Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

Leave blank

General Certificate of Secondary Education
June 2003

PHYSICS (MODULAR) SPECIFICATION A 3453/H
HIGHER TIER

Tuesday 17 June 2003 9.00 am to 10.30 am

H

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

Time allowed: 1 hour 30 minutes

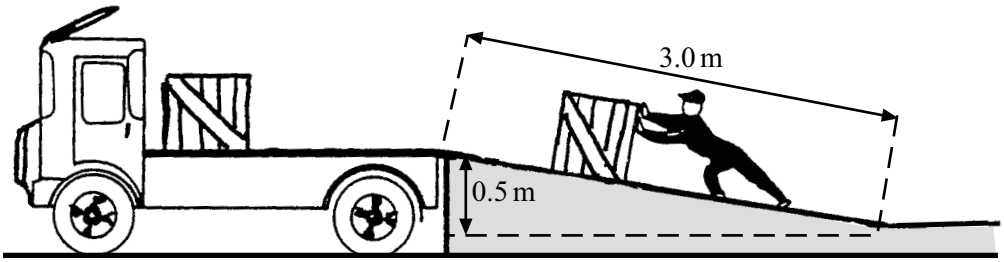
Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show all your working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

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

FORCES

1 The diagram shows a person pushing a crate up a slope on to a lorry.



(a) The person pushes the crate along the slope with a force of 200 N.

Calculate the work done pushing the crate along the slope.

Write down the equation you are going to use.

.....

(1 mark)

Show clearly how you work out your final answer.

.....

.....

.....

.....

Work done = ... J

(2 marks)

(b) The mass of the crate is 60 kg.

(i) Calculate the approximate weight of the crate.

Show clearly how you work out your final answer.

.....

.....

.....

.....

Weight = ... N

(2 marks)

(ii) Explain why more energy is transferred by pushing the crate along the slope than by lifting the crate the vertical distance 0.5 m.

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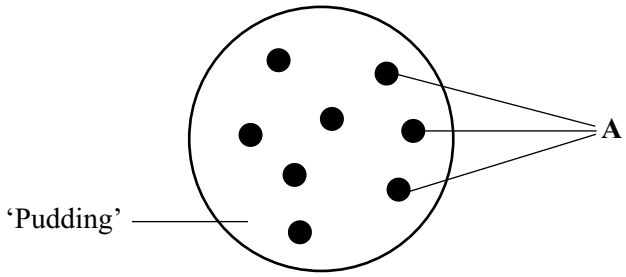
(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

WAVES AND RADIATION

2 The diagram shows the 'plum pudding' model of an atom.



(a) Scientists thought that the 'pudding' was positively charged.

(i) Name the particles labelled **A** in the diagram.

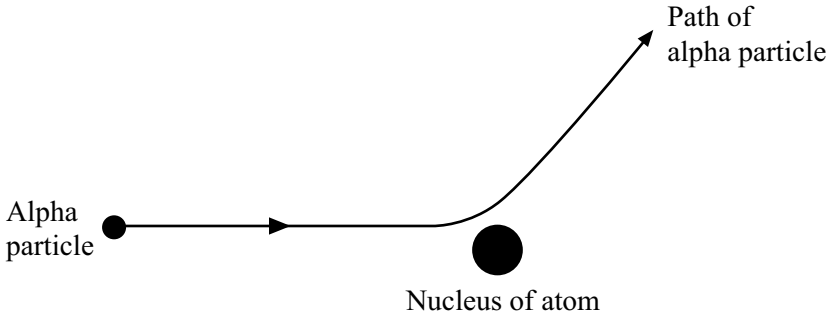
..... *(1 mark)*

(ii) Complete this sentence by choosing the correct words from the box.

negatively charged	**positively charged**	**uncharged**

The particles labelled **A** are .....
(1 mark)

(b) A new model of an atom was suggested by Rutherford and Marsden.
They fired alpha particles at thin metal foil.
Alpha particles are positively charged.
In their model each atom has a nucleus.
The diagram below shows the path of an alpha particle as it passes the nucleus of an atom.



(i) Explain why the alpha particle changes direction.

