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

Paper Reference(s)

4420/2H

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Wednesday 4 May 2005 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Materials required for examination

Ruler
Protractor
Compasses
Pencil
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. There are no blank pages.

Advice to Candidates

Write your answers neatly and in good English.

Question Number	Leave Blank
1	
2	
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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 $\qquad p_1 \times V_1 = p_2 \times V_2$

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

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

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

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

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

Leave blank

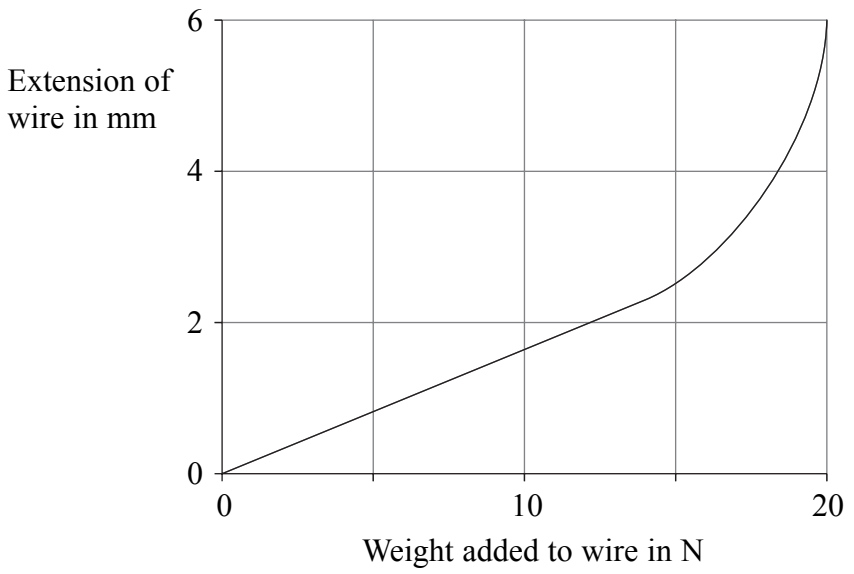
1. (a) A student wants to use metal wire as part of a model bridge that she is building. To test if a wire is suitable she hangs a mass of 0.5 kg from it and measures its extension. Calculate the weight in newtons of the 0.5 kg mass.

.....

..... Weight = ... N

(2)

(b) She continues to add masses to the end of the wire. The graph shows the results of her experiment.



(i) Indicate on the graph the region associated with Hooke's law.

(1)

(ii) Explain your answer.

.....

.....

(1)

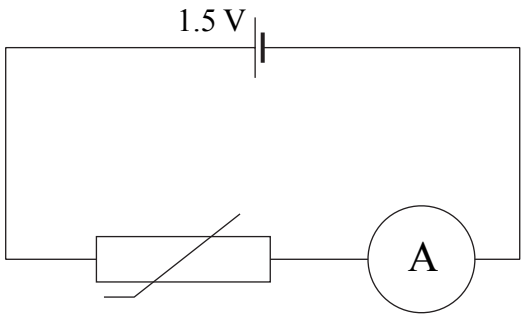
(c) The student thinks the wire is too weak and decides to replace it with a thicker wire of the same material and length. She tests it in the same way as before by hanging masses from its end.
Show her possible results on the axes above.

(2) **Q1**

(Total 6 marks)

Leave blank

2. The circuit below contains a 1.5 V dry cell, an ammeter and a thermistor at room temperature.



(a) At room temperature, the resistance of the thermistor is 1000 Ω.
Calculate the current, in amps.

.....

..... Current = ... A

(3)

(b) What happens to the resistance of the thermistor as its temperature increases?

.....

(1)

(c) What happens to the current as the temperature of the thermistor increases?

.....

(1) **Q2**

(Total 5 marks)

Leave blank

3. The diagram represents the electromagnetic spectrum.

Gamma-rays	X-rays	Ultraviolet	Visible	Infra-red	Microwaves	Radio waves

(a) Which of X-rays and radio waves has the longer wavelength?

.....

(1)

(b) Which of X-rays and radio waves has the higher frequency?

.....

(1)

(c) State one use of X-rays.

.....

(1)

(d) State one property that all electromagnetic waves have in common.

.....

