Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	4	2	0	/	2	H	Signature	

Paper Reference(s)

4420/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Tuesday 9 November 2010 – Morning

Time: 2 hours

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
Total	

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. Write your answers 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 individual questions and the parts of questions are shown in round brackets: e.g. **(2)**. There are 17 questions 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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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time	$E = I \times V \times t$
pressure × volume = constant	$p_1 \times V_1 = p_2 \times V_2$
$\frac{\text{pressure}}{\text{kelvin temperature}} = \text{constant}$	$\frac{p_1}{T_1} = \frac{p_2}{T_2}$
$\text{frequency} = \frac{1}{\text{time period}}$	$f = \frac{1}{T}$
$\text{power} = \frac{\text{work done}}{\text{time taken}}$	$P = \frac{W}{t}$
$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$	$P = \frac{W}{t}$

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

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Turn over for Question 1

Leave blank

1. (a) State an equation which relates voltage, current and resistance.

.....

(1)

(b) There is an electric current in a copper wire.

(i) Complete the sentence.

This electric current is the rate of flow of .....

(1)

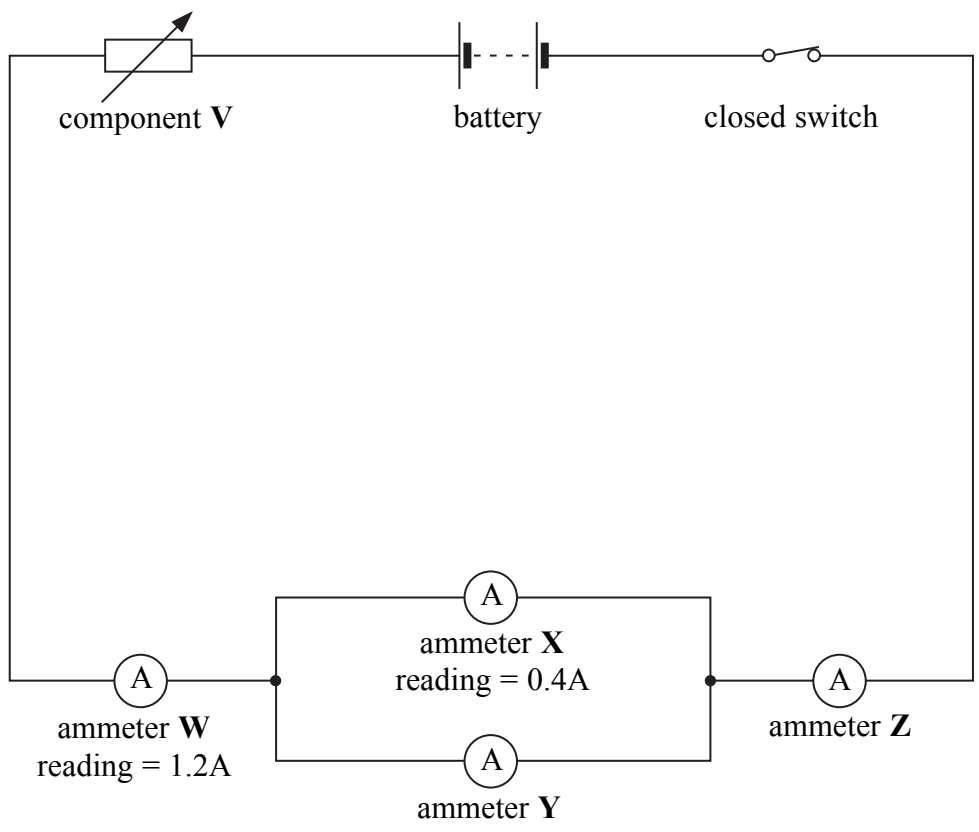
(ii) The copper wire is replaced by an aluminium wire.
This wire has the same thickness and the same length but a greater resistance.

What effect, if any, does this have on the electric current?

.....

(1)

(c) The following circuit diagram shows the places where a student measures the current in a circuit.



Leave blank

(i) Identify component **V**.

.....

