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

Paper Reference(s)

4420/2H

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Tuesday 2 May 2006 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
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12	
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14	
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 $\qquad p_1 \times V_1 = p_2 \times V_2$

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

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

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

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

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

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1. (a) Electromagnetic radiations are useful.
Draw a line from each of the four radiations to its use.

Radiation	Use
gamma rays	fluorescent lamps
infra-red	night vision equipment
microwaves	satellite transmissions
ultraviolet	sterilising medical equipment

(3)

(b) Electromagnetic radiations can be harmful.
Draw a line from each of the four radiations to the harm it can cause.

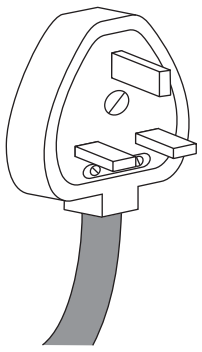
Radiation	Harm
gamma rays	blindness
infra-red	heat damage to internal body tissue
microwaves	mutations
ultraviolet	skin burns

(3) **Q1**

(Total 6 marks)

Leave blank

2. The drawing shows a three-pin plug for an electric iron.



(a) What are the pins made of?

.....

(1)

(b) (i) One wire is connected to the earth pin. State the colour (or colours) of the insulation on this wire.

.....

(1)

(ii) What is the other end of this wire connected to?

.....

(1)

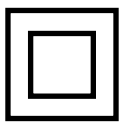
(c) Why is the electric iron earthed?

.....

.....

(1)

(d) This symbol is on some electric irons.



It means that they have double insulation. Explain what double insulation is and why it is used.

.....

.....

.....

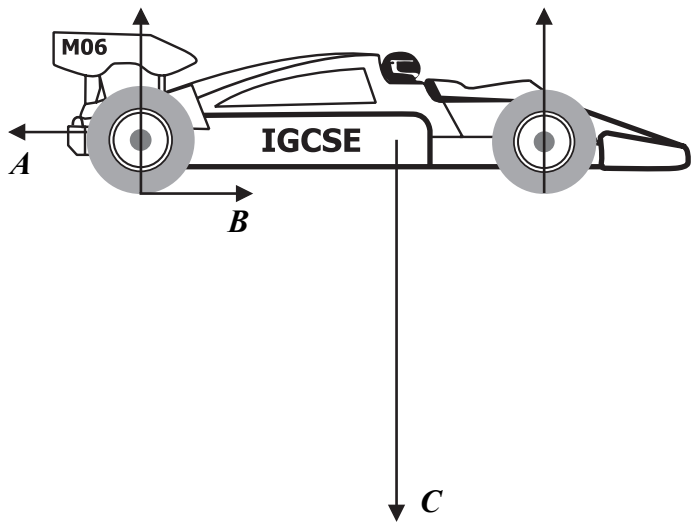
.....

(3) **Q2**

(Total 7 marks)

Leave blank

3. (a) A racing car is moving on a straight and level road. Several forces act on the racing car.
The size and direction of three forces is shown by arrows ***A***, ***B*** and ***C***.



(i) Mark with an **X** the centre of gravity of the racing car.

(1)

(ii) Complete the table. Use the letters ***A***, ***B*** and ***C*** from the diagram to show the forces acting on the car.

Force	Letter
force moving the racing car forward	
backward force	
weight	

(2)

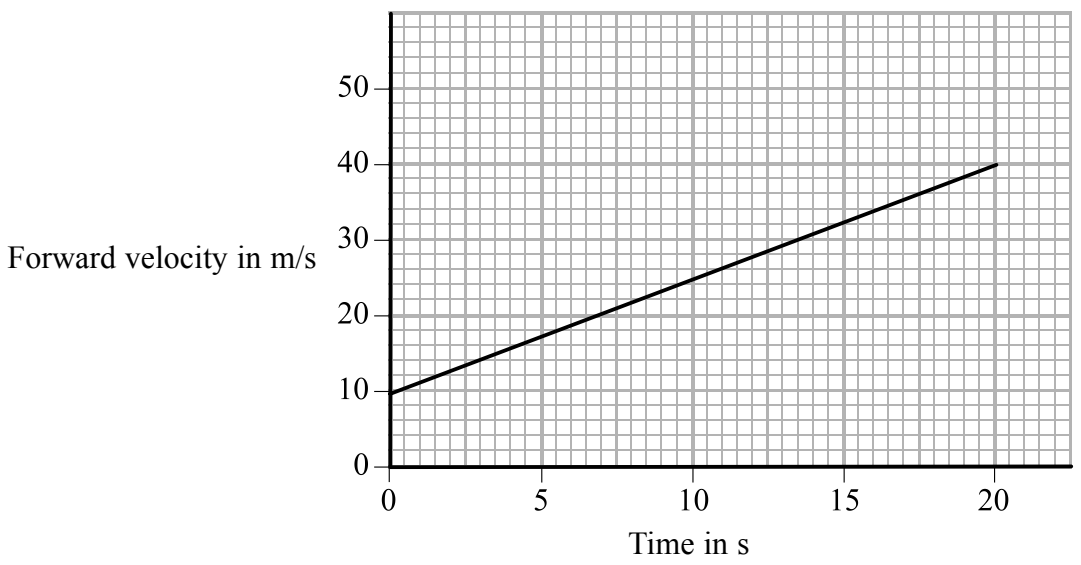
(iii) What causes most of the backward force acting on the racing car?