(1)

(e) State the law of reflection.

.....

.....

(1)

(f) A teacher wants to demonstrate the law of reflection to his class.
Suggest two reasons why he should use visible light rather than X-rays.

1 .....

2 .....

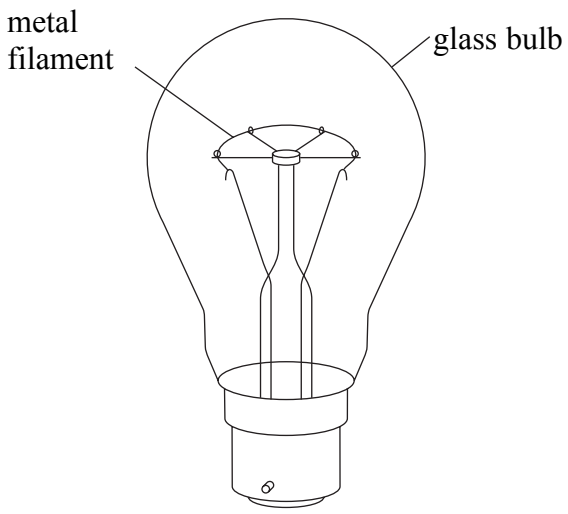
(2)

Q3

(Total 7 marks)

Leave blank

4.



(a) A metal filament lamp is switched on.
Complete the boxes to show the energy transfer that occurs.

..... energy	→	..... and ..... energy

(3)

(b) The lamp is rated at 100 W and is left on for 30 seconds.
How much energy, in joules, is transferred to the lamp?

.....

.....

Energy transferred = ... J
(2)

(c) The lamp is only 5% efficient. What does this mean?

.....

.....

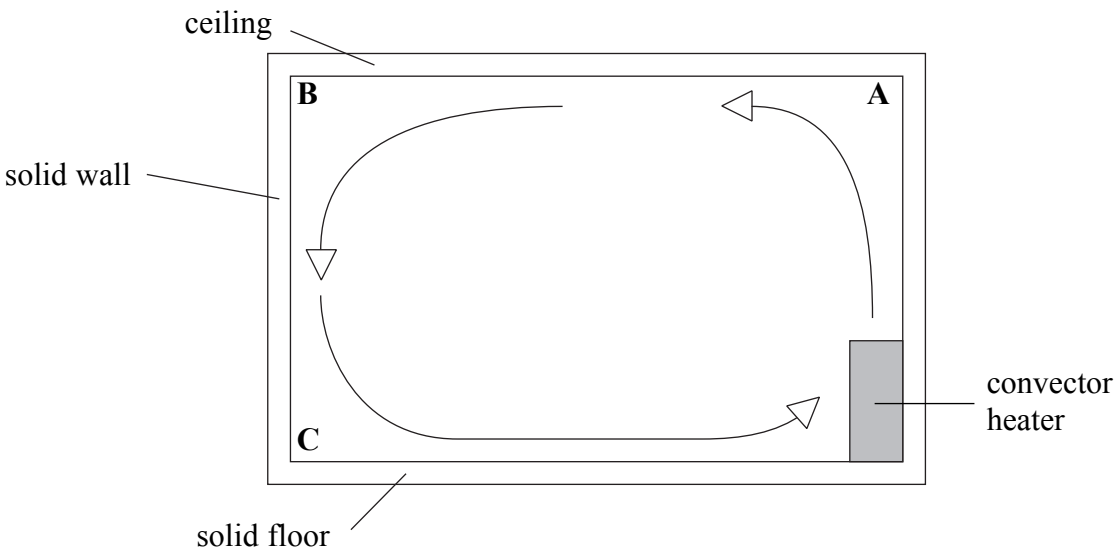
.....
(2)

Q4

(Total 7 marks)

Leave blank

5.



(a) The room shown is heated by a convector heater. The arrows show the direction of movement of the air within the room.
Is the highest temperature at **A** or **B** or **C**?

.....

(1)

(b) The room has a floor area of 20 m^2. The height of the room is 3 m and it contains air of mass 72 kg.
Calculate the density, in kilograms per cubic metre, of the air in the room.

.....

.....

..... Density = ... kg/m^3

(3)

(c) The density of air changes with temperature.
Is the density of air lowest at **A** or **B** or **C**?