(1)

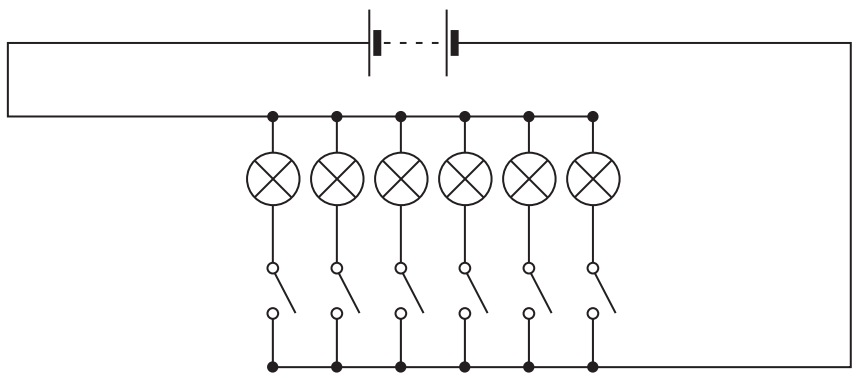
(ii) State the reading in amps on

ammeter **Y** reading = ...A

ammeter **Z** reading = ...A

(2)

(d) The following circuit diagram shows how a toymaker connects the lights in a toy house.



(i) Complete the sentence.

The lights in the toy house are connected in .....

(1)

(ii) Suggest **one** advantage of connecting the lights in this way.

.....

.....

(1) **Q1**

(Total 8 marks)

Leave blank

2. (a) The box contains the names of seven parts of the electromagnetic spectrum.

radio waves	**microwaves**	**infra-red**	**visible light**	**ultraviolet**	**X-rays**	**gamma rays**

(i) Describe the order in which they have been written.

.....

.....

(1)

(ii) The parts are all transverse waves.

State **one** other property which they all have in common.

.....

.....

(1)

(b) Some of the radiation from parts of the electromagnetic spectrum can damage human beings.

Draw lines connecting each of the four parts listed below with the damage caused.

Part	**Damage caused**
microwaves	mutations and cancers
infra-red radiation	internal heating of body tissues
ultraviolet radiation	skin burns
gamma radiation	damage to surface cells and blindness

(3)

(c) Microwaves can be used for cooking.

Give **one** other use for microwaves.

.....

(1)

Q2

(Total 6 marks)

BLANK PAGE

Turn over for Question 3

Leave blank

3. (a) A geologist has discovered a mineral which is radioactive.
The mineral is unstable. It emits ionising radiation in the form of alpha particles, beta particles and gamma radiation.

(i) Describe the nature of beta particles.

.....

.....

(1)

(ii) The emissions are **random**.

What does random mean?

.....

.....

(1)

(iii) Ionising radiations can be detected by using photographic film.

What else can be used to detect them?

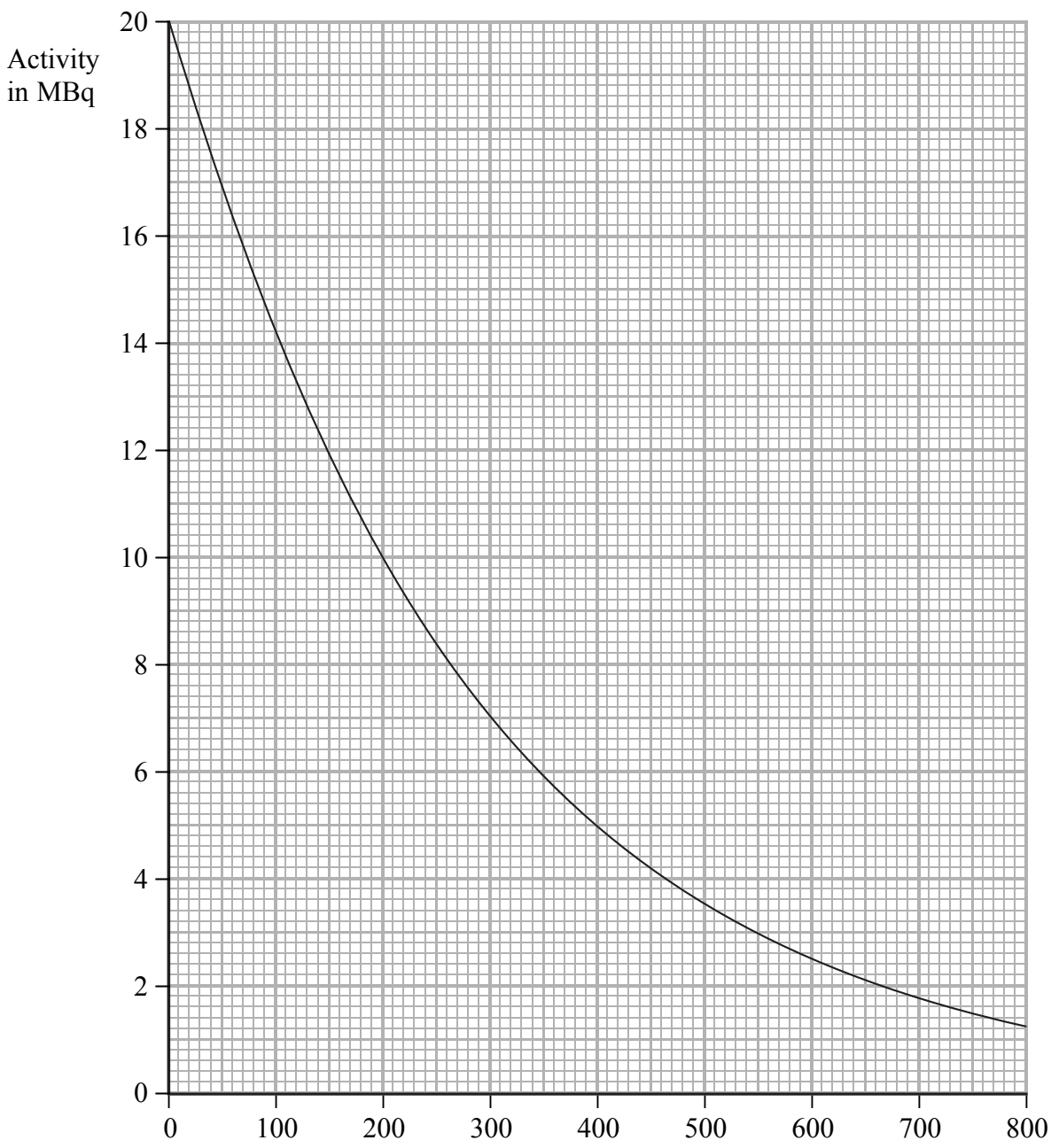
.....

