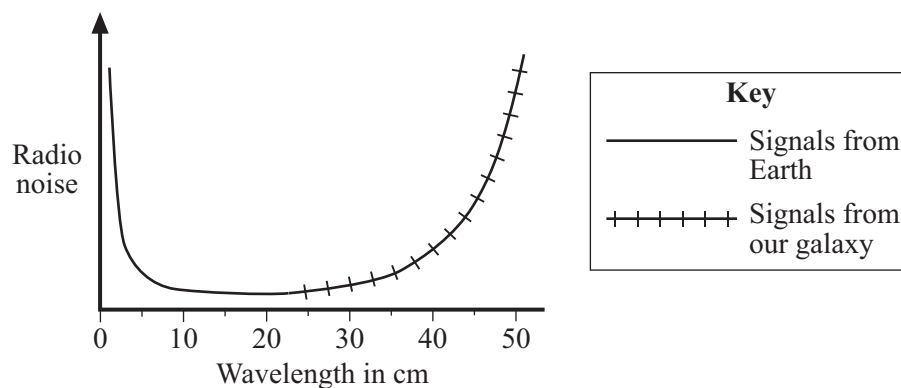
- (i) What is *SETI*?

.....
(1 mark)

- (ii) What piece of equipment does a *SETI* team use?

.....
(1 mark)

- (iii) The graph shows radio noise, of various wavelengths, detected by a *SETI* team.



Choose a range of wavelengths from the box to complete the sentence.

0 – 5	10 – 20	30 – 40	40 – 50
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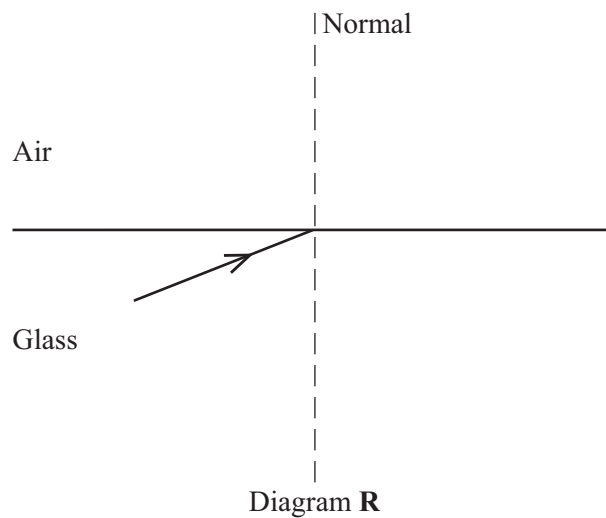
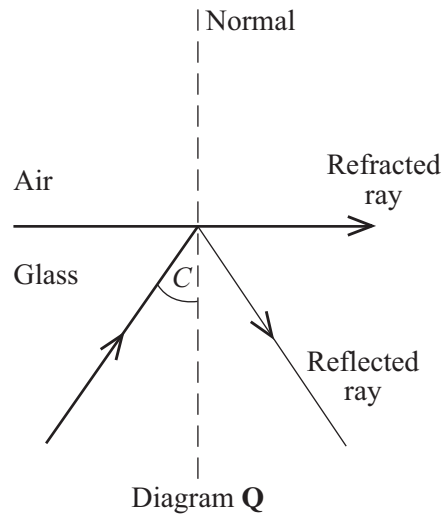
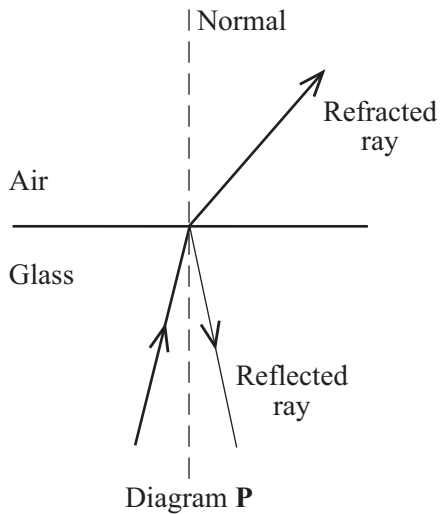
To monitor signals coming from space, the *SETI* team would investigate radio signals with wavelengths in the range cm. (1 mark)

WAVES AND RADIATION

- 3 (a) The diagrams show three different rays hitting the boundary between glass and air. The rays hit the boundary at different angles.