.....

(1)

(d) Some heat energy within the room is transferred through the solid floor.
Name the energy transfer process taking place.

.....

(1) **Q5**

(Total 6 marks)

Leave blank

6. A technician measures the activity of a radioactive source.
The activity is 400 Bq. After 20 minutes the activity decreases to 100 Bq.

(a) Calculate the half-life, in minutes, of the radioactive source.

.....

.....

.....

Half-life = ... minutes
(2)

(b) Why is this source unsuitable for dating archaeological specimens?

.....
(1)

(c) The technician continues measuring the activity from the source. The measured activity does not drop below a certain value due to background radiation.
Name two sources of background radiation.

1 .....

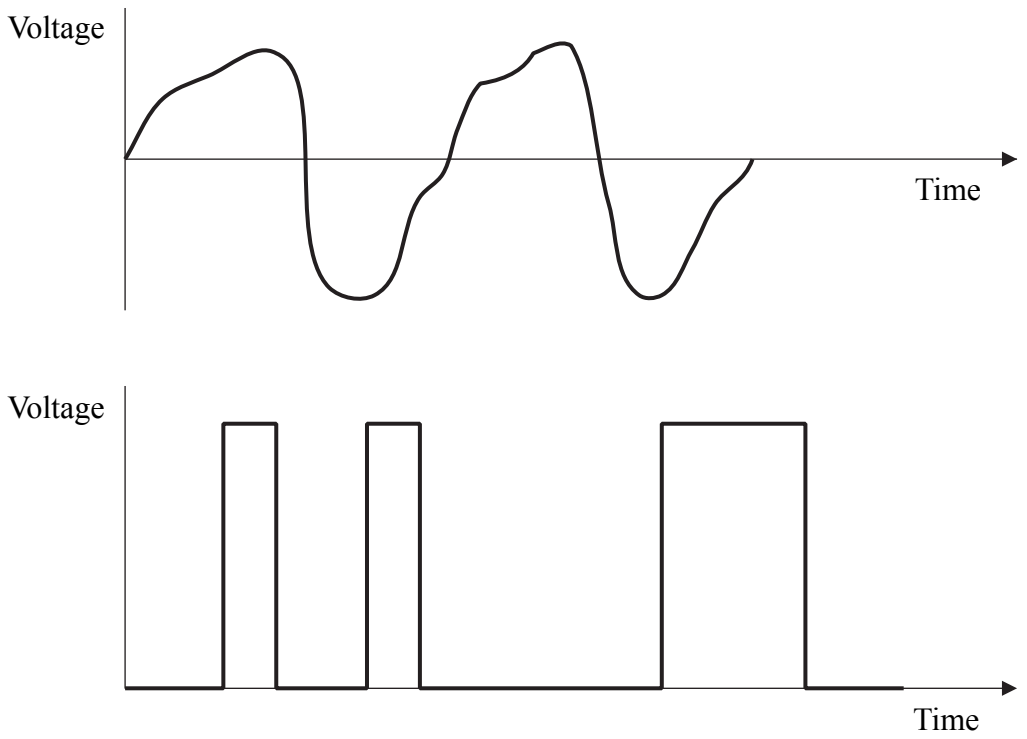
2 .....
(2)

(Total 5 marks)

Q6

Leave blank

7. The diagram shows an example of an analogue signal and an example of a digital signal.



Complete the sentences.

(a) The analogue signal varies ..... between a maximum and minimum value.

(1)

(b) The digital signal only has two values. These are 1 which corresponds to

..... and ..... which corresponds to .....