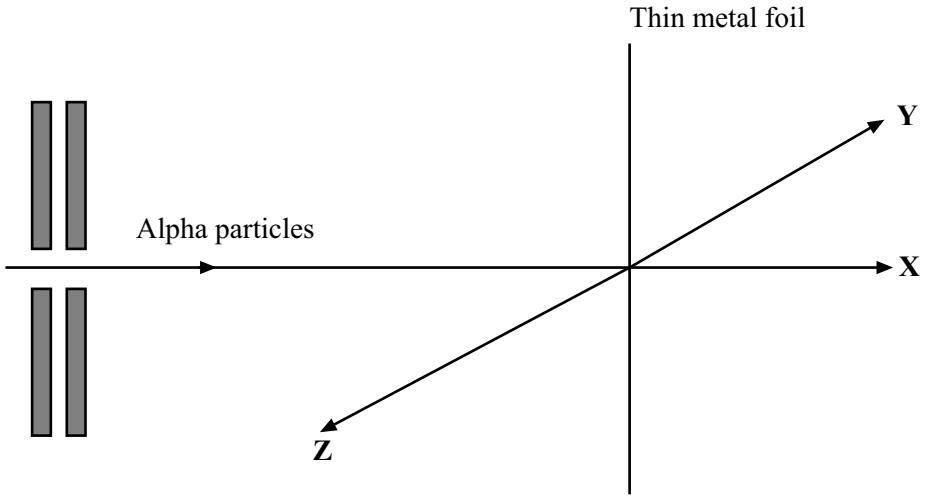
.....

.....

.....

.....
(2 marks)

(ii) The diagram shows different paths taken by alpha particles when they were fired by Rutherford and Marsden at the thin metal foil.



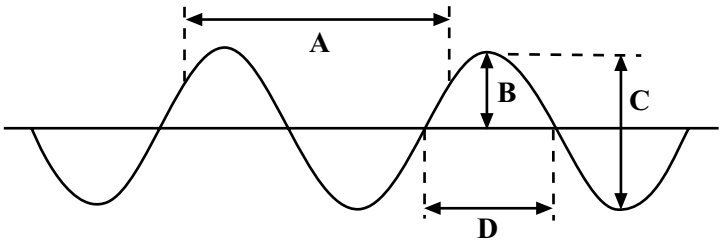
The boxes on the left show some observations from the experiment.
The boxes on the right give their explanations.
Draw a straight line from each observation to its explanation.
One has been done for you.

Observation	Explanation
some alpha particles travel along path **Y**	because the nucleus has a very large positive charge and a large mass
most of the alpha particles follow path **X**	because the nucleus is very small
some alpha particles rebound backwards along path **Z**	because most of each atom is empty space
very few alpha particles follow path **Z**	because the nucleus is positively charged

(2 marks)

6

3 The diagram shows a transverse wave.



(a) Which of **A**, **B**, **C** or **D** is:

(i) the wavelength; .....

(ii) the amplitude? .....

(2 marks)

(b) Light waves carry different information to sound waves.

Give **two** other ways in which light waves are different to sound waves.

.....

.....

.....

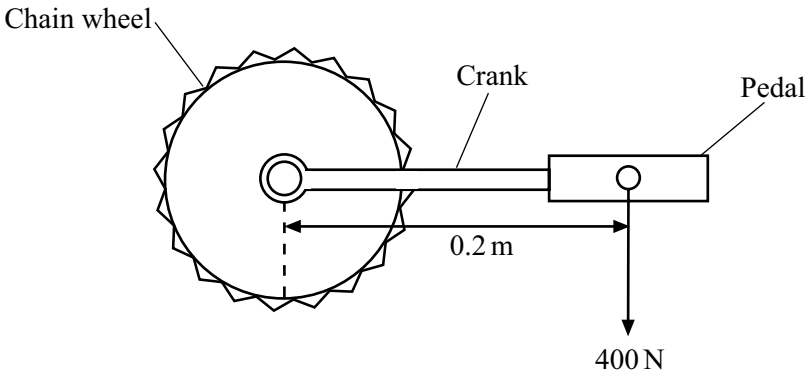
.....

(2 marks)

4

FORCES AND MOTION

4 The diagram shows a bicycle pedal, crank and chain wheel.



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

..... = ...

x perpendicular

.....

between line of action and pivot.