Complete diagram **R** to show what happens to the ray of light after it hits the boundary.

(1 mark)

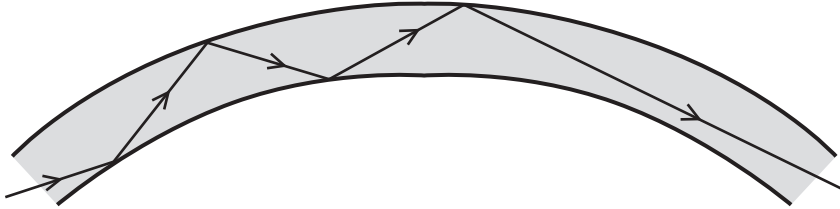


QUESTION 3 CONTINUES ON THE NEXT PAGE

Turn over ►

(b) Information can be carried by light travelling along optical fibres.

The diagram shows a ray of light travelling through an optical fibre.



(i) Name the process by which the ray of light travels through the fibre.

.....
(1 mark)

(ii) Explain, as fully as you can, why information is sent by means of light travelling along optical fibres, rather than by electrical signals in metal cables.

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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(2 marks)

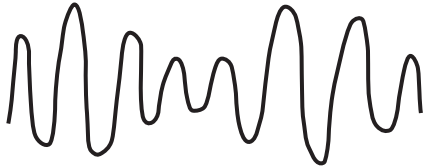
(c) The diagrams show four types of signal, **L**, **M**, **N** and **P**.



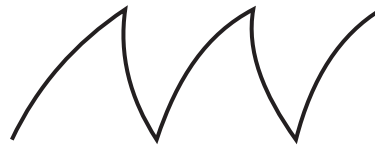
L



M



N



P

(i) Which of the signals, **L**, **M**, **N** or **P**, is a digital one?
(1 mark)

(ii) Explain, as fully as you can, why information is often sent as digital signals, rather than as analogue ones.

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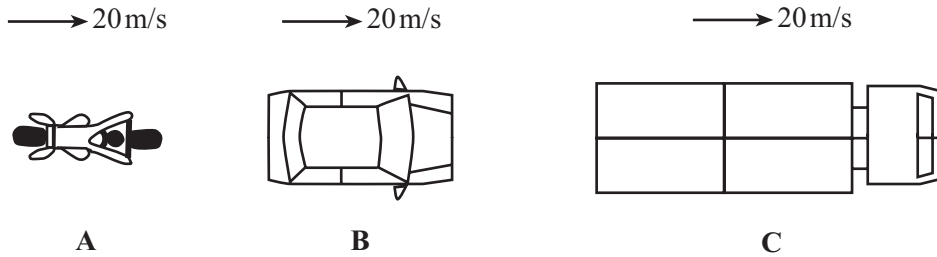
(2 marks)

TURN OVER FOR THE NEXT QUESTION

Turn over ►

FORCES AND MOTION

- 4 (a) The diagram shows three vehicles, **A**, **B** and **C**, travelling along a road at 20 m/s.



Which vehicle, **A**, **B** or **C**, has the greatest momentum?

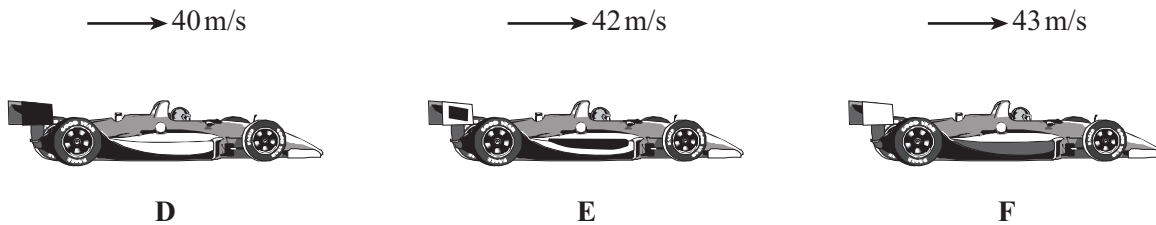
Give the reason for your answer.

Vehicle:.....

Reason:

.....
(2 marks)

- (b) The next diagram shows three racing cars, **D**, **E** and **F**, all with the same mass, travelling at different speeds along the straight part of the track.



