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

Paper Reference(s)

4420/2H

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Wednesday 31 October 2007 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
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8	
9	
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11	
12	
13	
14	
15	
16	
17	
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 and 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 marks for individual questions are shown in round brackets: e.g. **(2)**.
There are 17 questions in this question paper. The total mark for this paper is 120.
There are 32 pages in this question paper. Any blank pages are indicated.
Useful formulae are given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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Turn over

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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, $g = 10\ \text{m/s}^2$.

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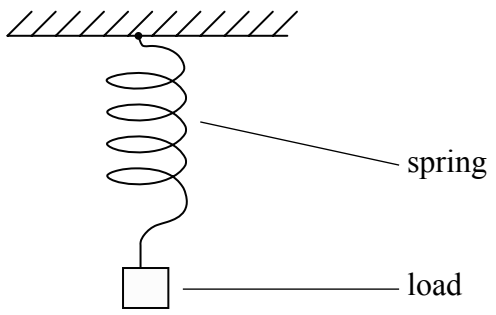
1. (a) Complete the sentence.

Hooke's law states that a force acting on a material produces an extension which is

..... to the force.

(1)

(b) A student attaches a load to the end of a spring.



(i) Name the type of force acting in the stretched spring.

.....

(1)

(ii) The student measured the length of the spring for different loads.
The table shows her data.

Load (N)	0	1.0	2.0	3.0	4.0	5.0	6.0
Length of spring (mm)	30	70	110	150	190	250	320

1. Deduce the load in newtons that would produce a length of 130 mm.

Load = ... N

(1)

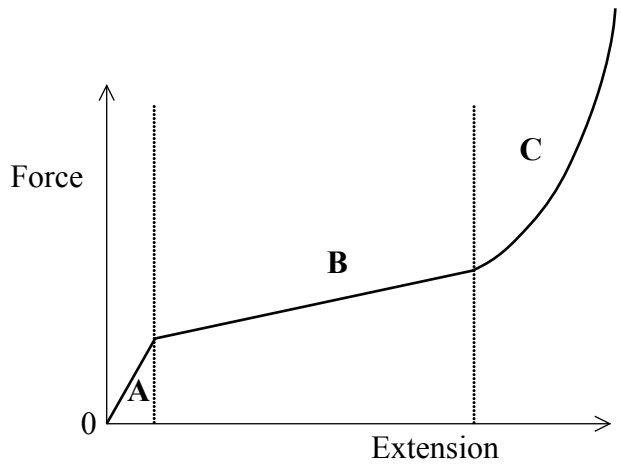
2. Estimate the maximum load in newtons at which the spring obeys Hooke's law.

Maximum load = ... N

(1)

Leave blank

(c) A force–extension graph for a material is shown. Three regions **A**, **B** and **C** are labelled.



(i) In which region is Hooke's law obeyed?

.....

(1)

(ii) In which region is the material easiest to extend?

.....

(1)

(iii) Explain your answer to (ii).

.....

.....

.....

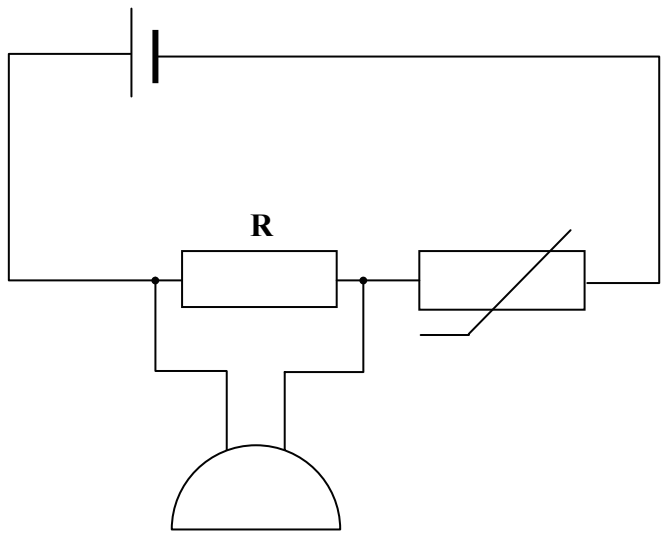
(1)

Q1

(Total 7 marks)

Leave blank

2. A circuit contains a resistor **R**, a thermistor and a buzzer connected to a cell as shown. The circuit can be used as a simple fire alarm.