(1 mark)

(ii) Calculate the turning effect of the force shown in the diagram.

.....

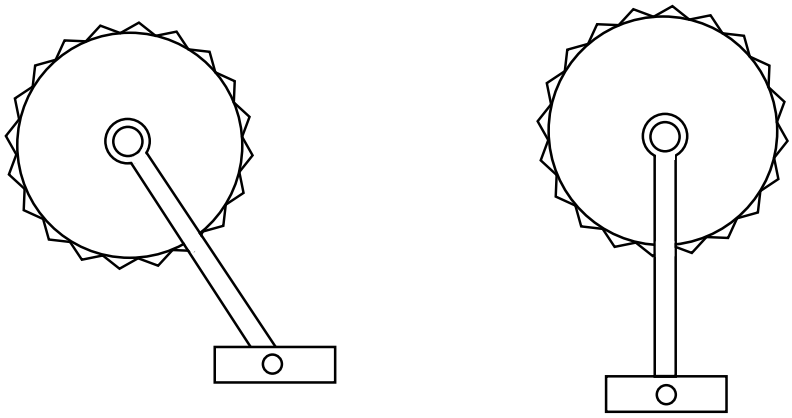
.....

.....

Turning effect = ... N m

(2 marks)

(b) These diagrams show two other positions of the pedal.



The cyclist keeps the size and direction of the force constant.
Explain why the turning effect changes as the cyclist pedals the bicycle.

.....

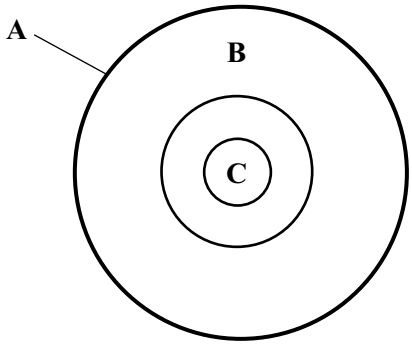
.....

(1 mark)

4

TURN OVER FOR THE NEXT QUESTION

5 The diagram shows a cross-section through the Earth.



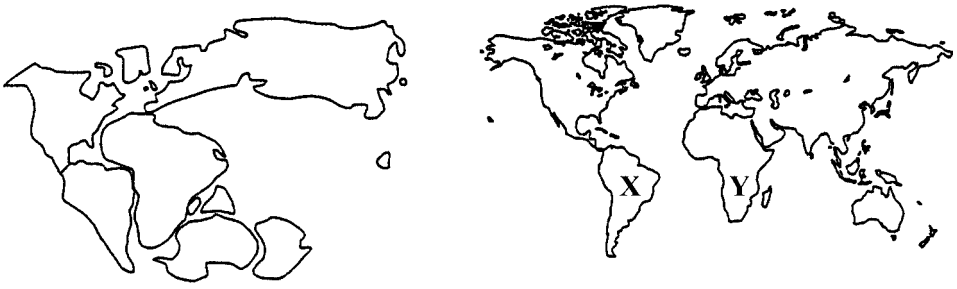
(a) Name the parts labelled **A**, **B** and **C**.

A .....

B .....

C ..... *(3 marks)*

(b) The diagrams show where we think the continents were 200 million years ago, and where they are today.



200 million years ago **Today**

What evidence suggests that **X** and **Y** were once joined?

.....

.....

.....

.....

(2 marks)

(c) The Earth's lithosphere is cracked into a large number of pieces.
These pieces are constantly moving.

(i) What are these pieces called?

.....

(1 mark)

(ii) What types of destructive event may occur at the boundaries between the pieces?

.....

.....