.....

(1)

Leave blank

(b) The racing car is moving forward at 10 m/s. The graph shows its velocity for the next 20 seconds.



(i) What feature of the graph shows that the racing car is accelerating?

.....

(1)

(ii) Use the graph to calculate the distance travelled in metres in these 20 seconds.

.....

.....

Distance travelled = ... m

(2)

Q3

(Total 7 marks)

Leave blank

4. The drawing shows a ship and a cliff on the coast.

not to scale

(a) The ship is not moving. It sounds its foghorn. An echo from the cliff is heard on the ship after 7.0 s.

(i) Complete the sentence.

There is an echo because the sound is ..... from the cliff.

(1)

(ii) How long in seconds does it take for the echo to travel from the cliff to the ship?

.....

Time = ... s

(1)

(iii) Sound travels through air at 330 m/s. Use the equation

distance = speed × time

to calculate the distance in metres from the cliff to the ship.

.....

..... Distance = ... m

(2)

(b) The ship moves and sounds its foghorn every ten seconds.
How can the captain tell from the echo if the ship is getting closer to the cliff?

.....

.....

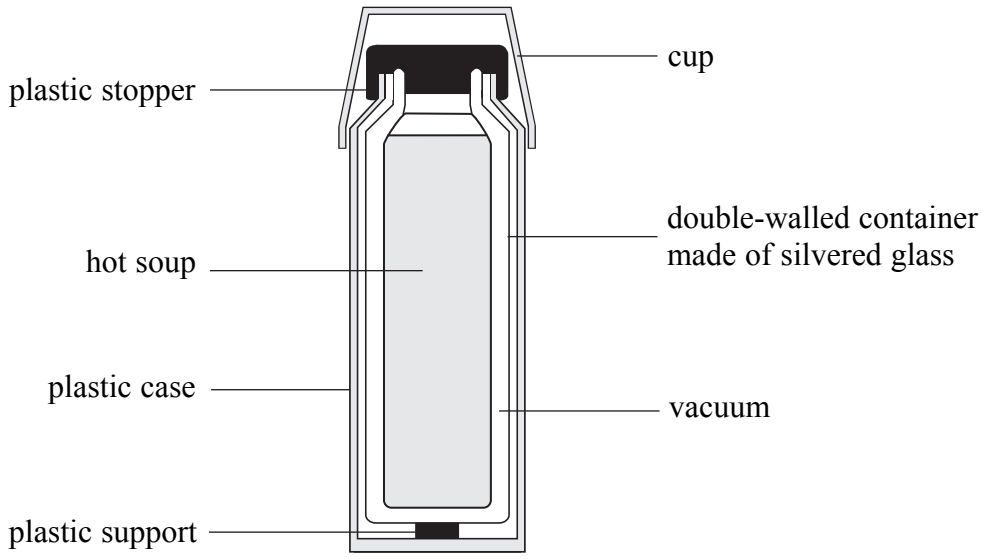
.....

(2) **Q4**

(Total 6 marks)

Leave blank

5. The diagram shows the inside of a vacuum flask. It may be used to keep soup hot.



(a) Energy transfer can take place by conduction, by convection and by radiation.

Which two of these energy transfers **cannot** take place through a vacuum?

..... and .....

(1)

(b) Explain how the vacuum flask reduces energy transfer by radiation.

.....

.....

.....