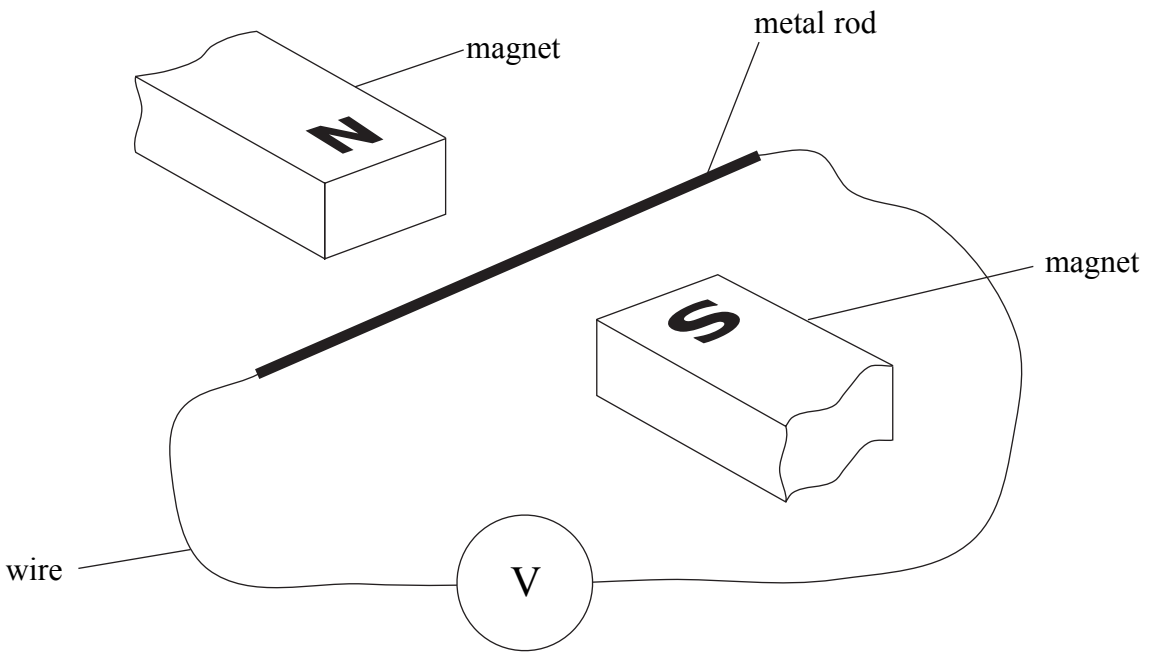
(3)

(Total 4 marks)

Q7

Leave blank

8. A physics teacher uses the apparatus shown in a demonstration to her class.



She moves the metal rod upwards and the voltmeter briefly shows a small reading.

(a) Why does the voltmeter show a reading?

.....

.....

.....

(3)

(b) A boy standing at the back of the class complains that he cannot read the voltmeter. Suggest two ways in which the teacher could use the same apparatus to produce a bigger reading on the voltmeter.

1 .....

2 .....

(2)

Q8

(Total 5 marks)

Leave blank

9. On a day when there is no wind, a rock falls from a very high cliff. It does not hit anything until it reaches the ground.

(a) Give the name and direction of each of the two forces, apart from upthrust, which act on the rock as it falls.

1 .....

2 .....

(2)

(b) One of the forces which acts on the rock changes significantly as the rock falls. Name the force and explain what happens.

.....

.....

(2)

(c) The mass of the rock is 450 kg. At one point in its fall the unbalanced force on the rock is 60 N.
Calculate the acceleration of the rock at this point and include its unit.

.....

.....

..... Acceleration = ...

(3)

(d) After some time, the falling rock reaches its terminal velocity.

(i) Describe the motion of the rock when it is at terminal velocity.

.....

(1)

(ii) State the size of the unbalanced force on the rock as it falls at terminal velocity.

.....

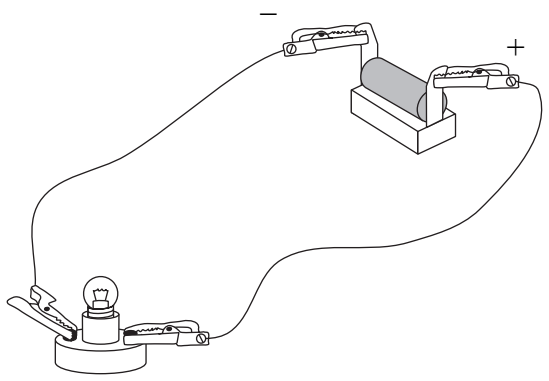
(1)

Q9

(Total 9 marks)

Leave blank

10. (a) The drawing shows an electrical circuit containing a cell, a lamp and some insulated copper wire with clips.



(i) A direct current passes through the circuit.

Name the particles that flow.

.....