Which racing car, **D**, **E** or **F**, has the greatest momentum?

Give the reason for your answer.

Vehicle:.....

Reason:

.....
(2 marks)

(c) Racing car **D** has a mass of 1250 kg.

Calculate its momentum.

Write down the equation you are going to use.

.....
(1 mark)

Show clearly how you work out your answer, and include the unit.

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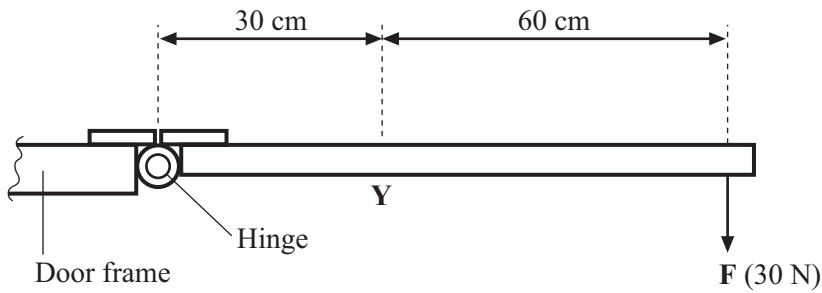
Momentum =
(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 5 The diagram shows an overhead view of a door.
The door is fixed to the door frame by a hinge. It can be opened by applying a force of 30 N.



- (a) (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 of the force, **F**, in the diagram.

Show clearly how you work out your answer.

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Moment = Ncm
(2 marks)

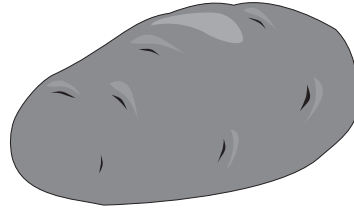
- (b) Someone pushes the door open by applying a force at **Y**. The force needed to open the door is **not** 30 N. Explain why the force needed to open the door is different.

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(2 marks)

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

6 The drawing shows a hot baked potato.



(a) The amount of energy radiated by the potato depends on the size and nature of its surface. What else affects the amount of energy radiated by the potato?

.....
(1 mark)

(b) Cooks often keep hot potatoes in shiny foil.

Explain why.

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

(c) When potatoes, wrapped in foil, are cooked on a barbecue, the foil goes black.

What effect does this have on the temperature of the potatoes when they are taken off the barbecue, compared with that of hot potatoes in clean shiny foil?
Give a reason for your answer.

Effect:

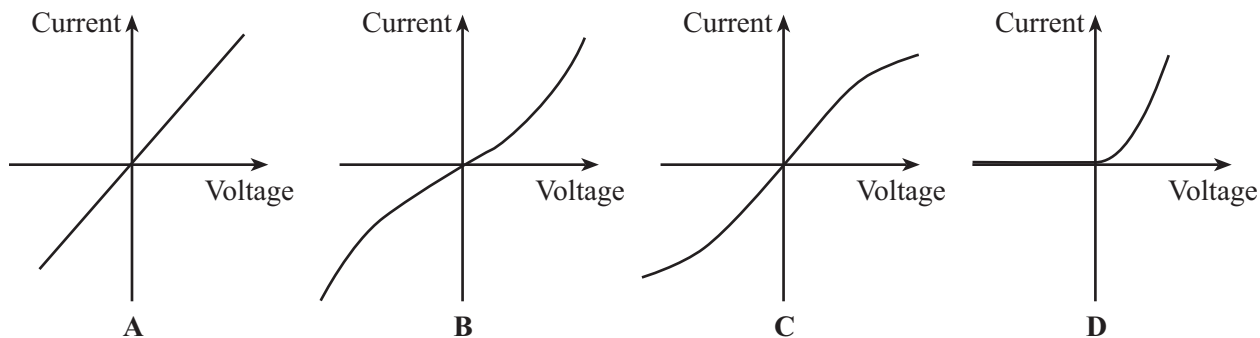
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Reason:

.....

(2 marks)

7 The graphs A, B, C and D show how the current through a component varies with the potential difference (voltage) across it.



