Centre No.						Surname	Initial(s)
Candidate No.						Signature	

Paper Reference(s)

4420/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Wednesday 1 November 2006 – Morning

Time: 2 hours

Question Number	Leave Blank
1	
2	
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15	
16	
17	
18	
Total	

Materials required for examination
Ruler, protractor, compasses, pencil and calculator

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer **ALL** the questions in the spaces provided in this question paper.
Show all the steps in any calculations and state the units.
Calculators may be used.

Information for Candidates

The total mark for this paper is 120. The marks for parts of questions are shown in round brackets: e.g. **(2)**.
Useful formulae are given on page 2.
This paper has 18 questions. All blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.

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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

pressure × volume = constant $\qquad p_1 \times V_1 = p_2 \times V_2$

$\dfrac{\text{pressure}}{\text{kelvin temperature}} = \text{constant} \qquad \dfrac{p_1}{T_1} = \dfrac{p_2}{T_2}$

$\text{frequency} = \dfrac{1}{\text{time period}} \qquad f = \dfrac{1}{T}$

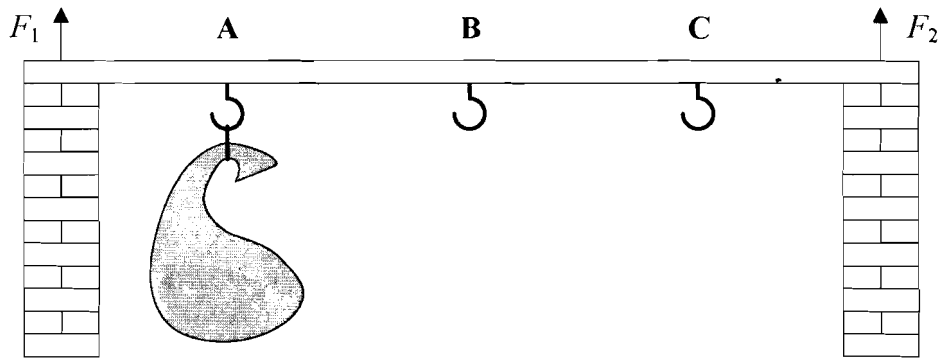
$\text{power} = \dfrac{\text{work done}}{\text{time taken}} \qquad P = \dfrac{W}{t}$

$\text{power} = \dfrac{\text{energy transferred}}{\text{time taken}} \qquad P = \dfrac{W}{t}$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

Leave blank

1. (a) The diagram shows a beam with three hooks. It is supported by two walls. A heavy sack hangs from hook **A**.



(i) F_1 and F_2 are the upward forces on the beam due to the walls. The weight of the sack is 500 N. Write an equation which connects these three forces.

.....

(1)

(ii) The sack is moved to hook **C**. Write an equation which now connects the three forces.

.....

(1)

(iii) The sack is moved to hook **B** at the midpoint of the beam. Calculate the value in newtons of F_1 and F_2.

.....

F_1 = ... N

F_2 = ... N

(1)

(iv) What assumption about the beam have you made in answering parts (i), (ii) and (iii)?

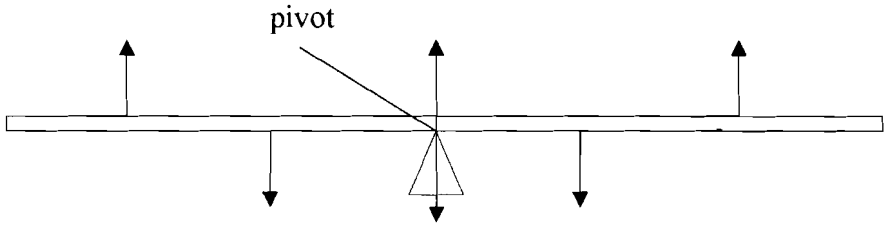
.....

.....

(1)

Leave blank

(b) The diagram shows another beam with forces acting on it. It is balanced.



Complete the sentence.

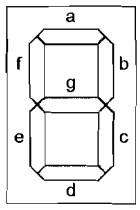
The sum of the ..... moments is equal to the sum of the ..... moments.

(1) **Q1**

(Total 5 marks)

Leave blank

2. (a) A display contains seven light-emitting diodes (LEDs), **a** to **g**. Each LED can be switched on separately. The display can show any digit from 0 to 9. The diagram shows how LEDs **a**, **b**, **c**, **d** and **g** display the digit 3.



(i) Are the LEDs and their switches arranged in series or in parallel?

.....

(1)

(ii) Explain why.

.....

.....

(1)

(iii) Different digits need different power inputs to the display.

- Which digit needs the lowest power input? .....