Why do the particles flow from the negative terminal to the positive terminal?

.....

.....

(2)

(ii) The circuit has a 1.5 V cell.

Complete the sentence by adding the names of the two missing units.

A volt is a ..... per .....

(1)

(b) A student has a reading lantern. It contains a 1.5 V rechargeable battery. The lantern uses solar cells to charge its battery during the day. The student switches on the lantern at night to read.

Use the relationship $E = I \times V \times t$ to calculate the average current from the battery when it delivers 216 J in 2.0 hours.
Show how you get your answer and include the unit.

.....

.....

..... Average current = ...

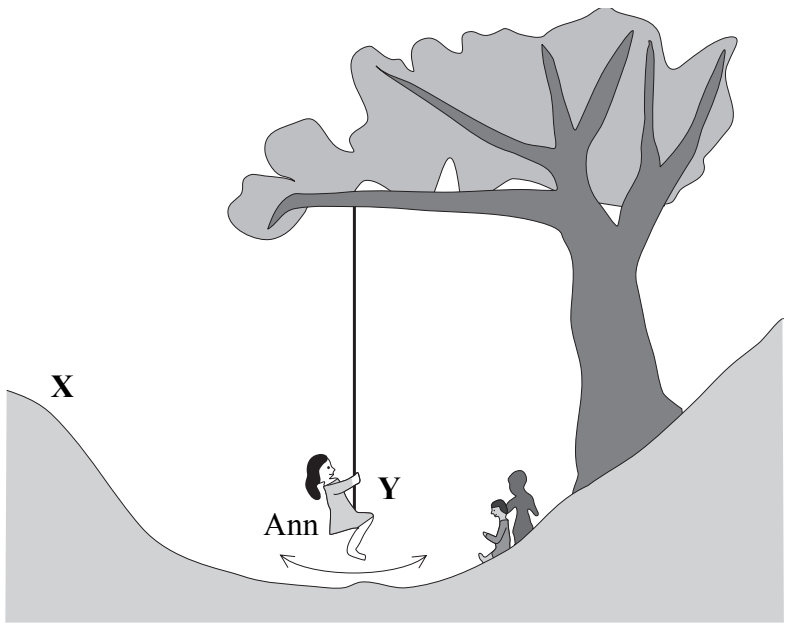
(3)

Q10

(Total 6 marks)

Leave blank

11. Some children are playing on a swing.



(a) Ann has a mass of 32 kg. At **Y** her kinetic energy is 784 J.
Calculate her speed in m/s.

.....

.....

..... Speed = ... m/s

(2)

(b) (i) Ann started her swing at **X**. How much more gravitational potential energy did Ann have at **X** than at **Y**?

.....

(1)

(ii) State two assumptions which you made.

1 .....

.....

2 .....

.....

(2)

Q11

(Total 5 marks)

Leave blank

12. (a) A student uses a rectangular glass block to determine the refractive index of the glass.

(i) Describe the experiment. Draw a diagram to illustrate your answer.

.....

.....

.....

.....

.....

(4)

(ii) The student finds that when the angle of incidence in the air is 68° the angle of refraction in the glass is 38°.

The table contains information about the two angles.

Angle	Cosine	Sine	Tangent
38°	0.79	0.62	0.78
68°	0.37	0.93	2.48

Calculate the refractive index of the glass.

.....

.....

..... Refractive index = ...

(3)

Leave blank

(b) (i) What does the term ‘critical angle’ mean?

.....

.....

.....

(2)

(ii) State the relationship between the critical angle and the refractive index.

.....

.....

(1)

Q12

(Total 10 marks)

Leave blank

13. A temperature of zero kelvin is sometimes described as absolute zero. It is equivalent to –273 °C and is the lowest possible temperature.

(a) Explain, in terms of particles, why absolute zero is the lowest possible temperature.

.....

.....

(1)

(b) Calculate the kelvin temperature which is equivalent to 22 °C.

.....

..... Kelvin temperature = ... K

(1)

(c) There was a large fire at a factory. In one part of the factory a sealed gas cylinder exploded due to the high temperature. This cylinder was designed to withstand a pressure of 2000 kPa. Before the fire the pressure in the cylinder was 500 kPa at 22 °C.
Investigators concluded that the temperature in that part of the factory must have been over 900 °C.