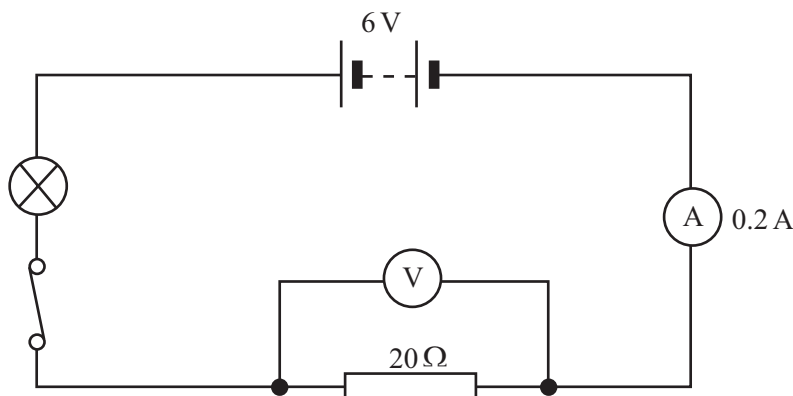
(a) Which graph, A, B, C or D, represents:

(i) a diode;

(ii) a filament lamp?

(2 marks)

(b) The diagram shows a simple circuit.



(i) Write down an equation used to calculate potential difference.

.....
(1 mark)

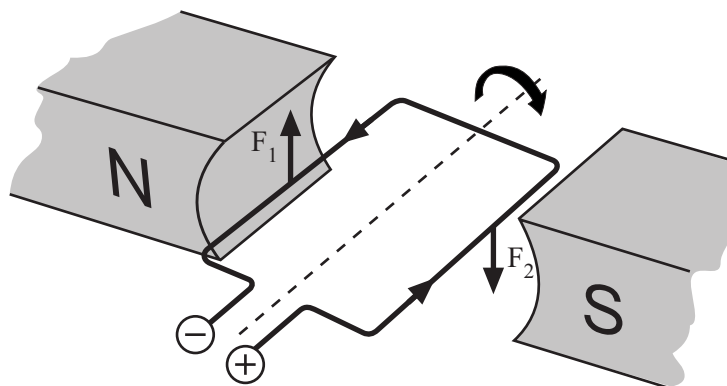
(ii) Calculate the reading on the voltmeter.

Show clearly how you work out your answer.

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Voltmeter reading = V
(2 marks)

8 The diagram shows a simple electric motor.



Source: adapted from KEITH JOHNSON, *Physics for You* (Stanley Thornes) 1996

The coil turns as shown in the diagram.

(a) State **two** ways of reversing the direction of forces F_1 and F_2 .

- 1
-
- 2
-

(2 marks)

(b) Give **two** ways in which the size of the forces can be increased.

- 1
-
- 2
-

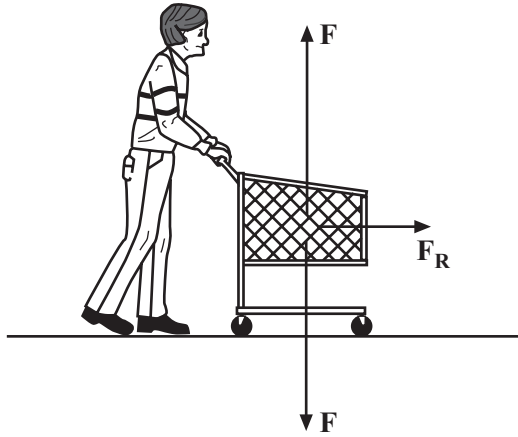
(2 marks)

4

Turn over ►

FORCES

9 The diagram shows a person pushing a supermarket trolley, and the forces acting on the trolley.



- (a) The mass of the trolley is 20 kg.
The resultant forward force, F_R , is 5 N.

Calculate the acceleration of the trolley.

Show clearly how you work out your answer.

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Acceleration = m/s²
(3 marks)

- (b) (i) The trolley starts from rest.

Calculate the speed of the trolley after 8 seconds.

Show clearly how you work out your answer.

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Speed = m/s
(3 marks)

(ii) Calculate the kinetic energy of the trolley after 8 seconds.

Show clearly how you work out your answer.

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Kinetic energy = J
(2 marks)

8

10 When a star “dies”, a *black hole* may be formed.

(a) Describe, as fully as you can, a *black hole*.

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(3 marks)

(b) *Black holes* cannot be seen.