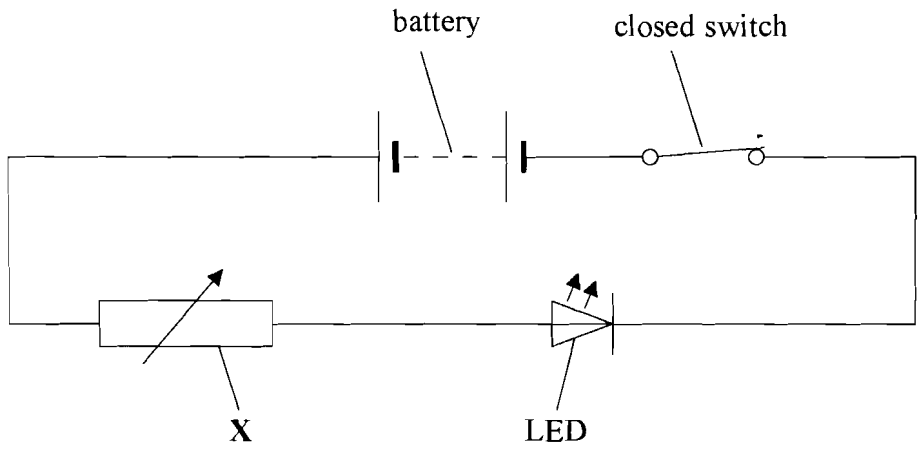
(1)

- Which digit needs the highest power input? .....

(1)

Leave blank

(b) The diagram shows another LED in a circuit.



(i) What is **X**?

.....

(1)

(ii) Explain how this circuit can be used to increase the current in the LED.

.....

.....

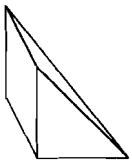
(2)

Q2

(Total 7 marks)

Leave blank

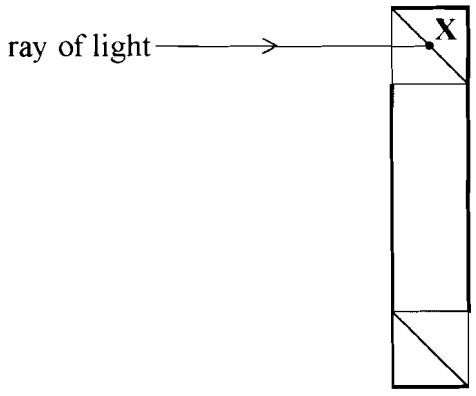
3. (a) The diagram shows a glass block.



Name this shape. .....

(1)

(b) The diagram below shows how two of these glass blocks are used in a periscope.



(i) Complete the diagram to show the path of the ray of light through the periscope.

(1)

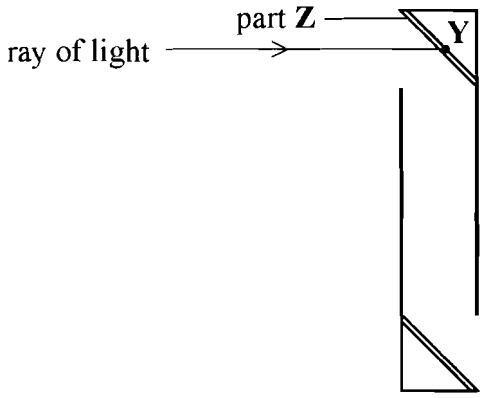
(ii) Give the full name of the process which occurs at point **X**.

.....

(1)

Leave blank

(c) The diagram below shows another type of periscope which uses mirrors.



(i) Complete the diagram to show the path of the ray of light through the periscope.

(1)

(ii) Name the process which occurs at point **Y**.

.....

(1)

(iii) Name part **Z**.

.....

(1)