(2)

(c) In some vacuum flasks both the case and the double-walled container are made of metal. These vacuum flasks are stronger. However they are heavier.

State and explain one other disadvantage apart from cost.

.....

.....

.....

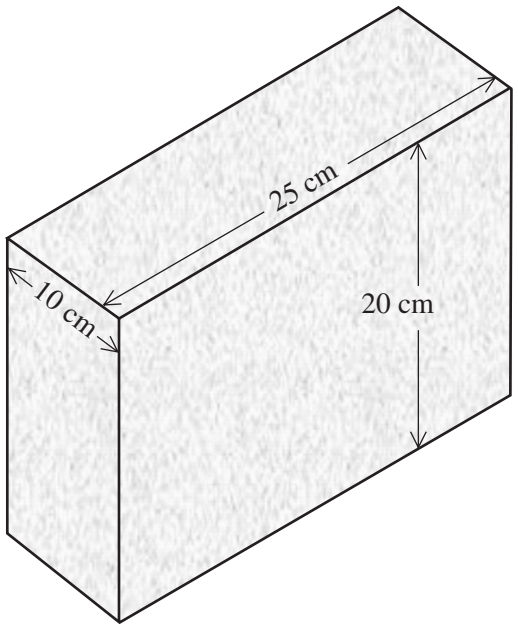
(2)

Q5

(Total 5 marks)

Leave blank

6. The diagram shows the measurements of a building block.



The building block weighs 120 N. It stands as shown.

(a) Calculate the area in m^2 under the building block.

.....

.....

.....

Area = ... m^2

(2)

(b) (i) State the equation which relates area, force and pressure.

.....

(1)

(ii) Calculate the pressure in Pa under the building block.

.....

.....

Pressure = ... Pa

(2) **Q6**

(Total 5 marks)

Leave blank

7. (a) A radio contains a small step-down transformer. It changes a 230 V a.c. input into a 5.75 V a.c. output.

(i) The letters a.c. stand for alternating current. What do the letters d.c. stand for?

.....

(1)

(ii) Complete the sentence.

The number of turns on the output coil of this transformer is

..... than the number of turns on the input coil.

(1)

(b) Large transformers are used in the system to transmit electrical energy from power stations.

(i) In which part of the system are step-up transformers used to increase the voltage?

.....

(1)

(ii) Why is the voltage increased?

.....

.....

(1) Q7

(Total 4 marks)

QUESTION 8 IS ON THE NEXT PAGE

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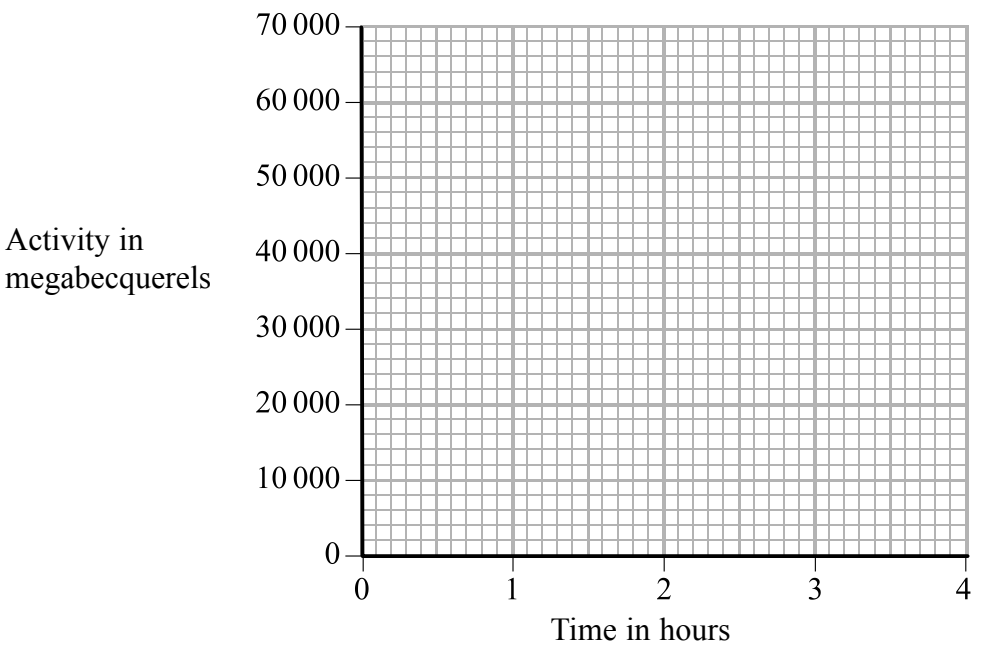
8. A scientist measured the activity of a radioactive isotope. The table shows her results.