Use the relationship $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ to show whether or not the conclusion was correct.

.....

.....

.....

(2)

(d) The average kinetic energy of the molecules of a sample of gas is doubled. What effect, if any, does this have on the kelvin temperature of the gas?

.....

(1)

Q13

(Total 5 marks)

Leave blank

14. (a) A family has a diesel generator. The output from the generator is 120 V a.c. They also have a transformer which will reduce the voltage from the generator to 6 V a.c.

(i) What do the letters a.c. stand for?

.....

(1)

(ii) Describe a.c.

.....

.....

(1)

(b) (i) Calculate the value of the output current, in amps, when the input current to the transformer is 1.5 A.

.....

.....

..... Current = ... A

(2)

(ii) What assumption have you made?

.....

.....

(1)

Q14

(Total 5 marks)

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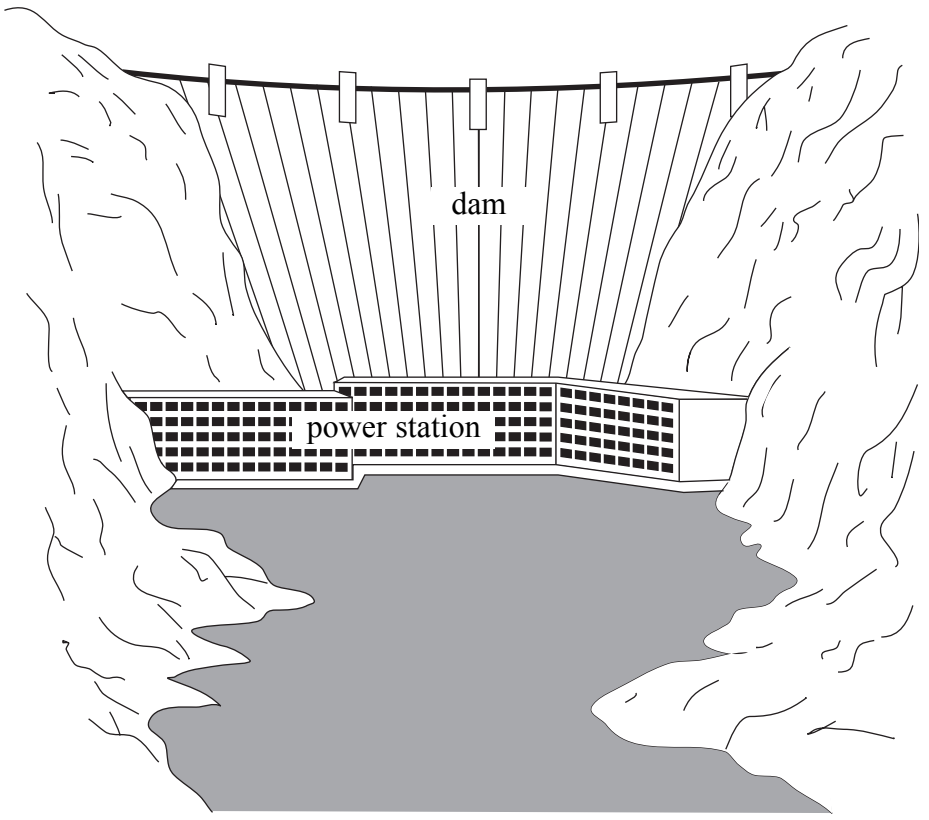
15. The drawing shows a dam and a hydroelectric power station. Water from near the top of the dam flows through pipes to turbines in the power station.



(a) The dam wall needs to be thicker at the bottom than at the top.
Explain why.

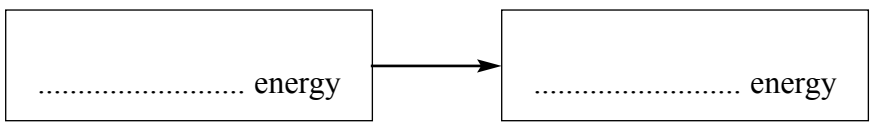
.....

.....

.....

(2)

(b) As water begins to flow through the pipes from near the top of the dam, a useful energy transfer takes place. Complete the boxes to show this energy transfer.