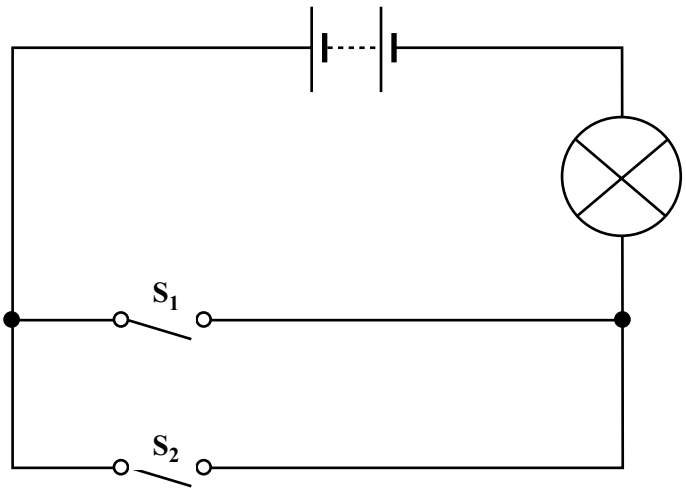
(2 marks)

8

TURN OVER FOR THE NEXT QUESTION

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

6 (a) The circuit contains a lamp and two switches, S_1 and S_2.



(i) Complete the truth table for the above circuit.

Switch S_1	Switch S_2	Lamp
OFF (0)	OFF (0)	OFF (0)
ON (1)	OFF (0)	
OFF (0)	ON (1)	
ON (1)	ON (1)	

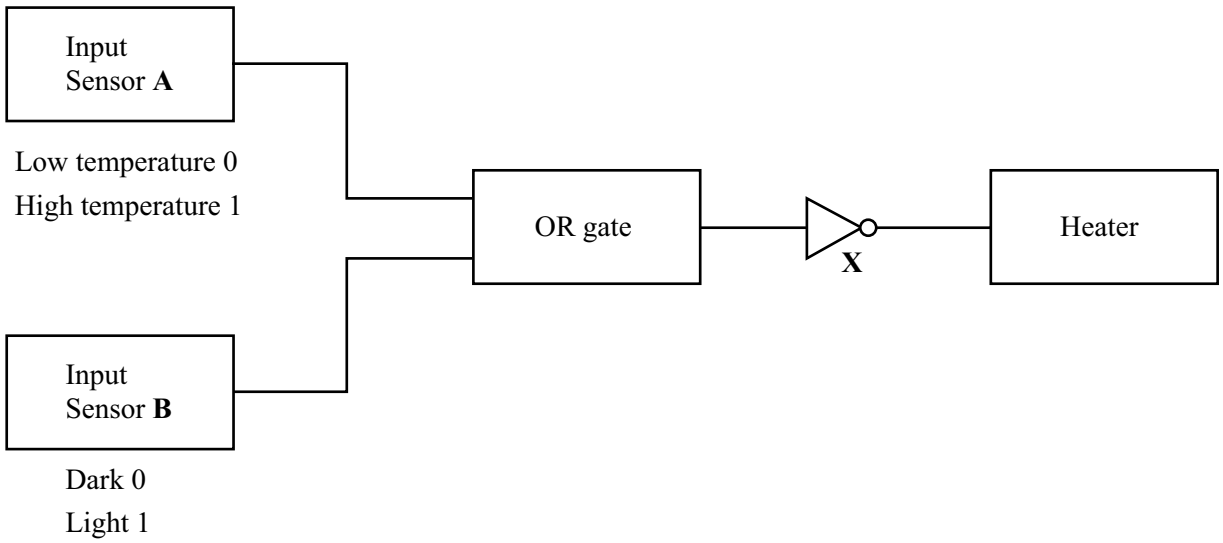
(1 mark)

(ii) Which type of logic gate produces this truth table?

.....

(1 mark)

(b) The diagram shows an electronic system used to switch on a heater in a greenhouse.



What is:

(i) **X**; .....

(ii) input sensor **A**; .....

(iii) input sensor **B**? .....

(3 marks)

(c) When will the heater be ON?

Explain your answer.

.....

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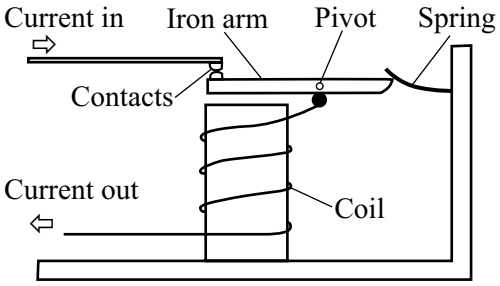
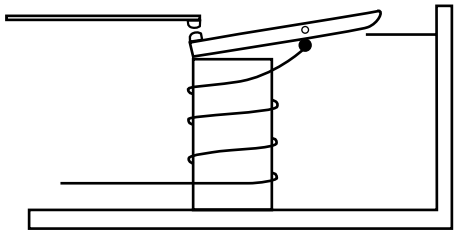
(3 marks)

8

7 The diagrams show a circuit breaker.



Normal current



Current larger than normal

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, as fully as you can, how the circuit breaker works.
The explanation has been started for you.