(1)

Leave blank

(b) The graph shows how the activity of a radioactive source varies with time.
Use the graph to calculate the half-life of this radioactive source in millions of years.

Show clearly on the graph how you do this.



Half-life of source = ... million years

(2)

(Total 5 marks)

Q3

Leave blank

4. Energy transfers take place during running.

(a) The box contains the descriptions of nine different forms of energy.

chemical	**electrical**	**kinetic**	**light**	**nuclear**
elastic potential	**gravitational potential**		**sound**	**thermal**

Use the best descriptions from the box to complete the following sentences.

(i) The food eaten and the oxygen breathed provide

the runner with ..... energy.

(1)

(ii) This energy is used in the runner's muscles to give

heat energy and ..... energy.

(1)

Leave blank

(b) In four minutes, a runner transfers 30 000 joules of useful energy output.

(i) Calculate the useful power output of the runner.
Show how you arrive at your answer and state the unit.

.....

.....

Useful power output = ...

(3)

(ii) State the relationship between efficiency and useful energy output.

.....

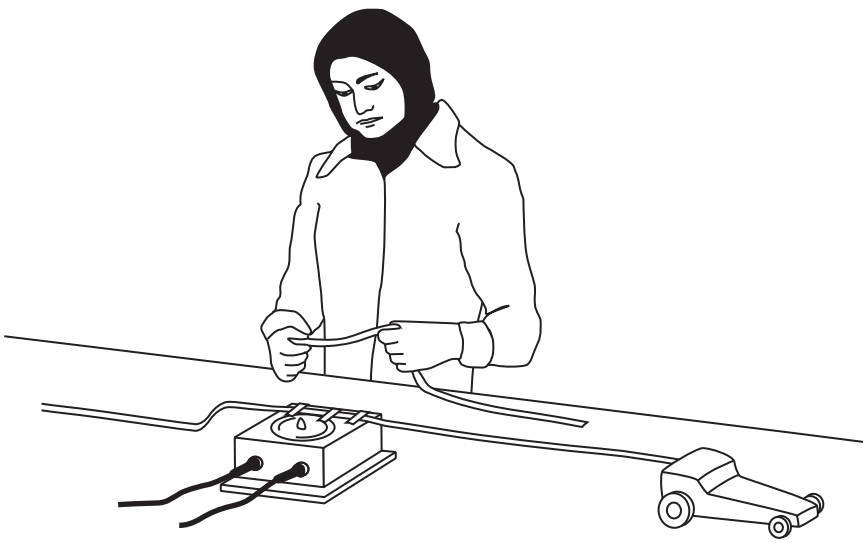
(1)

Q4

(Total 6 marks)

Leave blank

5. A ticker timer is a device which makes dots on a paper tape.
A student fastens one end of the tape to a toy car and uses the ticker timer to record the motion of the toy car.
Her investigation is shown below.