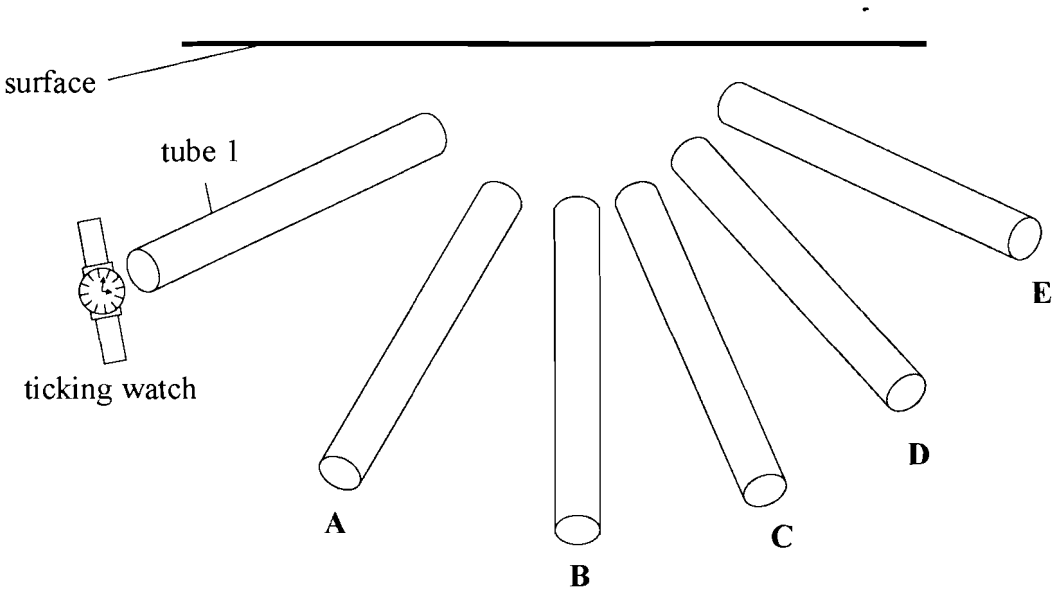
Q3

(Total 6 marks)

Leave blank

4. A student has two tubes. She puts a ticking watch at the end of tube 1.
She points tube 1 towards a hard, flat surface. Then she puts a finger in one ear.
She holds the second tube to her other ear and points this tube at the hard, flat surface.

The diagram shows five positions, **A**, **B**, **C**, **D** and **E**, for the second tube.



(a) (i) In which position do the ticks sound loudest?

Position .....

(1)

(ii) Explain your answer by adding lines to the diagram to show the direction of the sound waves.

(2)

(b) Complete the sentences.

When sound waves arrive at the hard, flat surface they are .....

(1)

The angle of ..... equals the angle of .....

(1)

(c) Suggest and explain one reason why the student puts a finger in one ear.

.....

.....

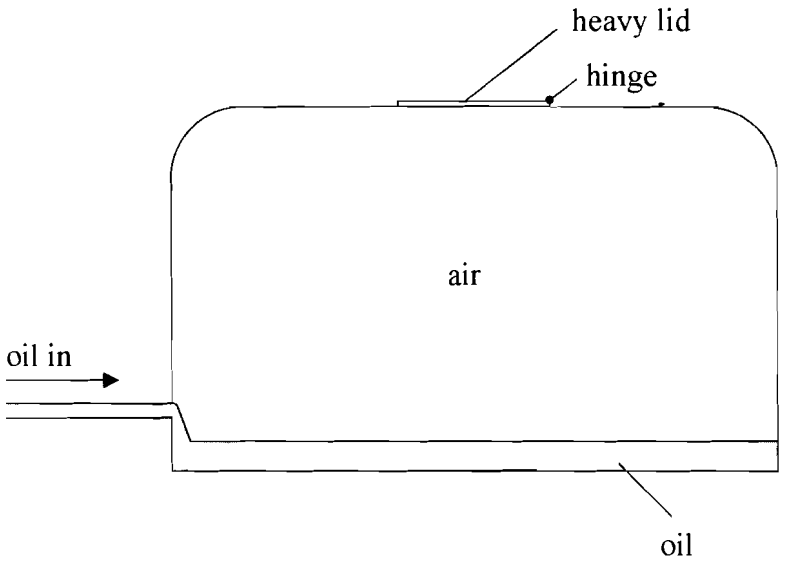
.....

(2) **Q4**

(Total 7 marks)

Leave blank

5. The diagram shows an oil storage tank. It has a heavy, hinged lid. The tank is nearly empty. When oil is pumped in this increases the pressure of the air inside the tank.



(a) What happens to the force on the inside of the lid when the pressure increases?

.....

(1)

(b) Name another force which acts on the lid.

.....

(1)

(c) Name the force which acts at the hinge as the lid opens.

.....

(1)

(d) When the lid opens, some of the air escapes from the tank. What happens to the pressure of the air in the tank?

.....

(1)

(e) On a hot day the temperature increases. What difference, if any, will this make to the speed of the molecules in the air in the tank?

.....

(1) **Q5**

(Total 5 marks)

Leave blank

6. Read the information in the box.

Water boils at 100 °C and freezes at 0 °C. **Ethanol boils at 78 °C and freezes at –117 °C..**

(a) Use these words to complete the table.

gas **liquid** **solid**

	at 80 °C	**at –173 °C**
water		
ethanol		

(2)

(b) Describe the movement, if any, of the particles in water and ethanol

(i) at –173 °C

.....

.....

(1)

(ii) at –273 °C.

.....

.....