(a) (i) Complete the sentence.

When temperature increases, the resistance of a

thermistor .....

(1)

(ii) What happens to the current in the circuit when the temperature increases?

.....

(1)

(b) (i) State the equation which relates voltage, current and resistance.

.....

(1)

(ii) When temperature increases, does the voltage across **R** stay the same, increase or decrease?

.....

(1)

(iii) Explain your answer.

.....

.....

(2)

Leave blank

(c) The buzzer starts to sound when the voltage across **R** is a particular value. Add a voltmeter to the circuit diagram to show how this voltage is measured.

(1)

Q2

(Total 7 marks)

QUESTION 3 IS ON THE NEXT PAGE

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3. (a) (i) Define frequency.

.....

(1)

(ii) Define time period.

.....

(1)

(b) A student has a heart rate of 72 beats per minute.
Calculate

(i) the frequency of his heart beat in hertz

Frequency = ... Hz

(1)

(ii) the time period of his heart beat in seconds.

Time period = ... s

(1)

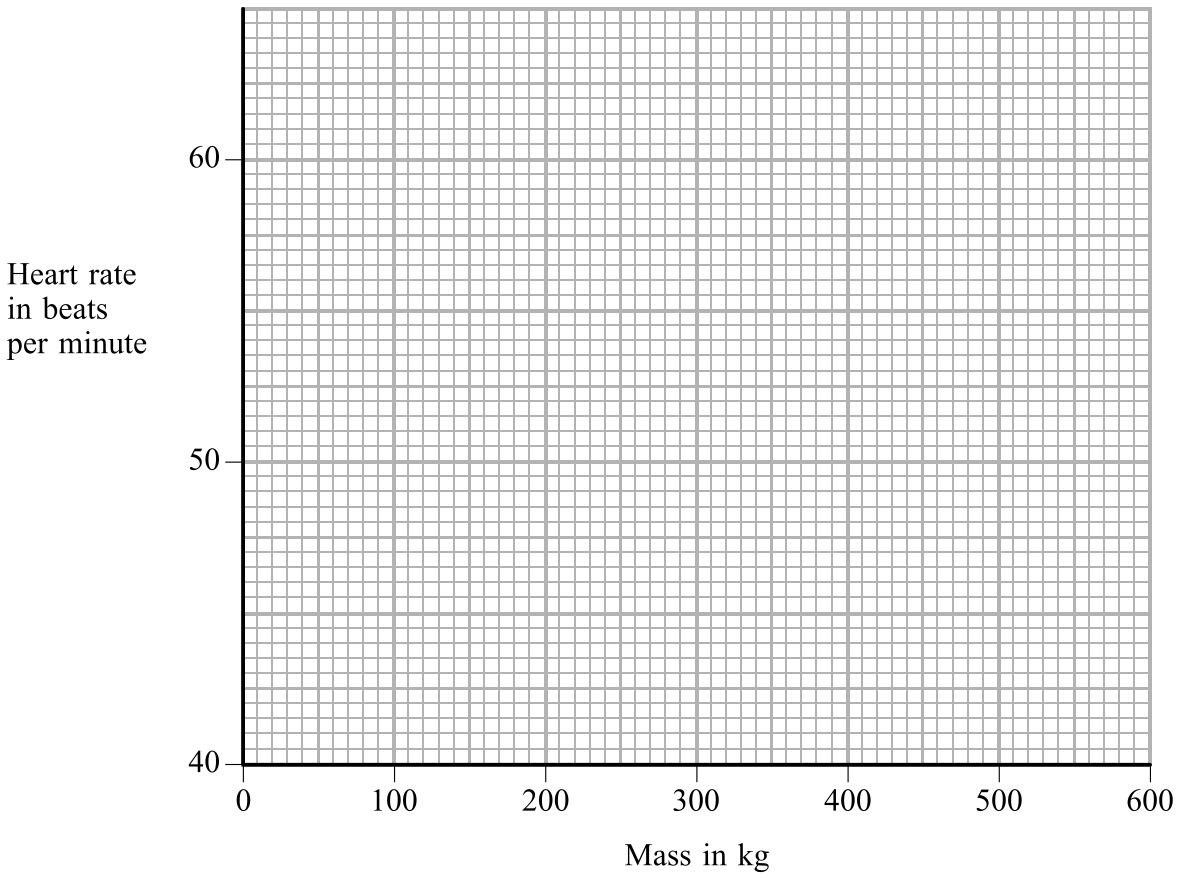
(c) Generally the heavier an animal is, the lower is its heart rate. The data in the table gives the heart rate of animals of different masses.