(1)

Leave blank

(c) State and explain one advantage and one disadvantage of using hydroelectric power stations for large-scale electricity production.

Advantage .....

.....

.....

(2)

Disadvantage .....

.....

.....

(2)

(d) Electricity generated by the power station is transmitted over long distances. Before this happens a step-up transformer is used to increase the voltage.
State and explain one advantage and one disadvantage of transmitting electricity at very high voltage.

Advantage .....

.....

.....

(2)

Disadvantage .....

.....

.....

(2)

(Total 11 marks)

Q15

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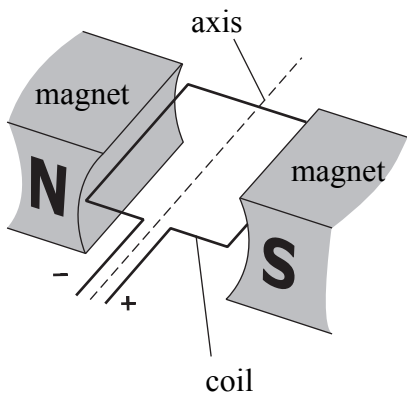
16. The diagram shows part of a simple electric motor.



The motor is connected to a d.c. power supply.

(a) A student predicts that, when the motor is switched on, the coil will turn in a clockwise direction.

(i) Name the rule which the student could use to make this prediction.

.....

(1)

(ii) Explain how the rule shows that the coil will turn in a clockwise direction.
You may add to the diagram or draw another diagram to help you explain.

.....

.....

.....

(2)

(iii) Suggest one change which would make the coil turn faster.

.....

(1)

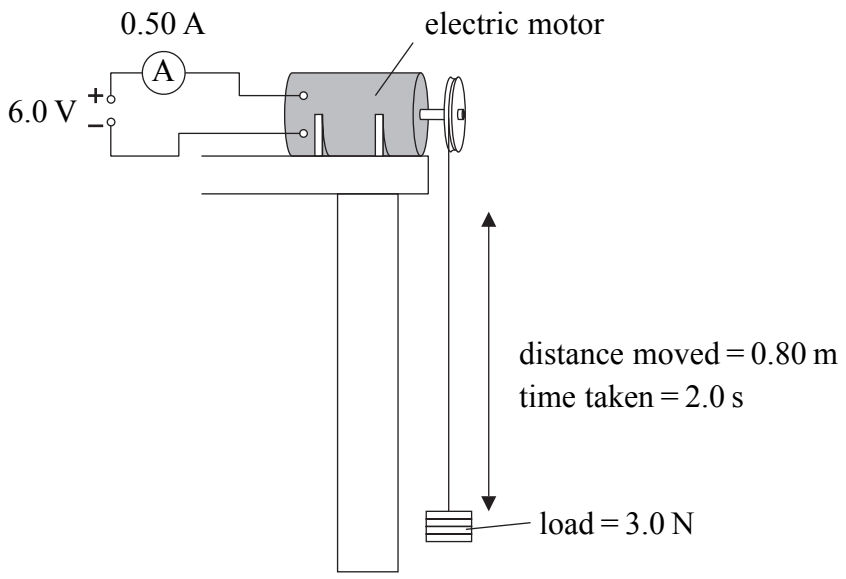
(iv) Suggest one change which would make the coil turn in the opposite direction.

.....

(1)

Leave blank

(b) The diagram shows an electric motor lifting a load.



Use information from the diagram to answer the following questions.

(i) Calculate the useful work done in lifting the load 0.80 m, and include the unit.

.....

.....

..... Work done = ...

(3)

(ii) How much useful energy was transferred to lift the load?

.....

(1)

(iii) The total energy transferred by the electric motor was 6.0 J.
Suggest two reasons for the difference between this value and your answer to (ii).

1 .....

2 .....