(1)

(c) What is the temperature at which the kelvin scale starts?

.....

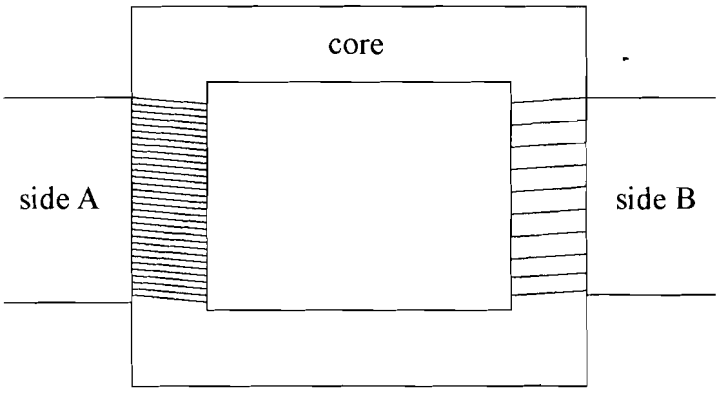
(1)

Q6

(Total 5 marks)

Leave blank

7. The diagram shows a transformer. It has a core made of laminated iron and a coil of insulated wire on each side. This transformer has 30 turns on the coil on side A. It has 10 turns on side B.



(a) How would it be used as a step-up transformer?

.....

.....

(1)

(b) Why is the wire insulated?

.....

.....

(1)

(c) The transformer is used as a step-up transformer. The input is an alternating voltage of 4 V. Calculate the output voltage in volts.

.....

.....

Output = ... V

(2)

(d) Complete the sentence.

In a transformer, an alternating input voltage drives an alternating current in the input coil. This produces a .... in the core.

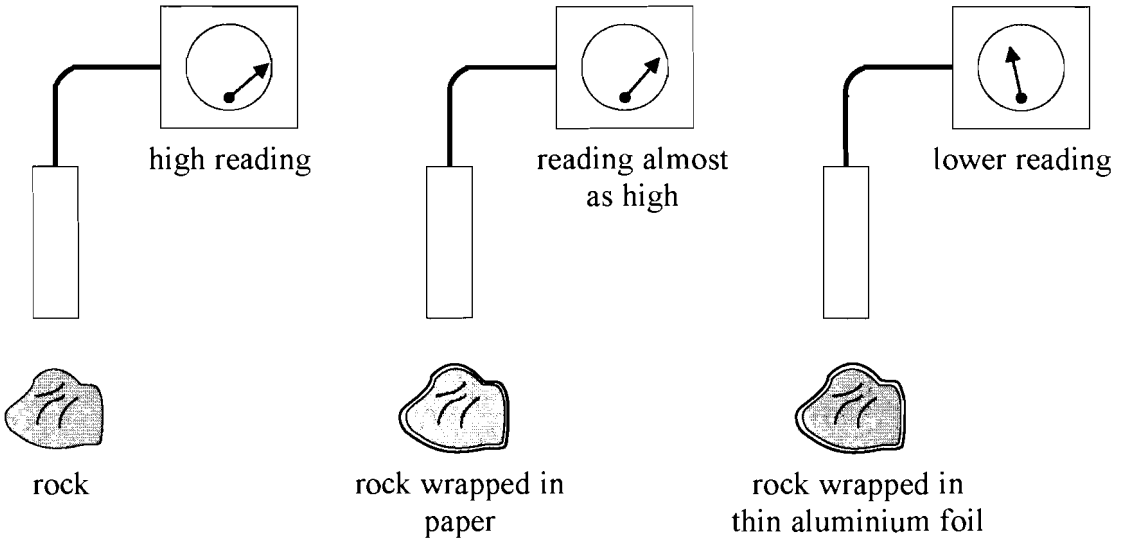
(1)

Q7

(Total 5 marks)

Leave blank

8. A rock gives a high reading on a radiation detector.
The rock gives different readings when it is wrapped in paper or in thin aluminium foil.



(a) Name a suitable radiation detector.

.....

(1)

(b) (i) Circle the type of radiation that the rock emits.

alpha (α) **beta (β)** **gamma (γ)**

(1)

(ii) Explain your choice.

.....

.....

.....

(2)

(c) The rock is now wrapped in several sheets of aluminium foil. How will this affect the reading?

.....

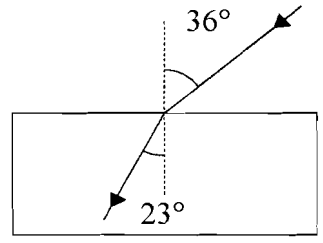
.....

(1) **Q8**

(Total 5 marks)

Leave blank

9. (a) The diagram shows a ray of light entering a glass block.