When current flows through the coil, it becomes .....

.....

.....

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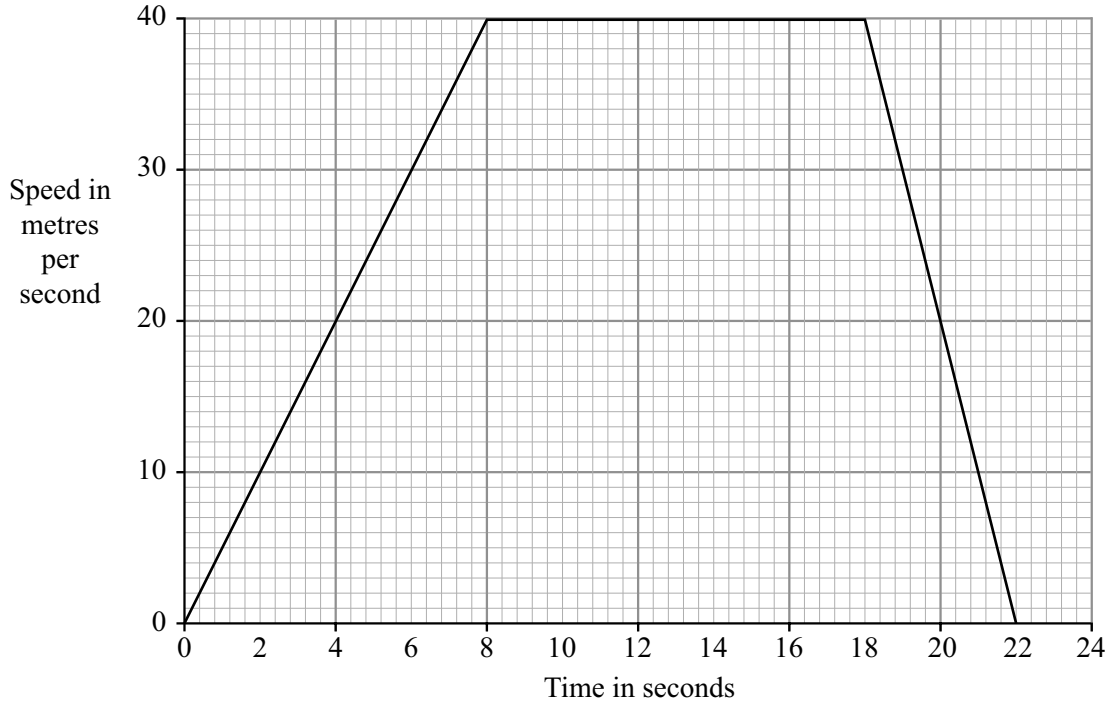
(4 marks)

4

FORCES

8 A car travels on a long straight road.
The graph shows how the speed of the car changes with time.



(a) Calculate the acceleration of the car during the first 8 seconds.
Show clearly how you work out your final answer and give the unit.

.....

.....

.....

.....

Acceleration = ...
(4 marks)

(b) Calculate the distance travelled, in metres, between 18 and 22 seconds.
Show clearly how you work out your final answer.

.....

.....

.....

.....

Distance = ... m
(3 marks)

7

Turn over ▶

9 The "big bang" theory is one theory of the origin of the Universe.

(a) Explain what is meant by the "big bang" theory.

.....

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(2 marks)

(b) One piece of evidence for the "big bang" theory is "red-shift".

(i) What is "red-shift"?

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(1 mark)

(ii) Explain how "red-shift" leads to the "big bang" theory.