Mass (kg)	100	200	300	400	500	600
Heart rate (beats per minute)	63	53	48	45	42	40

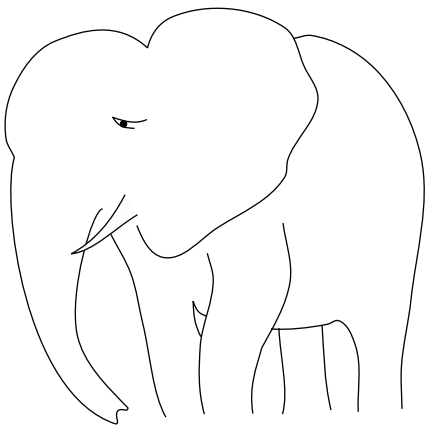
(i) Use the grid opposite to plot a graph of heart rate against mass. Draw a smooth curve for your plotted points.

(3)

Leave blank



(ii) This animal has a mass of 5000 kg.



Explain why you cannot use your graph to predict the heart rate of this animal.

.....

.....

(1) **Q3**

(Total 8 marks)

Leave blank

4. (a) Define the following terms.

(i) Atomic number

.....

(1)

(ii) Mass number

.....

(1)

(iii) Isotope

.....

(1)

(b) How many of the following particles are found in a neutral atom of $^{23}_{11}Na$?

(i) protons

.....

(1)

(ii) neutrons

.....

(1)

(iii) electrons

.....

(1)

(c) Alpha, beta and gamma are three types of ionising radiation. Which one of these radiations does **not** contain any of the particles mentioned in (b)?

.....

(1)

(d) State **one** danger of ionising radiations.

.....

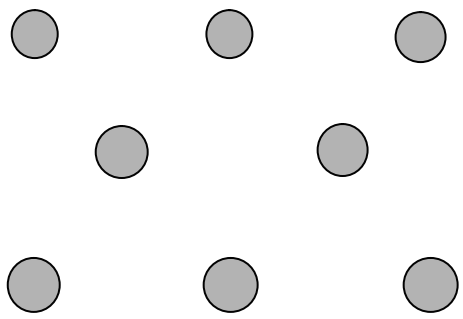
(1)

Q4

(Total 8 marks)

Leave blank

5. (a) Two students make a two-dimensional model of a liquid.



Give **one** criticism of the arrangement of the particles in this model.

.....

.....

(1)

(b) When the temperature of a liquid is raised, evaporation takes place.

(i) What happens to the particles during evaporation?

.....

.....

.....

(1)

(ii) Describe what has happened to the position and motion of the particles after all the liquid has evaporated.

.....

.....

.....

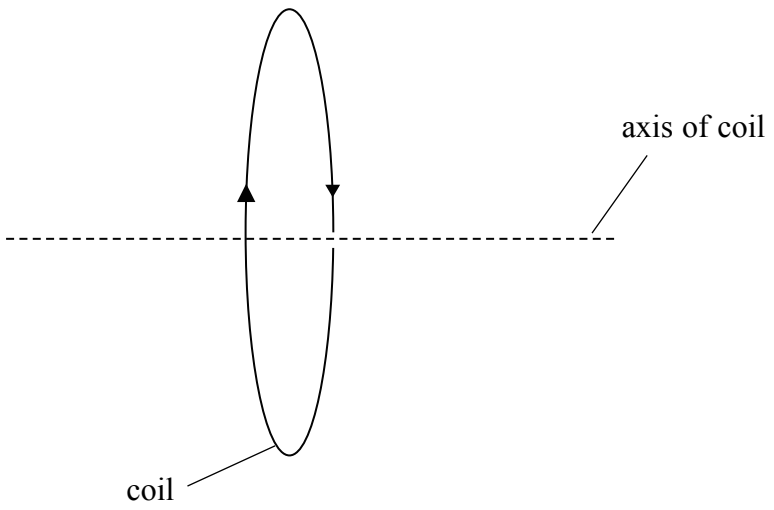
(2)