How can they be detected?

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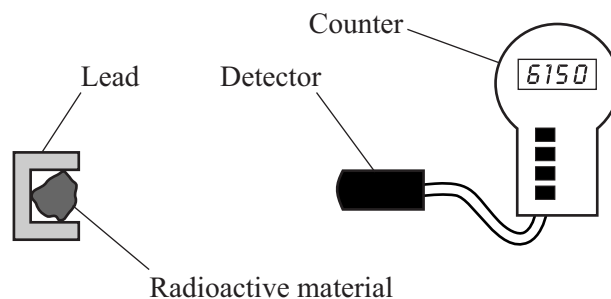
(3 marks)

6

Turn over ►

WAVES AND RADIATION

11 The diagram shows a radioactive material in front of a detector.

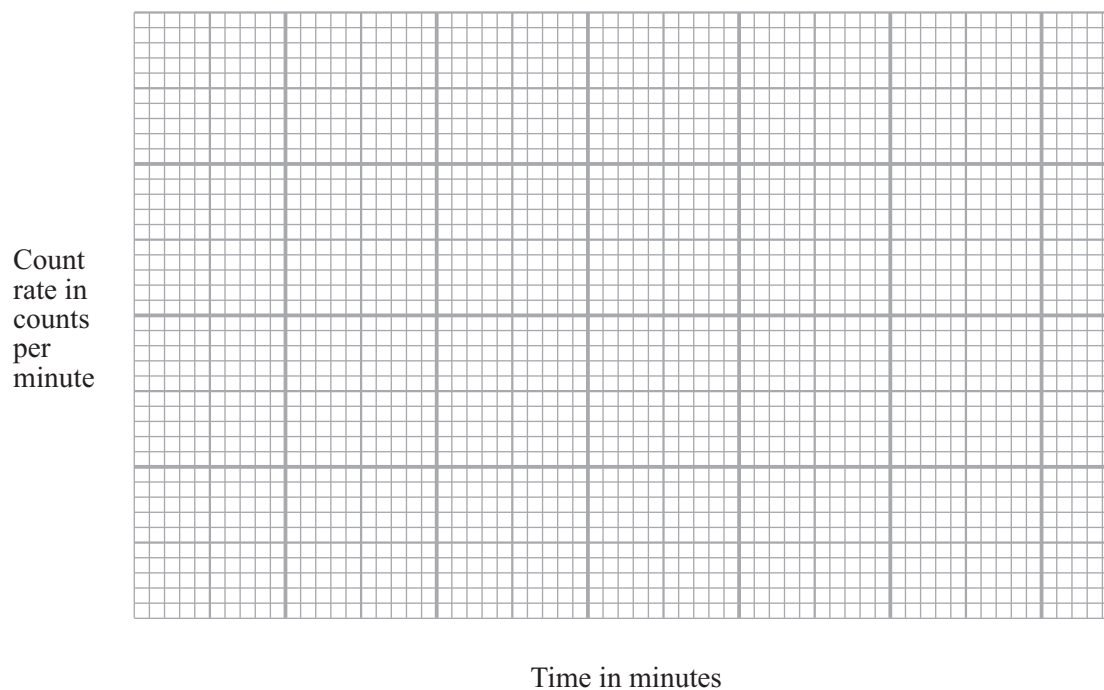


A student measures the count rate after different intervals of time.

The results are given in the table below.

Time in minutes	0	10	20	30	40	50	60
Count rate in counts per minute	6400	4040	2550	1600	1016	650	400

(a) (i) Plot a suitable graph of count rate against time.



(3 marks)

(ii) Use the graph to determine the half-life of the radioactive material.

.....

(1 mark)

(b) The table gives the half-lives of some radioactive sources, **A**, **B**, **C** and **D**. It also gives the type of radiation emitted.

Radioactive source	Half-life	Radiation emitted
A	200 years	alpha
B	6 hours	beta
C	20 years	beta
D	5 years	gamma

Which of the radioactive sources, **A**, **B**, **C** or **D**, would be most suitable to use for the following?

Give a reason for your answer.

(i) As a medical tracer injected into the body.

Radioactive source:

Reason:

.....

(2 marks)

(ii) To kill cancerous cells by focusing two beams of the radiation at a tumour.