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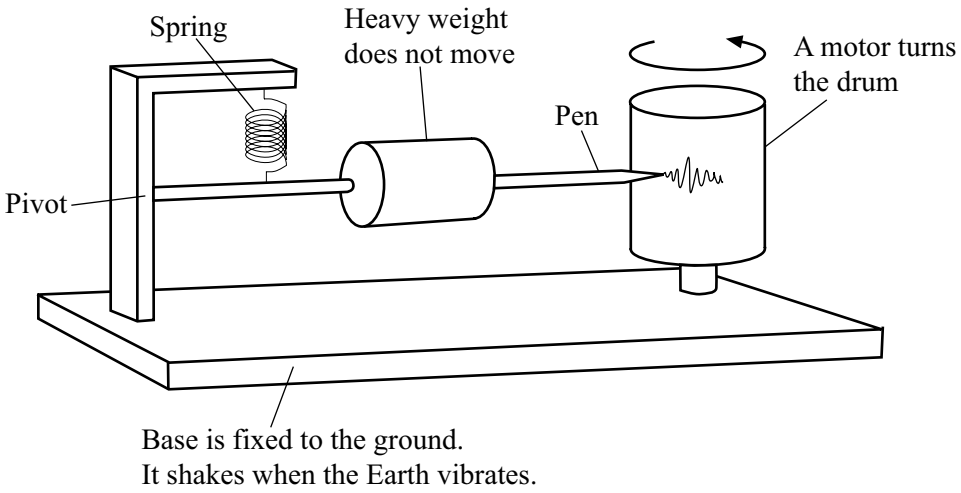
(4 marks)

7

WAVES AND RADIATION

10 The drawing shows how seismic waves (shock waves from earthquakes) are recorded.



Source: KEITH JOHNSON, *Physics for You Support Pack* (Stanley Thornes) 1996

(a) Two types of wave, **P** and **S**, travel from the earthquake through the Earth.

State the differences between **P** and **S** waves.

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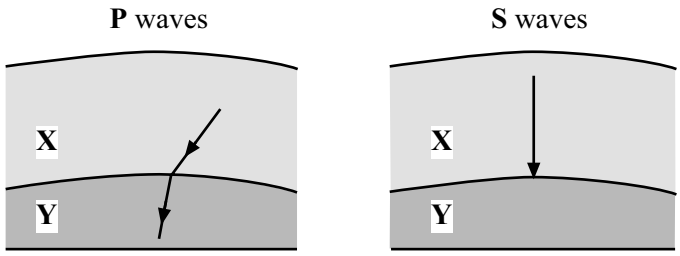
(3 marks)

(b) The diagrams show **P** and **S** waves meeting the boundary between two layers of the Earth.



(i) What happens to the **P** waves at the boundary?

.....

(1 mark)

(ii) Explain what the behaviour of the **P** and **S** waves at the boundary tells you about layer **X** and layer **Y**.

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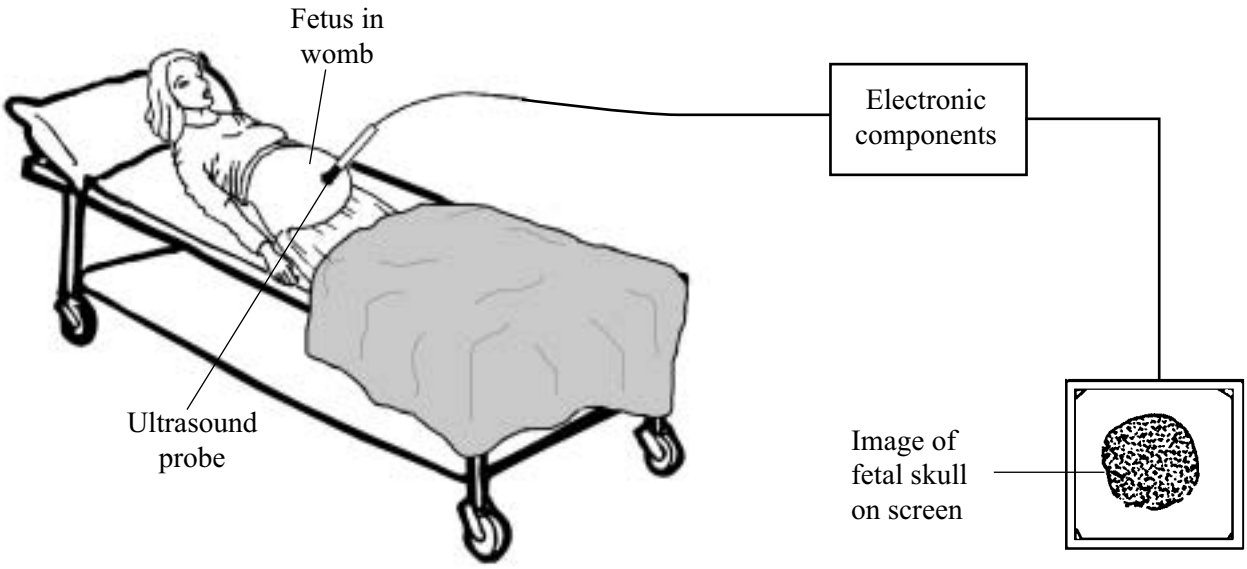
(3 marks)