Calculate the refractive index of the glass.

.....

.....

Refractive index = ...

(2)

(b) (i) Diamond has a refractive index of 2.4. A ray of light enters a diamond at an angle of incidence 36°. Would it change direction more than, the same as or less than the ray entering the glass block?

.....

(1)

(ii) Explain your answer.

.....

.....

(1)

(c) A teacher produces a list of the apparatus required to determine the refractive index of glass. One item is shown. Add three more items.

Glass block

.....

.....

.....

.....

(3)

Q9

(Total 7 marks)

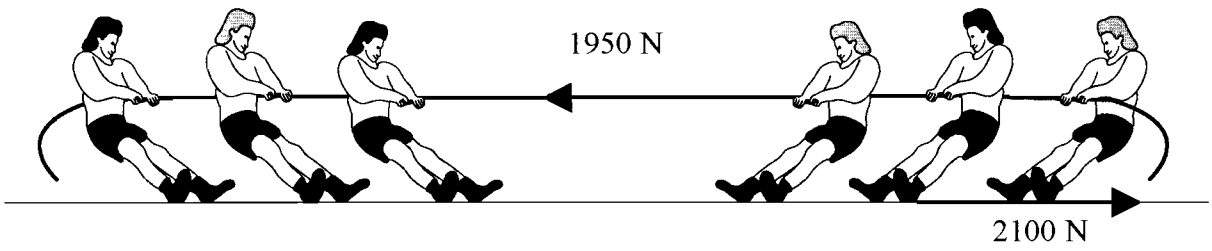
Leave blank

10. (a) Place a tick (✓) next to the vector quantities in the table.

acceleration	
distance	
kinetic energy	
power	
speed	
velocity	

(2)

(b) (i) Force is a vector quantity. Two tug-of-war teams are pulling in opposite directions. The horizontal forces on one team are shown.



Describe the movement of this team.

.....

.....

(1)

(ii). The team has a mass of 300 kg. Calculate the acceleration of the team and give its unit.

.....

.....

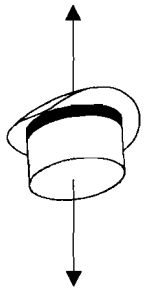
.....

Acceleration = ...

(3)

Leave blank

(c) (i) A supporter of the winning team throws his hat high in the air.
The diagram shows the forces acting on the hat as it falls back. Label these forces.



.....

.....

(2)

(ii) Explain why the hat reaches a terminal velocity.

.....

.....

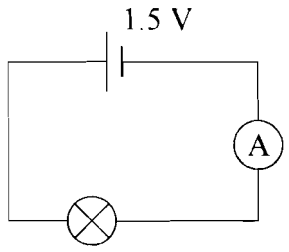
(2)

Q10

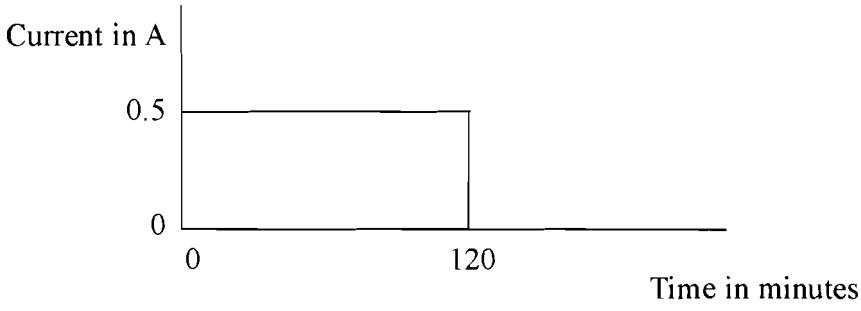
(Total 10 marks)

Leave blank

11. (a) Some students set up a circuit to measure the energy available from a rechargeable cell.



The graph shows how the ammeter reading changes with time.



(i) Calculate the amount of energy in joules transferred from the cell to the lamp in 120 minutes.

.....

.....

Energy transferred = ... J

(2)

(ii) Is the current supplied by the cell a.c. or d.c.?

.....

(1)

(iii) How can you tell from the graph?

.....

.....

.....

(1)

Leave blank

(b) One student tells the others that the area under the graph represents charge. Explain why she is correct.

.....

.....