Time (hours)	Activity (megabecquerels)
0	64 000
1	45 000
2	32 000
3	23 000
4	16 000

(a) (i) Plot these results on the grid and draw a curve of best fit.



(3)

(ii) Calculate the half-life in hours of this radioactive isotope.

Half-life = ... hours

(1)

(b) The scientist measured the activity in megabecquerels.
How many becquerels (Bq) are there in a megabecquerel (MBq)?

1 MBq = ... Bq

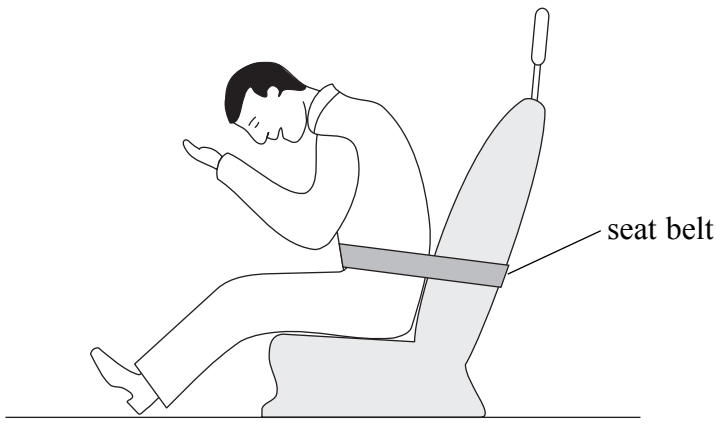
(1)

Q8

(Total 5 marks)

Leave blank

9. A car is travelling along a road. The driver brakes suddenly. A passenger in the car is restrained by his seat belt as shown.



The mass of the passenger is 60 kg. The force exerted by the seat belt on the passenger is 1440 N.

(a) Calculate the deceleration of the passenger and give its unit.

.....

.....

.....

Deceleration = ...

(3)

(b) Draw an arrow on the diagram to show the direction and line of action of the 1440 N force acting on the passenger.

(2)

(c) Force has direction as well as size.
Complete the sentence.

Force is an example of a ..... quantity.

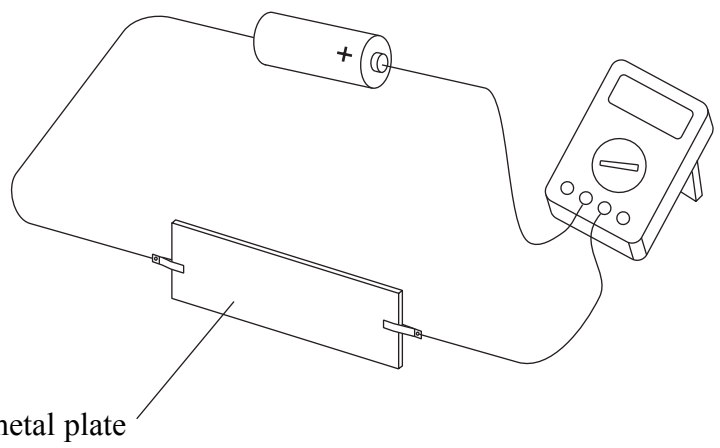
(1)

Q9

(Total 6 marks)

Leave blank

10. (a) A teacher connects a 1.5 V cell to an ammeter and a thin metal plate as shown.



The ammeter shows a reading. The teacher tells the class that the charge carriers in the circuit are electrons. He leaves the circuit connected for ten seconds. A student touches the plate and it feels warm.

(i) Draw an arrow on the plate to show the direction of flow of the electrons.

(1)

(ii) Explain your answer.

.....

.....

(2)

(b) Voltage is energy transferred per unit charge passed.
State the relationship between the volt, the joule and the coulomb.

.....

.....

(1)

Leave blank

(c) The teacher replaces the metal plate with a glass slide of the same shape. He connects the circuit again for ten seconds. The ammeter reading is too low to read.

Explain why the glass slide does not get warm.

.....

.....

.....

.....