(Total 4 marks)

Q5

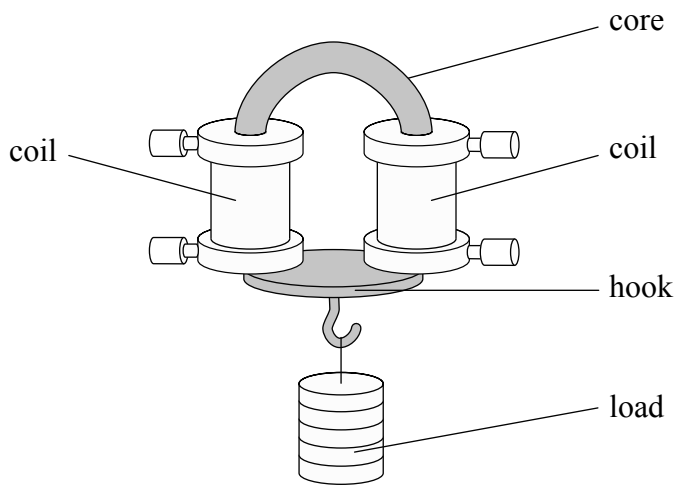
Leave blank

6. (a) The diagram shows a flat circular coil carrying a current. On the diagram, sketch the magnetic field pattern of the coil. Use arrows to show the direction of the magnetic field lines.



(3)

(b) When there is a current in the coils the electromagnet shown below is able to carry small loads from a hook. When the current is switched off the hook and load fall off.



(i) Name a suitable material for the core and the hook.

.....

(1)

Leave blank

(ii) Explain why this material is suitable.

.....

.....

.....

(2) **Q6**

(Total 6 marks)

QUESTION 7 IS ON THE NEXT PAGE

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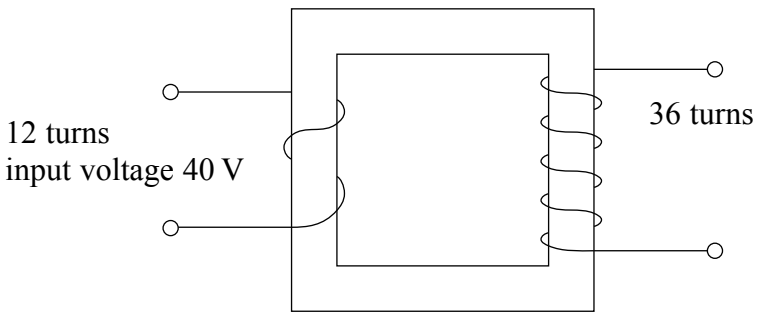
7. (a) The diagram shows a step-up transformer.



(i) Calculate the value of the output voltage.

.....

.....

Output voltage = ... V

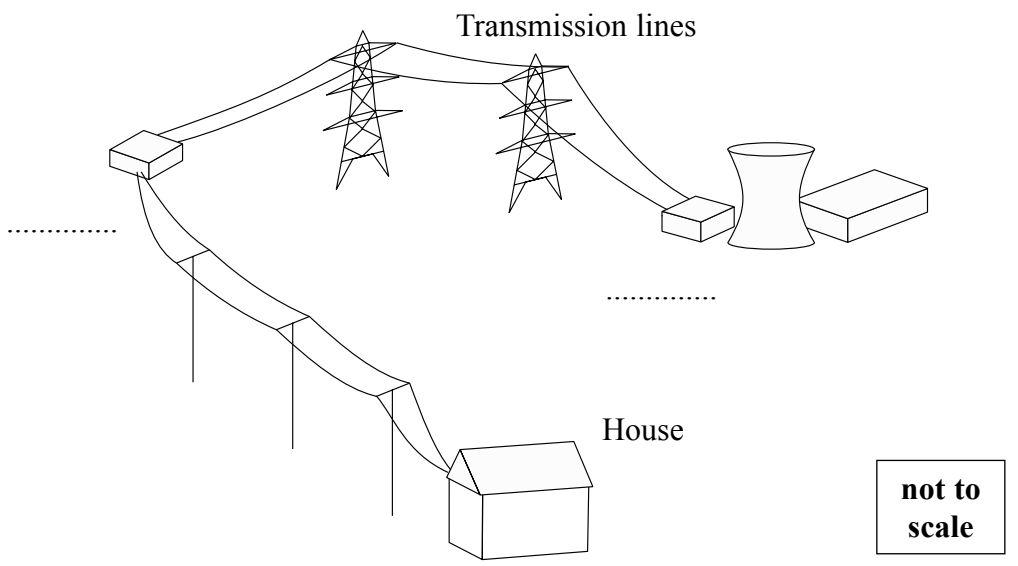
(3)

(ii) Is the output voltage a.c. or d.c.?