7

TURN OVER FOR THE NEXT QUESTION

11 The drawing shows a scan being carried out on a pregnant woman.
The scanner uses ultrasonic waves to check on the progress of the fetus.



(a) The frequency of the ultrasonic waves is 3 MHz (3 000 000 Hz).
These ultrasonic waves travel at a speed of 1500 m/s in the human body.

(i) Calculate the wavelength of the ultrasonic waves.
Write down the equation you are going to use. Show clearly how you work out your final answer and give the units.

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Wavelength = ...
(4 marks)

(ii) Explain how ultrasonic waves produce an image of the fetus.

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(3 marks)

(b) Explain, as fully as you can, why X-rays are not used for pre-natal scans.

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(3 marks)

10

TURN OVER FOR THE NEXT QUESTION

FORCES AND MOTION

12 The drawing shows a tennis racket hitting a ball.

(a) The ball has a mass of 0.06 kg.
The racket is in contact with the ball for 0.03 s.
The force exerted by the racket on the ball is 130 N.

(i) Write down the equation which links change in momentum, force and time.

.....

(1 mark)

(ii) Calculate the velocity of the ball, in m/s away from the racket.
You should assume that the ball is stationary when it is hit.
Show clearly how you work out your final answer.

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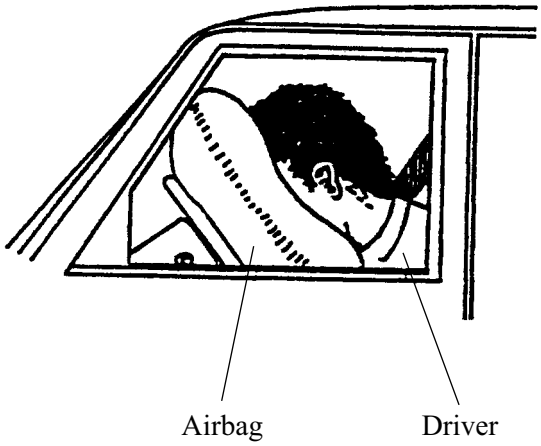
Velocity of ball = ... m/s away from the racket

(3 marks)

(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.*

Many cars are fitted with airbags.
In a crash the airbags inflate.



Use the idea of momentum to explain, as fully as you can, why airbags reduce injuries to the driver.