(3)

Q10

(Total 7 marks)

QUESTION 11 IS ON THE NEXT PAGE

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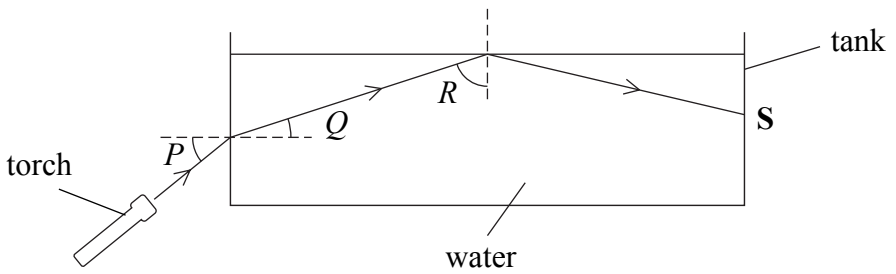
11. (a) A technician sets up a demonstration using a torch and a glass tank. The tank is filled with water. Light from the torch is shone into the tank.



(i) Which of the angles *P*, *Q* or *R* must be greater than the critical angle for water?

Angle .....

(1)

(ii) Explain your answer.

.....

.....

(1)

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

.....

.....

(1)

(ii) The refractive index of water is 1.33. Calculate the critical angle for water.

.....

Critical angle = ...

(1)

(c) (i) Add to the diagram the path of the ray after it strikes the tank at **S**.

(2)

(ii) Explain your answer.

.....

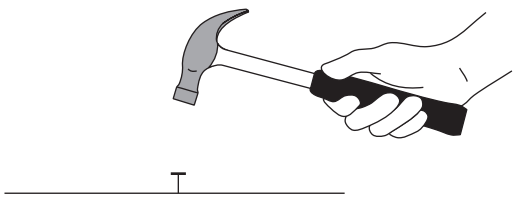
.....

(2) **Q11**

(Total 8 marks)

Leave blank

12. (a) A technician uses a hammer to force a nail into a wooden beam.
The hammer has a mass of 0.40 kg. It has a speed of 5.0 m/s just before it hits the nail.



Calculate the kinetic energy of the hammer just before it hits the nail and give its unit.

.....

.....

Kinetic energy of the hammer = ...

(3)

(b) The technician raises the hammer to a height of 0.75 m above the beam before bringing it down to hit the nail.
Calculate the increased gravitational potential energy of the hammer at a height of 0.75 m above the beam.

.....

.....

Increased gravitational potential energy = ...

(2)

(c) (i) After raising the hammer to a height of 0.75 m, how much work does the technician do in hitting the nail with the hammer? Give its unit.

.....

Work done = ...

(2)

(ii) Explain your answer.

.....

.....

(2)

Q12

(Total 9 marks)

Leave blank

13. (a) Complete the sentences.

(i) The pitch of a sound depends on the ..... of the vibration of the source.

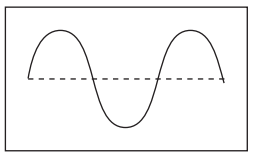
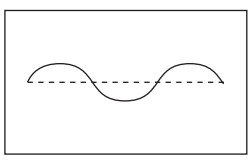
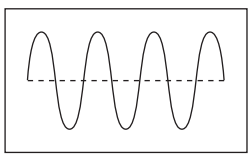
(1)

(ii) The loudness of a sound depends on the ..... of the vibration.

(1)

(b) A sound wave can be displayed using a microphone and an oscilloscope.

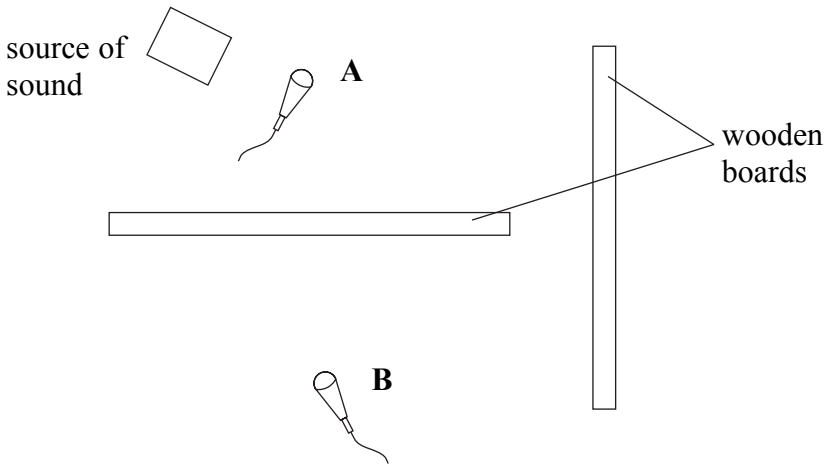
Match each wave pattern to its description. Join the boxes with straight lines.