Part of the tape from the student's investigation is shown in the following drawing.

(a) (i) The ticker timer produces dots at a steady rate of 50 dots per second.

Calculate how long, in seconds, it took the toy car to travel from **A** to **B**.

.....

.....

Time taken = ... s
(2)

(ii) Distance **A** to **B** is 73 mm.

Calculate the average speed, in mm/s, of the car as it travelled this distance.

.....

.....

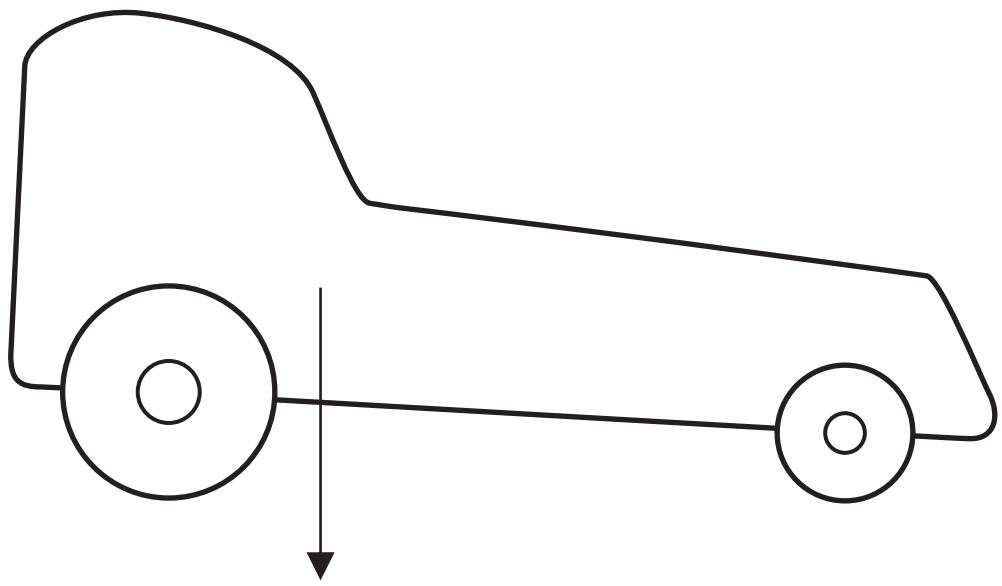
Average speed = ... mm/s
(2)

Leave blank

(b) The diagram shows the toy car and the arrow shows where its weight acts.

Put an **X** on the diagram to show the position of the centre of gravity of the car.

The centre of the **X** should be at the centre of gravity.



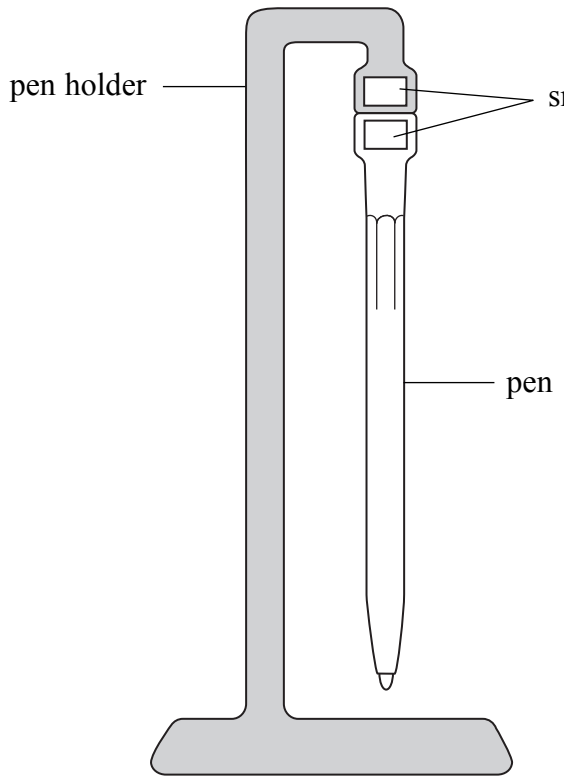
(1)

Q5

(Total 5 marks)