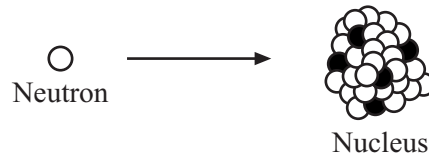
Radioactive source:

Reason:

.....

(2 marks)

- 12 In nuclear reactors, atoms which have large unstable nuclei, such as uranium-235, are bombarded with neutrons.
The diagram shows a neutron approaching a large unstable nucleus.



Describe, as fully as you can, what happens when the neutron hits the nucleus.

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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(4 marks)



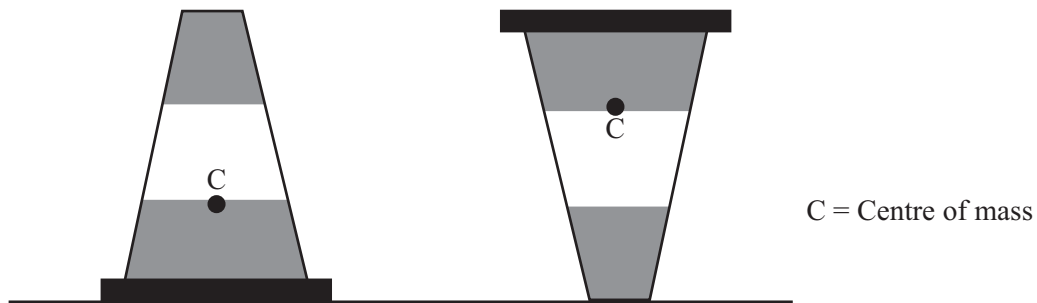
NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

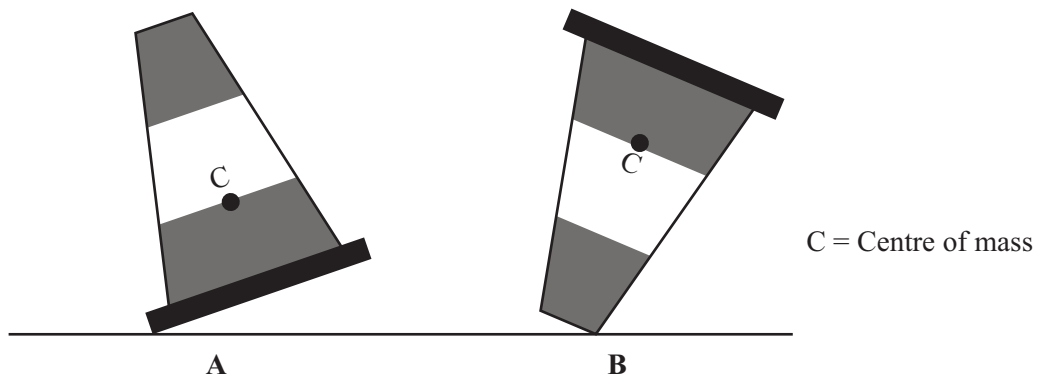
Turn over ►

FORCES AND MOTION

- 13 The diagrams show two traffic cones.
In the first diagram, the cones are balanced.



In the second diagram, the cones have been tilted.



- (a) Describe and explain what happens to the tilted cone A when released from this position.

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(3 marks)

(b) Describe and explain what happens to the tilted cone **B** when released from this position.

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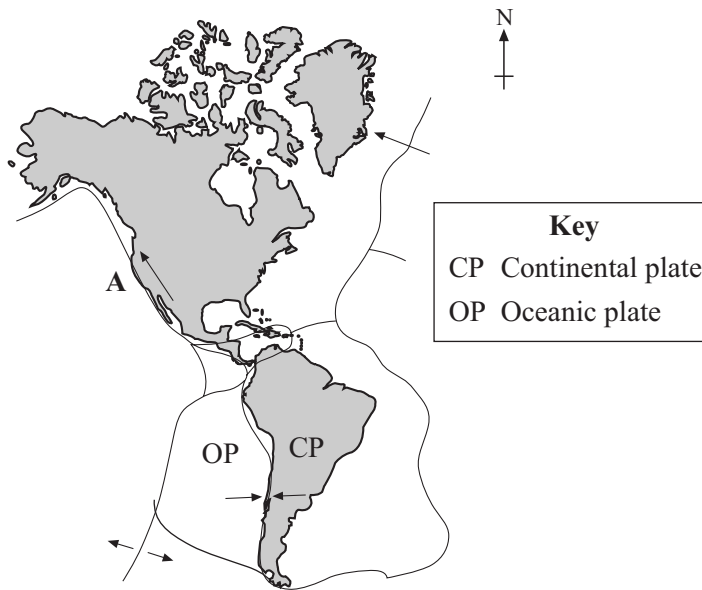
(3 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 14 The map shows some of the Earth’s tectonic plates in North and South America. It also shows the directions in which the plates are moving.