(1)

Q11

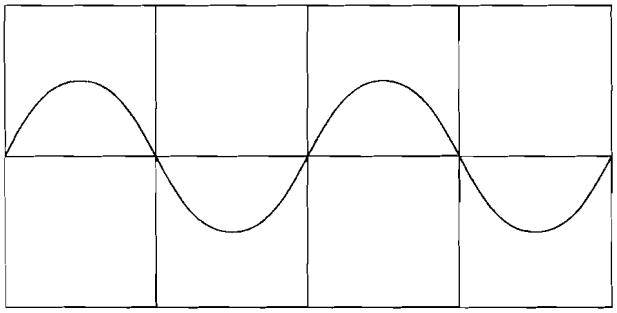
(Total 5 marks)

12. (a) A wave from a source of sound can be displayed on an oscilloscope screen. Name the other piece of equipment required.

.....

(1)

(b) The diagram shows a waveform on an oscilloscope screen.



(i) The timebase is set at 0.05 s per division. Determine the frequency of this wave and give its unit.

.....

.....

Frequency = ...

(3)

(ii) Explain whether or not humans can hear a sound of this frequency.

.....

.....

(1)

Q12

(Total 5 marks)

Leave blank

13. (a) Geothermal resources may be used to produce electricity.
One advantage is that geothermal resources are renewable.
Describe two other advantages and two disadvantages.

Advantages

1 .....

2 .....

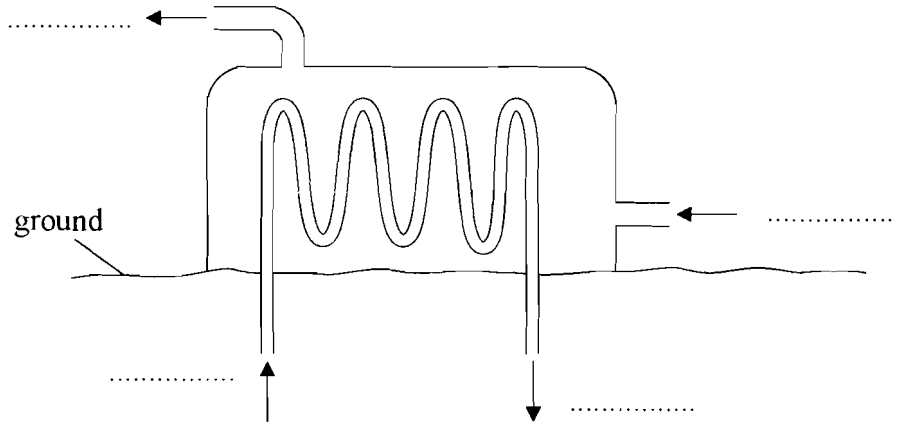
Disadvantages

1 .....

2 .....

(4)

(b) The diagram shows a heat exchanger in a geothermal power station.



On the dotted lines write **A**, **B**, **C** or **D** where:

A is the hot geothermal water in
B is the geothermal water out
C is the liquid in from condenser
D is the vapour out to turbine

(2)