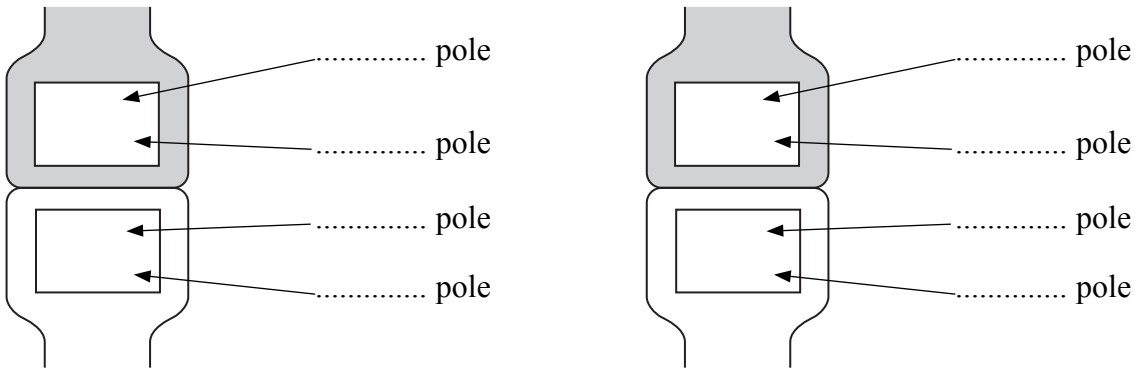
Leave blank

6. The diagram shows a magnetic pen holder.
There is a small magnet in the top of the pen holder and there is another small magnet in the top of the pen.
The upward force from the magnets is greater than the weight of the pen.



There are two ways in which the magnets can be arranged.

Use the letters **N** and **S** to show, on the diagrams below, the magnetic poles in each of the two arrangements.



Q6

(Total 2 marks)

Leave blank

7. (a) There is a lowest possible temperature.
It is known as absolute zero.

(i) State this temperature, in degrees celsius, to the nearest whole number.

Absolute zero of temperature = ... °C
(1)

(ii) The air in a room is at 20 °C.
Calculate its temperature in kelvins.

.....

Temperature = ... K
(2)

(b) Complete the sentences.

(i) Increasing the temperature of a gas results in an increase in the average

..... of its molecules.

(1)

(ii) A metal cylinder contains hydrogen gas. The cylinder is sealed.

When the temperature of the cylinder increases the

pressure of the hydrogen gas ..... and

the mass of the hydrogen gas ..... .

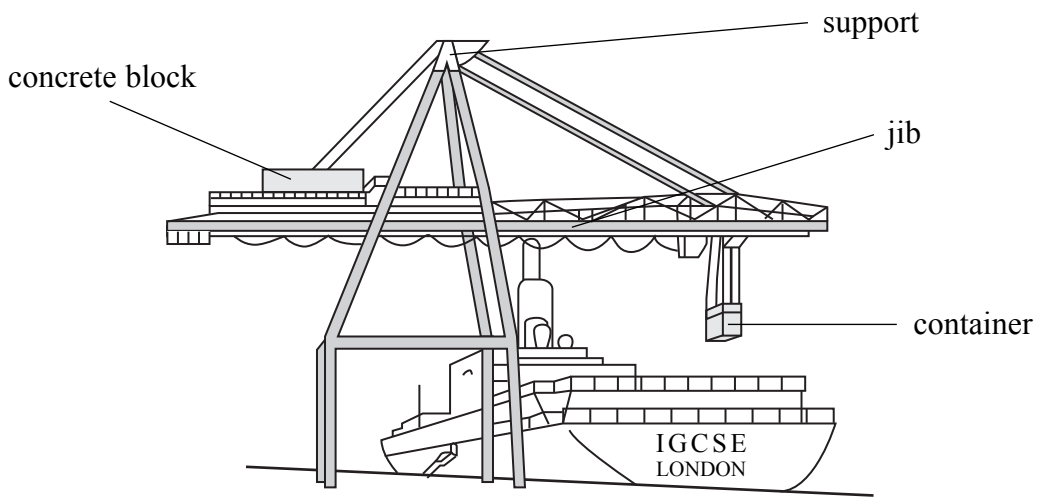
(2)

Q7

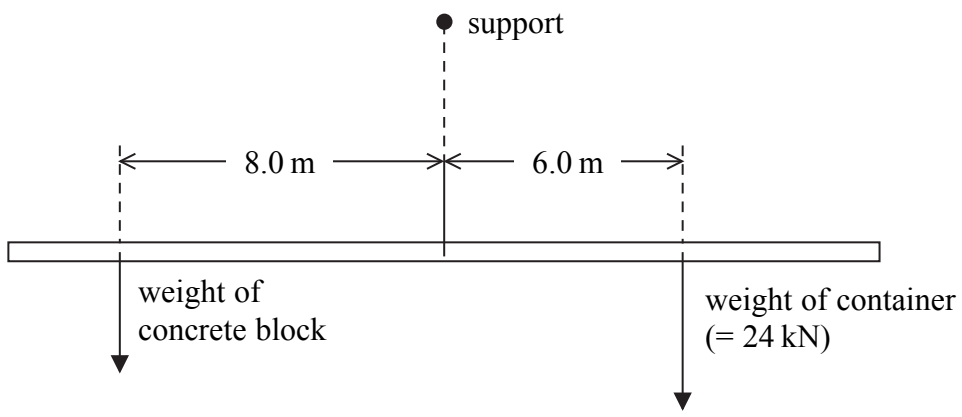
(Total 6 marks)