Source: WITNEY, DROZDOWSKA & MAILE, *Waves* (Hodder & Stoughton) 2002 adapted and reprinted by permission of Hodder Arnold.

- (a) The map shows the San Andreas fault, labelled **A**, where plates move past each other.

What is likely to occur along faults such as this?

.....
(1 mark)

- (b) Off the west coast of South America two plates are moving towards each other.

- (i) What happens to the oceanic plate?

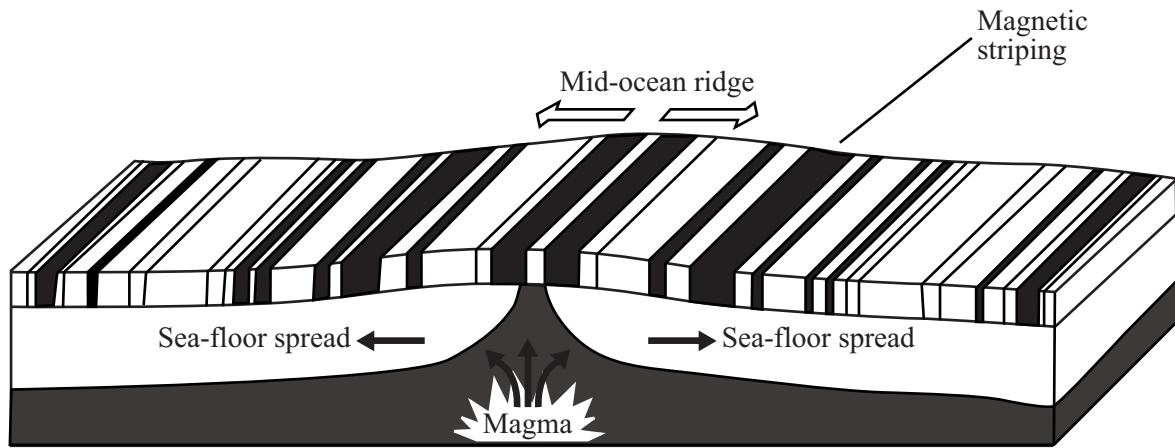
.....
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(2 marks)

- (ii) What happens to the continental plate?

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(2 marks)

- (c) In 1912, Alfred Wegener put forward a theory suggesting that the continents had drifted apart. The scientists of that time believed that continents could not move. In the 1950s, surveys of the ocean floor showed a huge mountain range.

The diagram shows the structure of the mountain range.



- (i) Explain how the mountain range is thought to have formed.

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(2 marks)

- (ii) Explain how the magnetic stripes convinced scientists to accept Wegener's theory.

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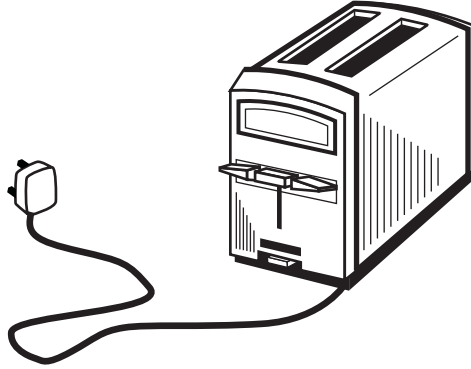
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(2 marks)

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

- 15 The drawing shows an electric toaster which takes a current of 3 A from the 230 V mains supply.



- (a) Calculate the resistance of the heating element.

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Resistance = ohms
(2 marks)

- (b) The drawing shows a hair dryer designed to run from the 230 V mains supply.



The resistance of the device is 45 ohms.

Calculate the current taken from the mains.

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Current = A
(2 marks)

END OF QUESTIONS

4

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