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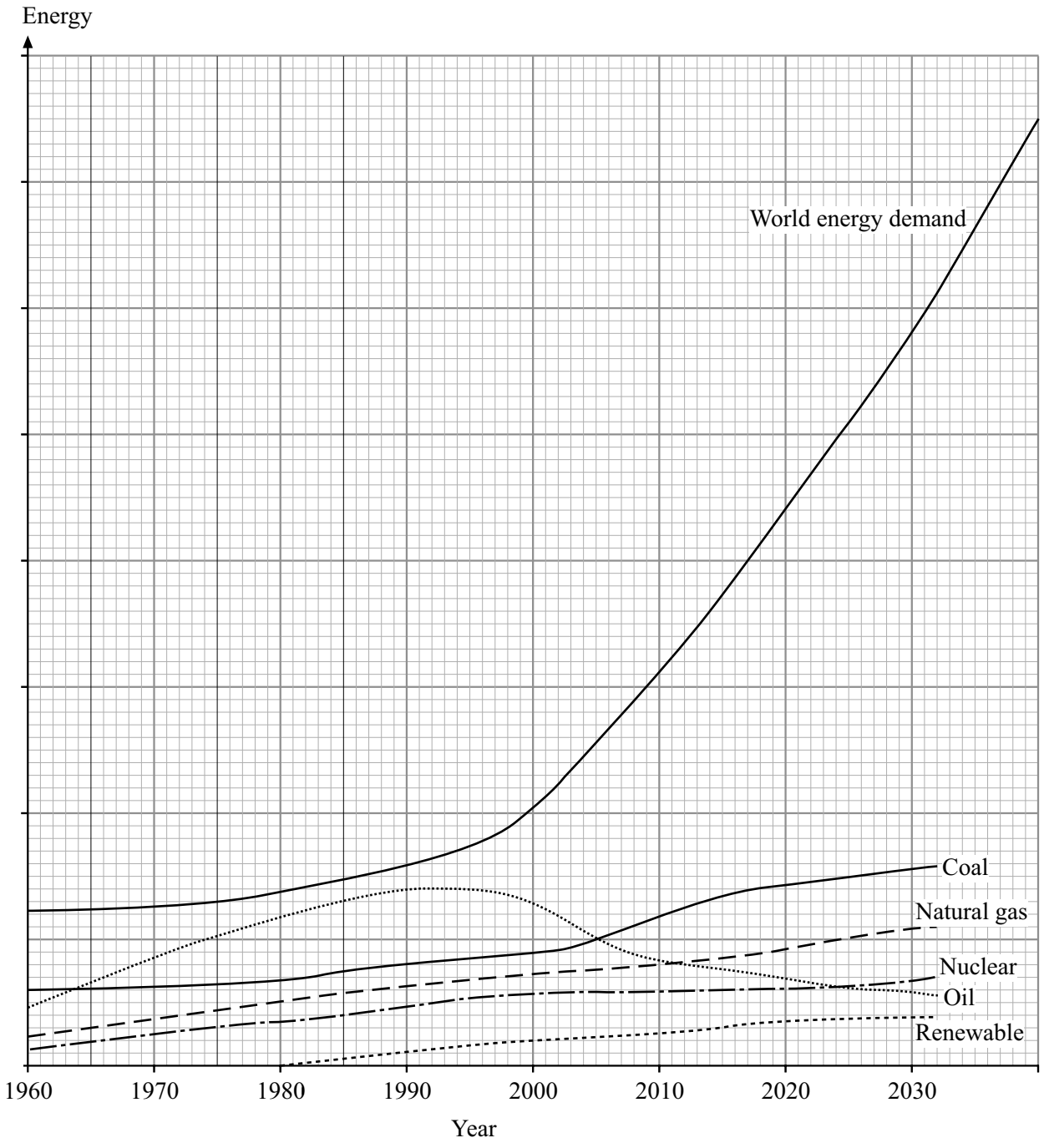
(3 marks)

7

TURN OVER FOR THE NEXT QUESTION

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

13 The graph shows the expected change in the world demand for energy.
It also shows how the supplies of various energy resources are expected to change.



(a) The supply of energy from oil is decreasing.
The supply from coal is increasing.

(i) Why is this a problem for the environment?

.....

.....

(1 mark)

(ii) Use the graph to estimate when supplies from oil and coal will be equal.

.....

(1 mark)

(b) We have relied on fossil fuels to supply most of our energy needs.
Use the graph to explain why:

(i) there could be a supply problem in the future;

.....

.....

.....

(1 mark)

(ii) we must find alternative energy resources.

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.....

.....

(1 mark)

(c) On average, the energy use of each family in the UK releases over 25 tonnes of carbon dioxide and 4 kilograms of sulphur dioxide into the air every year.

(i) State **one** environmental effect which is increased by releasing carbon dioxide into the atmosphere.

.....

(1 mark)

(ii) State a different environmental effect caused by releasing sulphur dioxide into the atmosphere.

.....

(1 mark)

QUESTION 13 CONTINUES ON THE NEXT PAGE

(d) Electricity may be generated using nuclear fuels.

Apart from the cost of the electricity, what are the advantages and disadvantages of doing this?

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(5 marks)

11

END OF QUESTIONS