Leave blank

8. A dockside crane is used to load containers onto a ship.



The jib is designed so that its weight is equally balanced on each side of the support.
The following diagram shows the other turning forces on the jib.
The jib is in equilibrium.



(a) (i) State the principle of moments for a system which is in equilibrium.

.....

.....

(1)

Leave blank

(ii) Use the principle of moments to calculate the weight, in kilonewtons, of the concrete block.

.....

.....

.....

Weight of the concrete block = ... kN

(2)

(b) Another container weighs 26 000 N.

(i) State the equation which relates weight, mass and the gravitational field strength, *g*.

.....

(1)

(ii) Calculate the mass of this container.

Show how you arrived at your answer and state the unit.
g = 10 N/kg

.....

.....

Mass of container = ...

(3)

Q8

(Total 7 marks)

Leave blank

9. The photograph shows two people pushing a car.
They have to push the car with a large force before it just starts to move.

(a) Name the type of force that opposes motion.

.....

(1)

(b) When the car is moving the unbalanced force acting on the car is 150 N.

(i) State the equation which relates unbalanced force, mass and acceleration.

.....

.....

(1)

(ii) What does the term **unbalanced force** mean?

.....

.....

.....

(1)

Leave blank

(iii) The mass of the car is 1200 kg.

Calculate the acceleration of the car and state its unit.

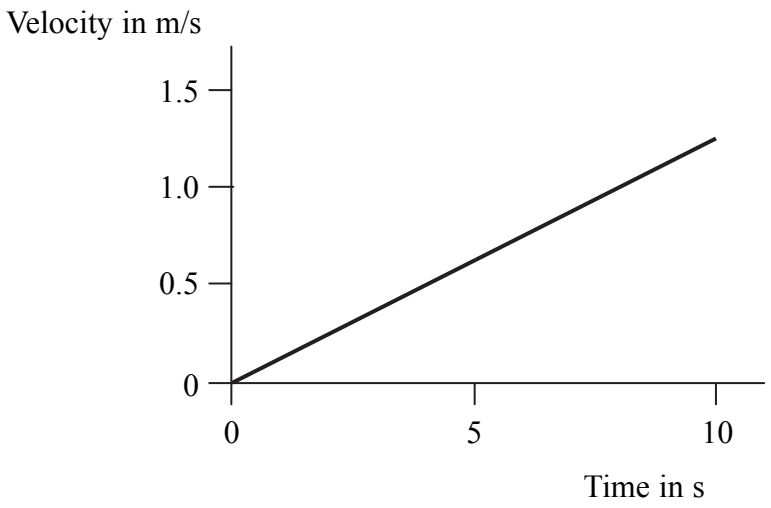
.....

.....

Acceleration .....

(2)

(c) The velocity-time graph shows how the car moves from rest during ten seconds.



Explain whether the graph supports your answer in (b)(iii).

.....

.....

.....

(2)

Q9

(Total 7 marks)

Leave blank

10. The symbol represents a nucleus of carbon-14.

$$^{14}_{6}C$$

(a) (i) State what the number 6 represents.

.....

(1)

(ii) State what the number 14 represents.

.....

(1)

(b) Carbon-14 decays by beta emission to become nitrogen-14.
The chemical symbol for nitrogen is N.

(i) Add numbers to the dotted lines to complete the balanced nuclear equation for this decay.

$$^{14}_{6}C \longrightarrow {}^{\ldots\ldots}_{\ldots\ldots}N + {}^{\ldots\ldots}_{\ldots\ldots}\beta$$

(1)

(ii) Carbon-14 and nitrogen-14 are not isotopes of the same element.

State the difference in their nuclear structures that makes them different elements.