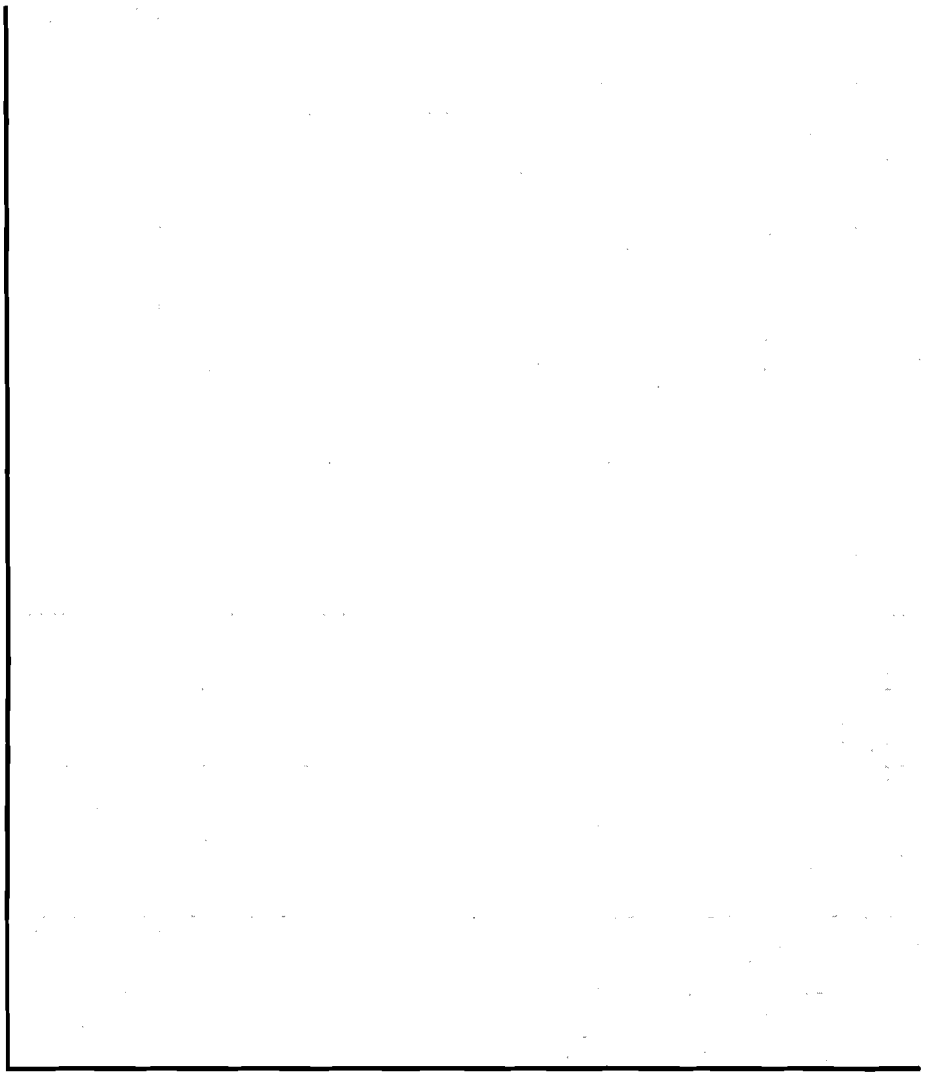
Leave blank

(c) The data show how the temperature varies with depth where the ground is suitable for geothermal electricity production.

Temperature (°C)	25	40	63	100	155	245
Depth (m)	0	200	400	600	800	1000

(i) Plot a graph of temperature (y-axis) against depth (x-axis).

(ii) Draw a smooth curve through your points.



(5)

(iii) Geothermal electricity production is possible using temperatures as low as 85 °C. Use your graph to find the depth in metres where this temperature occurs.

Depth = ... m

(1)

Q13

(Total 12 marks)

Leave blank

14. (a) The kelvin temperature of a fixed mass of gas is **not** proportional to one of the following quantities. Place a tick (✓) next to this quantity.

average kinetic energy of its molecules	
celsius temperature	
pressure at constant volume	

(1)

(b) A car handbook recommends that the tyre pressures should be checked. Explain why this should be done when the tyres are cold.

.....

.....

(2)

(c) The pressure in a tyre at a temperature of 290 K is 200 kPa. Calculate the pressure in kPa in the tyre when the temperature is 310 K.

.....

.....

Pressure = ... kPa

(2)

(d) (i) State the relationship between pressure, force and area.

(1)

(ii) A four-wheel car has a weight of 10 000 N. The pressure in each tyre is 200 kPa. Calculate in m^2 the area of each tyre which is in contact with the road. Assume the weight of the car is distributed uniformly.

.....

.....

Area = ... m^2

(2) **Q14**

(Total 8 marks)

Leave blank

15. (a) Describe the process of nuclear fission of uranium.

.....

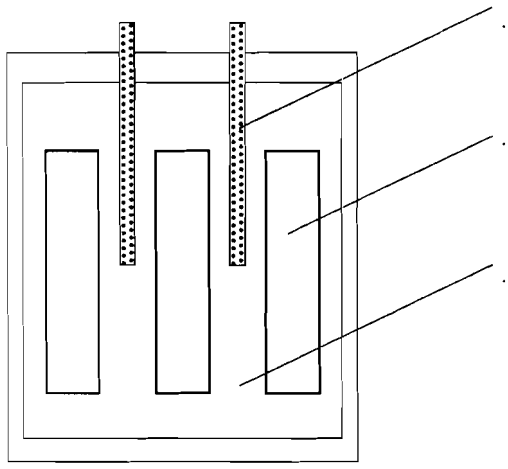
.....

.....

.....

(3)

(b) The diagram shows a nuclear reactor.



.....

.....

.....

Use words from the box to label the diagram.

control rod	**fuel rod**	**moderator**

(2)

(c) Explain the purpose of

(i) the control rods

.....

.....

(2)

(ii) the moderator.

.....

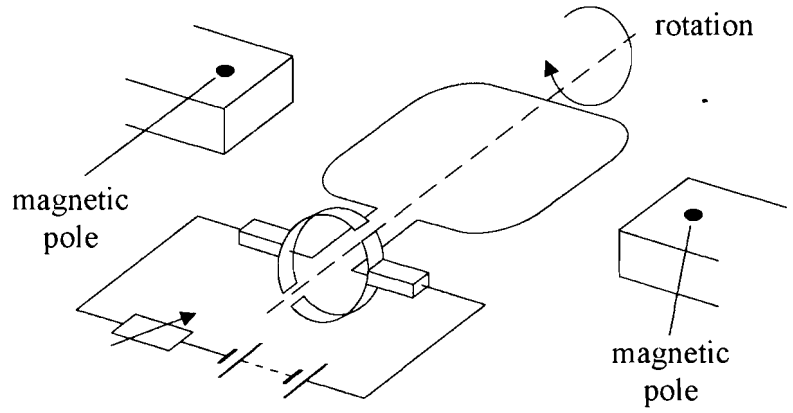
.....