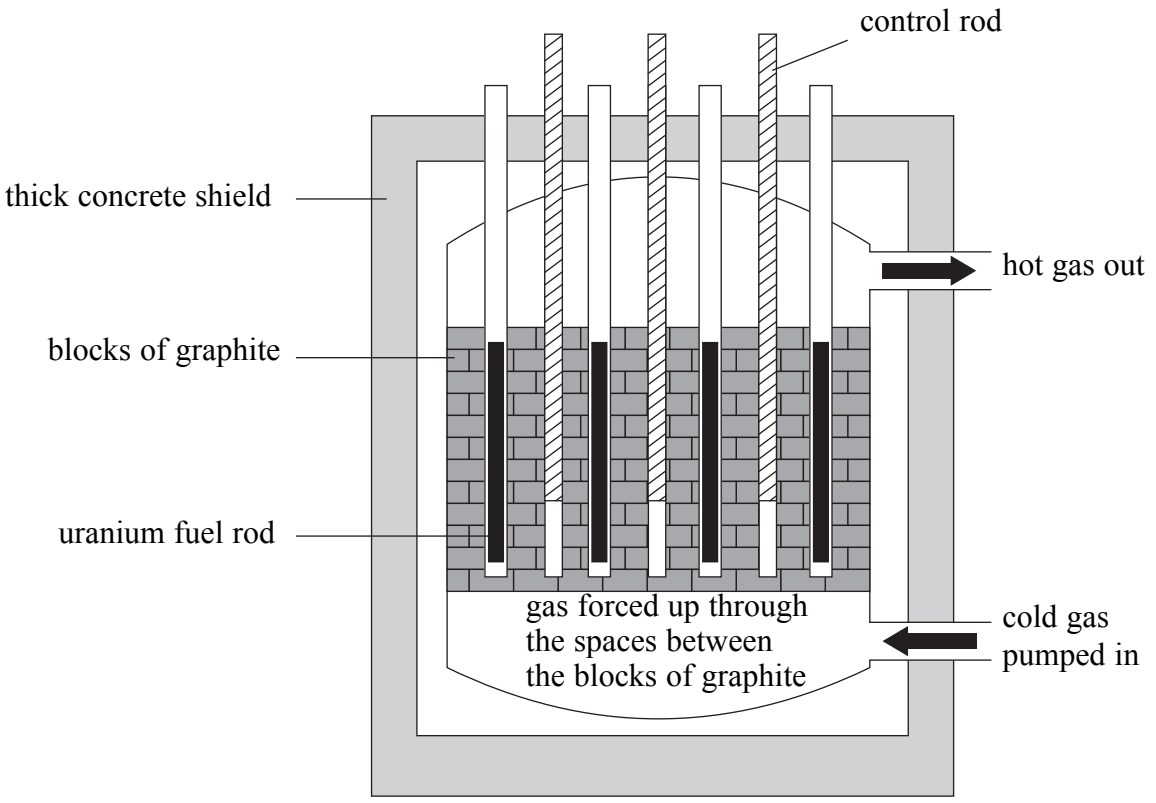
(2)

Q16

(Total 11 marks)

Leave blank

17. The diagram shows the inside of a gas-cooled nuclear reactor.



(a) What is the form of the main energy output from the reactor?

.....

(1)

(b) Complete the sentence.

The nuclear reaction which takes place in the reactor is an example of a

..... reaction.

(1)

(c) Explain why the blocks are made of graphite.

.....

.....

.....

(2)

Leave blank

(d) Explain how the control rods are used

(i) in the normal operation of the reactor

.....

.....

.....

(2)

(ii) in an emergency.

.....

.....

.....

(2)

Q17

(Total 8 marks)

TURN OVER FOR QUESTION 18

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18. (a) All living things contain carbon atoms. All materials such as leather or wood, which come from living things, also contain carbon atoms.
Of all these carbon atoms, a tiny proportion is carbon-14.

The nuclear equation for the radioactive decay of carbon-14 is

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

Beta particles are emitted in this decay. How can you tell this from the equation?

.....

.....

.....

(2)

(b) There are three forms of carbon: carbon-12, carbon-13 and carbon-14.
Complete the sentence.

These three forms are ..... of carbon.

(1)

(c) Radium-226 is a radioactive metal which decays by alpha emission to radon-222 which is a radioactive gas.

Complete the nuclear equation for this decay.

$$^{226}_{88}Ra \rightarrow {}^{\cdots\cdots}_{\cdots\cdots}Rn + {}^{\cdots\cdots}_{\cdots\cdots}He$$

(2) **Q18**

(Total 5 marks)

TOTAL FOR PAPER: 120 MARKS

END