.....

(1)

(b) The diagram below shows an electricity generation and transmission system. Step-up and step-down transformers are used.
On the dotted lines label these transformers **U** (step-up) or **D** (step-down).



(1) **Q7**

(Total 5 marks)

Leave blank

8. A student makes a list of some of the quantities she has learned about in physics.

Tick (✓) those quantities on her list which are vectors.

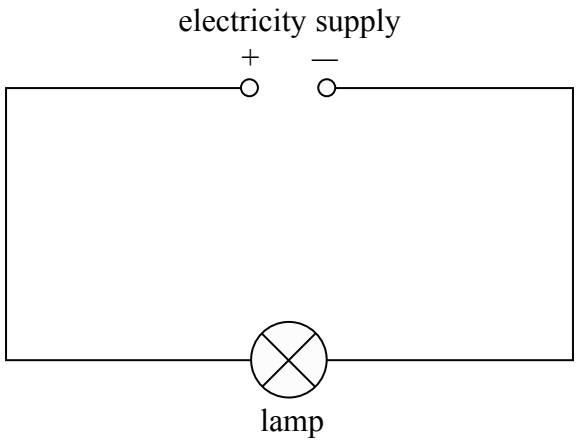
acceleration
density
force
frequency
energy
mass
power
speed
temperature
time
velocity
volume

Q8

(Total 3 marks)

Leave blank

9. The diagram shows an electrical circuit.



(a) Complete the sentence.

The ..... across the lamp is the energy transferred per unit ..... passing through the lamp.

(2)

(b) Complete the table to show what each abbreviation represents in the equation

$$Q = I \times t$$

One has been done for you.

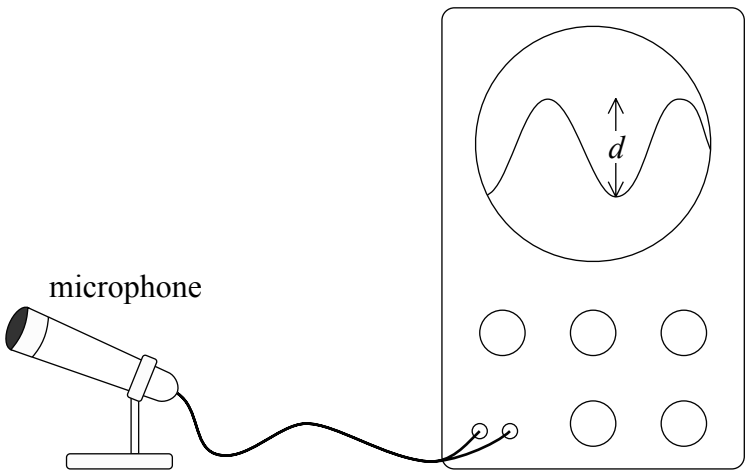
Abbreviation	Represents
Q	
I	
t	time

(2) **Q9**

(Total 4 marks)

Leave blank

10. A teacher uses a microphone and another piece of equipment to display a sound wave.



(a) Name the other piece of equipment.

.....

(1)

(b) The teacher measures distance *d* on the screen.

Complete the sentences.

(i) Distance *d* represents .....

(1)

(ii) Distance *d* becomes smaller. This is because the sound which goes to the microphone has become .....

(1)

(c) Complete the sentence.

The pitch of the sound depends on .....

.....

(1)

Q10

(Total 4 marks)

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11. Coal-fired power stations are used to produce large quantities of electricity. There are advantages and disadvantages of producing electricity in this way.

(a) State **two** advantages other than cost.

1 .....

.....

2 .....

.....

(2)

(b) State **two** disadvantages other than cost.

1 .....

.....

2 .....