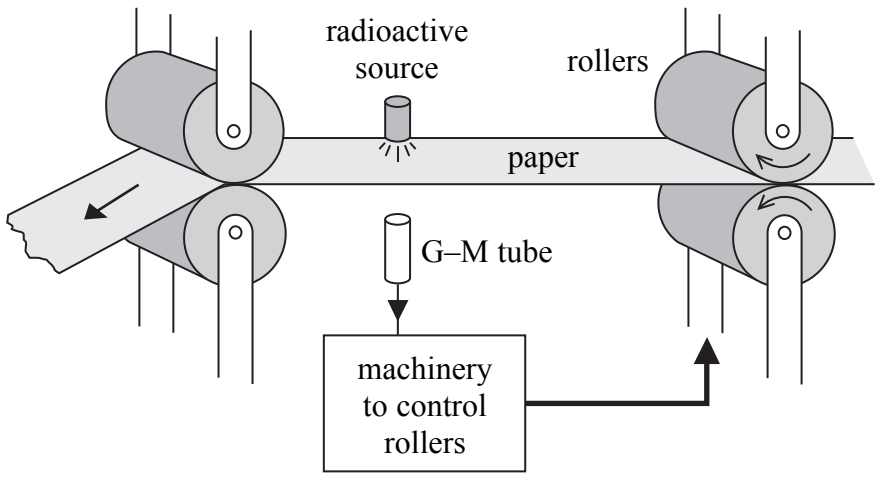
.....

.....

(1)

Leave blank

(c) The diagram shows a radioactive beta source being used to monitor the thickness of paper.



(i) Explain why alpha particles and gamma rays are **not** suitable for this purpose.

Alpha .....

.....

.....

Gamma .....

.....

.....

(2)

(ii) The beta source used is promethium (Pm-147) with a half-life of 2.6 years. The source has to be replaced regularly.

Would you use a source with a longer or shorter half-life?
Explain your answer.

.....

.....

.....

(2)

Q10

(Total 8 marks)

Turn over

Leave blank

11. (a) (i) Choose words from the box to complete the sentences.

cadmium	**gold**	**lead**	**uranium**

You may use each word once, more than once or not at all.

In Rutherford's alpha particle scattering experiment, some alpha particles are deviated when directed at a ..... nucleus.

In nuclear fission, neutrons can be absorbed by ..... nuclei.

(2)

(ii) Considering the charge of each of the particles involved, explain why particles are deviated in Rutherford's experiment but can be absorbed in nuclear fission.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

Leave blank

(b) In Rutherford's alpha scattering experiment the alpha particle can rebound from the target at a similar speed to the incoming speed.
However when a neutron strikes the moderator in a nuclear reactor the neutron slows down.

Apart from electric charge, state which property of the nuclei in the target and the moderator affect the speed of the particle after a collision?

.....

(1)

(c) State why it is necessary to use a moderator to slow neutrons down in a nuclear reactor.

.....

.....

(1)

(d) Describe the action and the purpose of a control rod in a nuclear reactor.

Action .....

.....

Purpose .....

.....

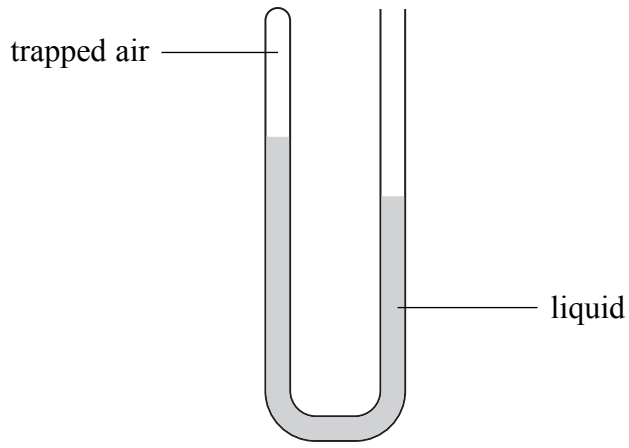
(2)

Q11

(Total 10 marks)

Leave blank

12. The diagram shows part of the apparatus for investigating Boyle's Law.



The volume V of the trapped air can be changed by changing the pressure p exerted on it.

(a) Suggest a way in which p could be increased in this experiment.

.....

.....

.....

(1)

(b) The relationship between p and V is given by

$$p_1V_1 = p_2V_2$$

(i) When the pressure acting on the trapped air is 380 kPa, its volume is 130 cm^3.

Calculate the pressure, in kPa, acting on the trapped air when its volume is 520 cm^3.

.....

.....

.....

Pressure = ... kPa

(2)

Leave blank

(ii) State **two** assumptions made in this calculation.

1 .....

2 .....

(2)

(c) The trapped air exerts a force on the surface of the liquid.

(i) Describe the motion of the air molecules.

.....

.....

.....