Wave pattern	**Description**
	loud and high pitched
	quiet and high pitched
	loud and low pitched
	quiet and low pitched

(3)

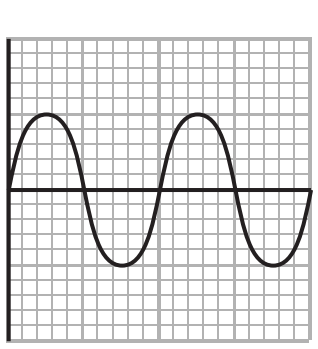
Leave blank

(c) A teacher sets up a demonstration using a source of sound, two microphones, **A** and **B**, and two wooden boards. Each microphone is connected to an oscilloscope. The apparatus is set up as shown.

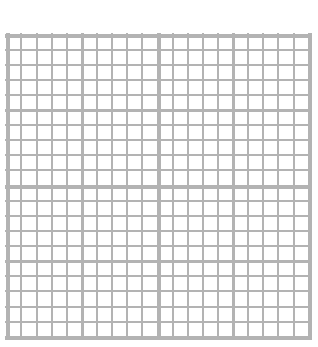


The wave pattern seen on the oscilloscope connected to microphone **A** is shown.

Wave pattern A



Wave pattern B



(i) Draw the wave pattern you would see on the oscilloscope connected to microphone **B**.

(2)

(ii) Explain your answer.

.....

.....

(2) **Q13**

(Total 9 marks)

Leave blank

14. (a) (i) A student takes a balloon to a swimming pool. The balloon is filled with air at a pressure of 120 kPa. The volume of the balloon is 0.025 m^3. He takes the balloon to the bottom of the pool. The pressure inside the balloon increases by 20 kPa.
Calculate the new volume of the balloon.

.....

.....

New volume = ... m^3

(2)

(ii) State two assumptions you have made in your calculation.

1 .....

2 .....

(2)

(b) (i) Define density.

.....

(1)

(ii) Did the density of the air in the balloon decrease, stay the same or increase when the student took the balloon to the bottom of the pool?

.....

(1)

(iii) Explain your answer.

.....

.....

.....

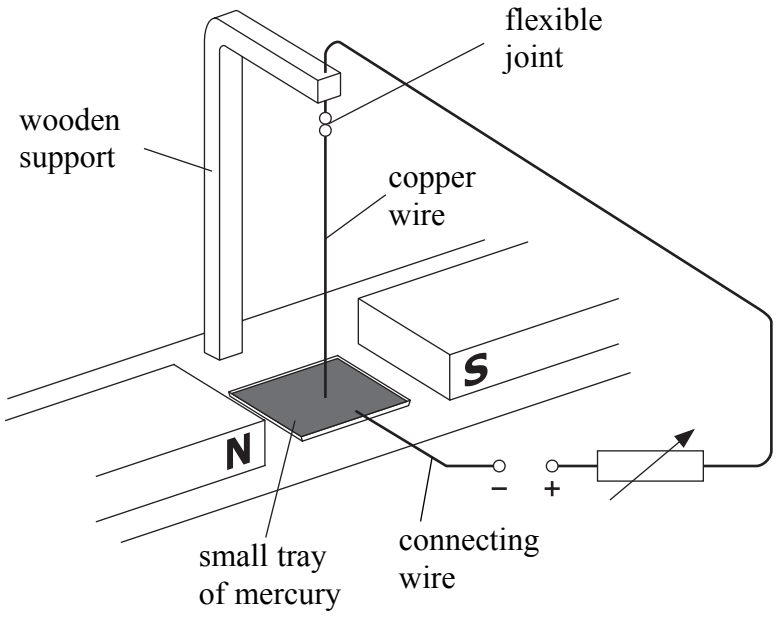
(2)

Q14

(Total 8 marks)

Leave blank

15. (a) A teacher sets up the apparatus shown. A copper wire carrying a current is placed between the poles of two bar magnets. This wire dips into a small tray of mercury.



The teacher sets up the apparatus in a fume cupboard because mercury vapour is poisonous.