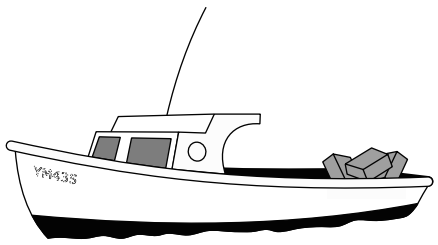
.....

(2) **Q11**

(Total 4 marks)

Leave blank

12. A fishing boat is floating on the still water of a deep lake.



The fisherman drops a heavy anchor into the lake. The anchor falls through the water and does not hit anything until it reaches the bottom.

(a) Three forces act on the anchor as it falls through the water.

(i) One of these forces is upthrust. State the name and direction of the other two forces.

1 .....

2 .....

(2)

(ii) Which of the three forces changes significantly as the anchor falls?

.....

State how and why it changes.

.....

.....

(2)

Leave blank

(b) The mass of the anchor is 12 kg. At one point in its fall the unbalanced force on the anchor is 15 N.

Calculate the acceleration of the anchor at this point and give its unit.

.....

.....

Acceleration = ...

(3)

(c) After a short time the anchor reaches its terminal velocity.

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

.....

.....

(2)

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

.....

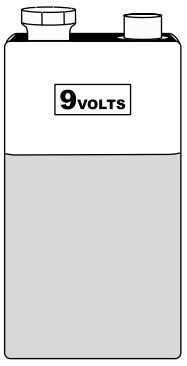
(1)

(Total 10 marks)

Q12

Leave blank

13. The diagram shows a 9 V battery.



(a) The battery contains six cells connected in series.

Calculate the voltage of each cell.

.....

Voltage = ... V

(1)

(b) Complete the sentence.

Current is the rate of flow of .....

(1)

(c) The battery supplies an average current of 0.20 A for 3.0 hours. Use the equation

energy transferred = current × voltage × time

to calculate how much energy the battery transfers during this time and give its unit.

.....

.....

Energy = ...

(3)

(d) Describe the nature of an electric current in a metal wire.

.....

.....

(2)

Leave blank

(e) The battery is described as a 9 V d.c. supply.
State what the letters **d**.**c**. stand for.

.....

(1)

(f) State **two** differences between a mains supply and the supply from the battery.

1 .....

2 .....

(2)

Q13

(Total 10 marks)

Leave blank

14. (a) State **one** use for optical fibres.

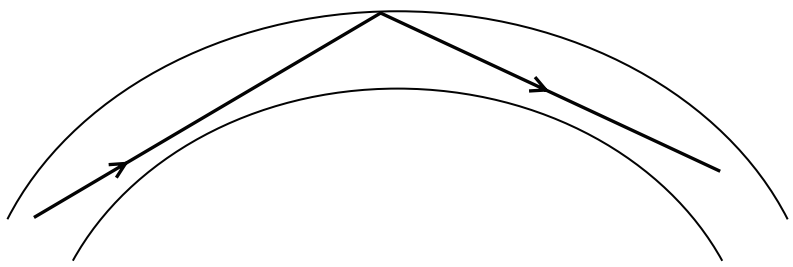
.....

(1)

(b) The diagram shows a ray of light moving through part of an optical fibre.

(i) Add the normal and the angle of incidence to the diagram.

(2)



(ii) Name the process which takes place in the diagram.

.....

(1)

(iii) Use the term **critical angle** to explain why the process takes place.

.....

.....

(1)

Leave blank

(c) (i) State the equation which relates critical angle and refractive index.

.....

(1)

(ii) The critical angle for glass in an optical fibre is 41.5°.

$\cos 41.5° = 0.749$

$\sin 41.5° = 0.663$

$\tan 41.5° = 0.885$

Calculate the refractive index of glass to three significant figures.

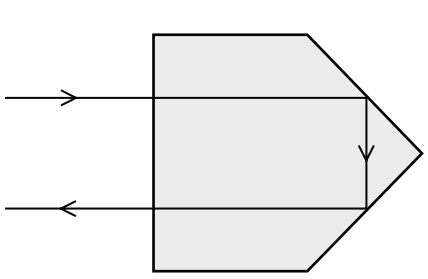
.....

.....

Refractive index = ...

(3)

(d) A bicycle reflector is made of transparent red plastic. The diagram shows the path of a ray of light through part of the reflector.



The critical angle for the transparent red plastic is less than 45°. Explain how you can tell this from the diagram.

.....

.....