(2) **Q15**

(Total 9 marks)

Leave blank

16. (a) A student plans to build an electric motor. He starts with the diagram below and wants the coil to rotate in the direction shown.



(i) Add an arrowhead to indicate the direction of the current in the coil. Label this arrowhead **I**.

(1)

(ii) Write **N** or **S** at each magnetic pole on the diagram to show the correct polarity.

(1)

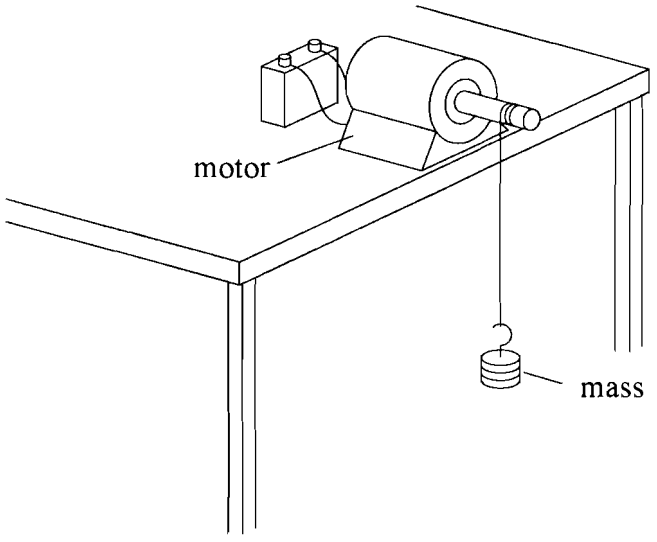
(iii) State two changes that can be made to make the coil rotate faster.

1 .....

2 .....

(2)

(b) A motor is used to lift a mass of 0.080 kg through a distance of 0.70 m. The time taken is 4.0 s.



Leave blank

(i) Calculate the gravitational potential energy in joules gained by the mass.

.....

.....

Gravitational potential energy = ... J

(2)

(ii) State the useful work done in joules by the motor on the mass.

Work done = ... J

(1)

(iii) Calculate the useful output power of the motor and give its unit.

.....

.....

Power = ...

(2)

Q16

(Total 9 marks)

QUESTION 17 IS ON THE NEXT PAGE

Leave blank

17. (a) (i) Complete the sentence.

The volt is a ..... per .....

(1)

(ii) A conductor is connected into an electric circuit. When 0.50 C of charge passes through the conductor, 20 J of energy is transferred to it.
Calculate the voltage in volts across the conductor.

.....

.....

Voltage = ... V

(1)

(b) Complete the sentence.

Electric current in solid ..... conductors is a flow of

negatively charged ..... .

(2) **Q17**

(Total 4 marks)

18. (a) The following was written about Geiger and Marsden's experiment.

They expected to find that most of the alpha particles travel straight through the gold foil with the remainder being deviated by a few degrees.
This thinking was based on the idea that positive and negative charges were spread evenly within the atom.

(i) In what way did Geiger and Marsden's results differ from what they expected?

.....

.....

(1)

(ii) In what two ways did Rutherford's interpretation differ from the original idea?

1 .....

.....

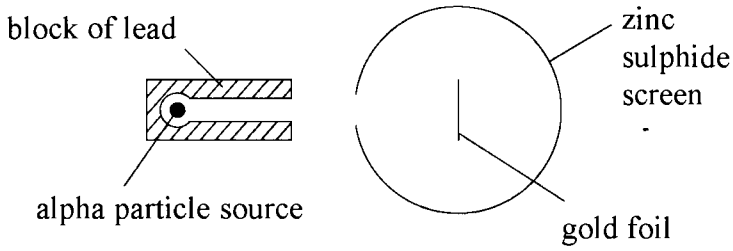
2 .....

.....

(2)

Leave blank

(b) The diagram shows the apparatus used by Geiger and Marsden.



What was the purpose of

(i) the zinc sulphide screen

.....

(1)

(ii) the block of lead

.....

(1)

(iii) having a vacuum throughout the apparatus?

.....

(1) **Q18**

(Total 6 marks)

TOTAL FOR PAPER: 120 MARKS

END