Draw arrows on the diagram to show the direction of

(i) the current in the copper wire and label it **I**

(1)

(ii) the magnetic field between the poles and label it **M**

(1)

(iii) the resulting force on the copper wire and label it **F**.

(1)

(b) At first the copper wire does not move.
State two changes that could be made to increase the force acting on the copper wire.

1 .....

2 .....

(2)

(c) Give two reasons why mercury is used in this demonstration.

1 .....

2 .....

(2) **Q15**

(Total 7 marks)

Leave blank

16. (a) Alpha, beta and gamma radiations are emitted during radioactive decay.
Complete the table to show the effects that these emissions have on the atomic and mass numbers of the decaying nuclei.
Choose from the following:

−4 −3 −2 −1 0 +1 +2 +3 +4

	Change in atomic number during decay	**Change in mass number during decay**
alpha	−2	
beta		
gamma		

(5)

(b) During a process called nuclear fusion, two hydrogen-2 nuclei join to form an element X and a neutron.
The nuclear equation describing this process is

$$ {}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} = {}^{\cdots\cdots}_{\cdots\cdots}\mathrm{X} + {}^{1}_{0}\mathrm{n} $$

Balance the equation by writing numbers on the dotted lines.

(2)

(c) ${}^{2}_{1}\mathrm{H}$ and X are not isotopes.
Complete the sentence.

Isotopes have the same number of ..... but a

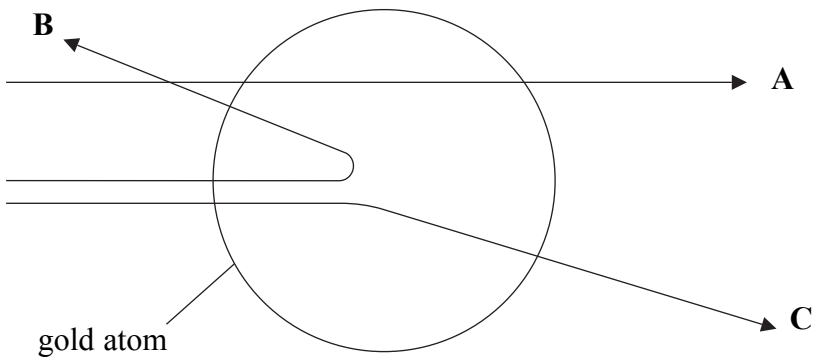
different number of .....

(2) **Q16**

(Total 9 marks)

Leave blank

17. **A**, **B** and **C** are the paths of three alpha particles. They pass through a gold atom.



(a) What information about the structure of the atom is provided by path **A**?

.....

.....

(1)

(b) What information about the size and mass of the nucleus is provided by path **B**?

.....

.....

(2)

(c) What information about the type of charge on the nucleus is provided by path **C**? Explain your answer.

.....

.....

(2) **Q17**

(Total 5 marks)

QUESTION 18 IS ON THE NEXT PAGE

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18. This question is about nuclear fission.

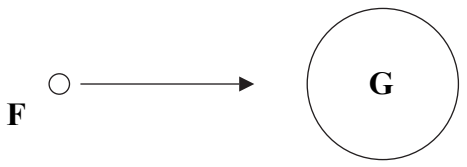
(a) Complete the sentences.

In the process of nuclear fission a ..... collides with a nucleus of ..... . This process releases energy in the form of ..... energy of the fission ..... .

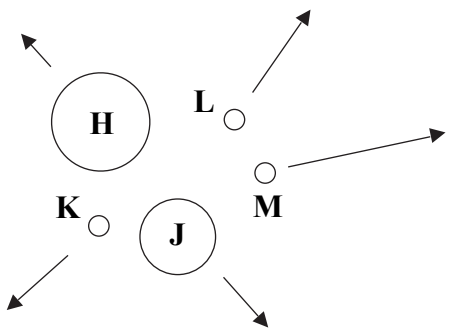
(4)

(b) The diagram shows the process of nuclear fission. The particles are labelled **F** to **M**.

Before



After



Complete the table. Identify particles **H** to **M** by inserting one of the following into each box.

$^{235}_{92}\mathbf{U}$ $^{1}_{0}\mathbf{n}$ $^{141}_{56}\mathbf{Ba}$ $^{92}_{36}\mathbf{Kr}$

H	J	K	L	M

(3) **Q18**

(Total 7 marks)

TOTAL FOR PAPER: 120 MARKS

END