.....

.....

(3)

Q14

(Total 12 marks)

Leave blank

15. (a) A student reads in a science text book that

molecules in a gas exert a force on the walls of their container

(i) Describe the motion of the molecules in a gas.

.....

.....

.....

.....

(3)

(ii) Explain how molecules exert a significant force.

.....

.....

.....

.....

.....

(3)

Leave blank

(b) The student also reads that

the relationship between pressure and volume for a gas is $p_1V_1 = p_2V_2$

A weather balloon is elastic. On the ground the pressure of the gas inside the weather balloon is 500 kPa and its volume is 1.2 m^3. As the weather balloon rises its volume increases.

(i) Calculate the pressure in kilopascals inside the weather balloon when its volume has become 6.0 m^3.

.....

.....

.....

Pressure = ... kPa

(2)

(ii) State **two** assumptions that you made.

1 .....

2 .....

(2)

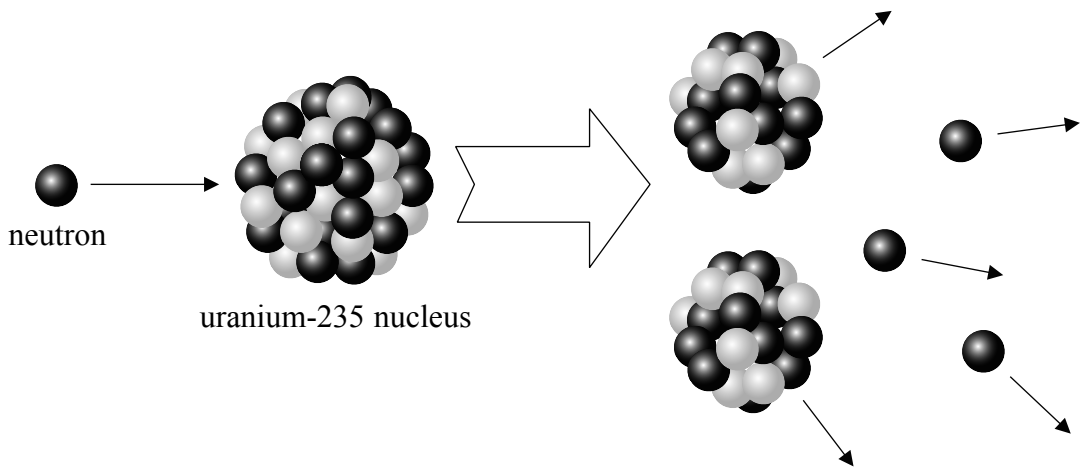
Q15

(Total 10 marks)

Leave blank

16. Uranium-235 can be used as the fuel in a nuclear power station.

(a) A uranium-235 nucleus can be split by a collision with a neutron. The diagram shows what happens.



(i) Name the process shown.

.....

(1)

(ii) Three more neutrons are produced in this case. Describe how they can produce a chain reaction.

.....

.....

.....

(2)

(iii) The process releases a lot of energy. In what form is this energy released?

.....

(1)

Leave blank

(iv) It is easier to hit a nucleus with a neutron than with an alpha particle. Explain why.

.....

.....

.....

.....

(3)

(b) The process in (a) occurs in the reactor of a nuclear power station. The reactor contains a moderator and control rods. State and explain the purpose of

(i) the moderator .....

.....

.....

(2)

(ii) the control rods .....

.....

.....

(2)

(Total 11 marks)

Q16

QUESTION 17 IS ON THE NEXT PAGE

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17. The mass of a rugby ball is 0.44 kilograms.

The ball is kicked into the air. Just after it has been kicked the kinetic energy of the rugby ball is 26.62 joules.

(a) (i) State the equation that relates kinetic energy, mass and speed.

.....

(1)

(ii) Calculate the speed, in metres per second, of the ball just after it has been kicked.

.....

.....

Speed = ... m/s

(2)

Leave blank

(b) (i) State the equation which relates the acceleration of free fall *g*, gravitational potential energy, height and mass.

.....

(1)

(ii) Calculate the maximum change in height in metres reached by the ball.

.....

.....

Maximum height = ... m

(2)

(iii) What assumption did you make to calculate the maximum height?

.....

.....

(1) **Q17**

(Total 7 marks)

TOTAL FOR PAPER: 120 MARKS

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