(2)

(ii) Describe how the air molecules exert a force on the liquid's surface.

.....

.....

.....

(1) **Q12**

(Total 8 marks)

Leave blank

13. (a) (i) A magnetic field pattern consists of a number of magnetic field lines.

What is shown by the direction of the arrow on a magnetic field line?

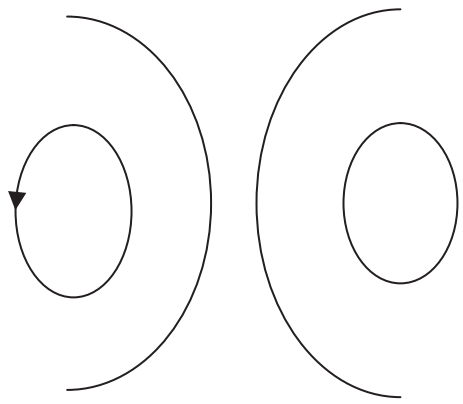
.....

.....

(1)

(ii) The diagram shows part of the magnetic field pattern for a flat circular coil carrying a current.
One of the field lines has its arrow drawn on it.

Add an arrow to **any other line** in the pattern.



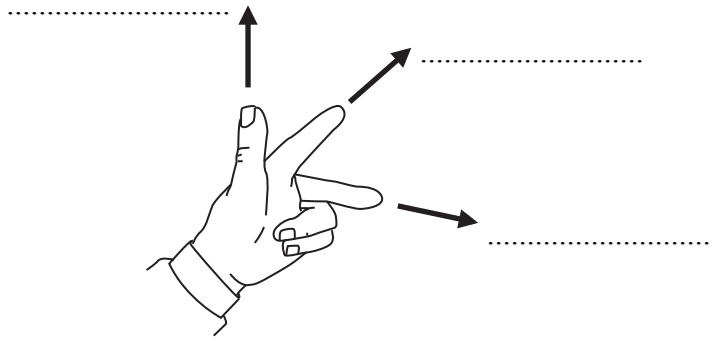
(1)

Leave blank

(b) The left-hand rule can be used to determine the direction of the force acting on a current-carrying conductor in a magnetic field.

(i) Add the following labels to the diagram below to show what the thumb and the fingers represent:

- magnetic field
- current
- force



(2)

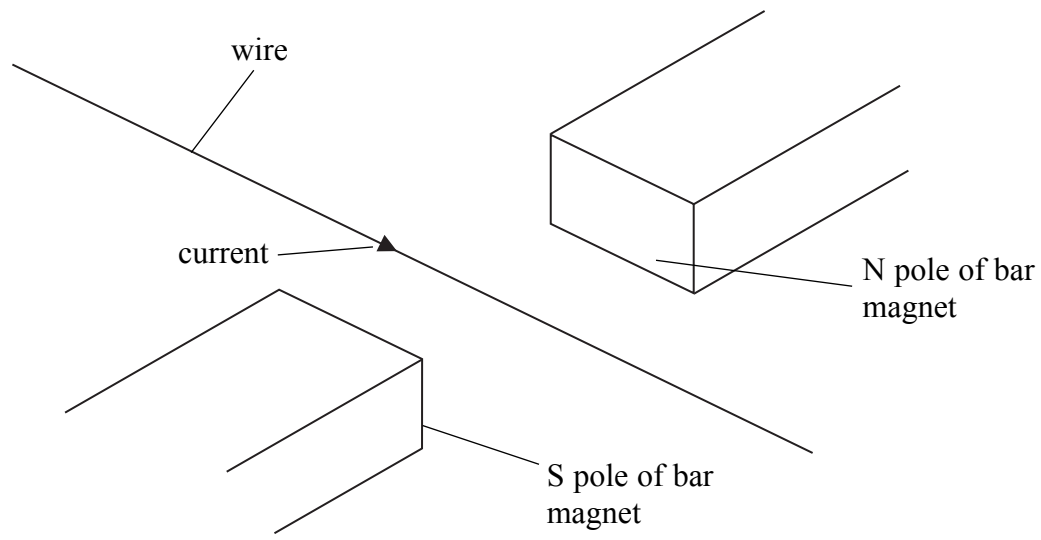
(ii) State **one** application of the effect indicated by the left-hand rule.

.....

(1)

Leave blank

(c) The diagram below shows a wire carrying a current in the magnetic field between the poles of two bar magnets.



(i) Add an arrow to the diagram to show the direction of the force acting on the wire.

(1)

(ii) State **two** ways in which this force could be increased.

1 .....

2 .....

(2)

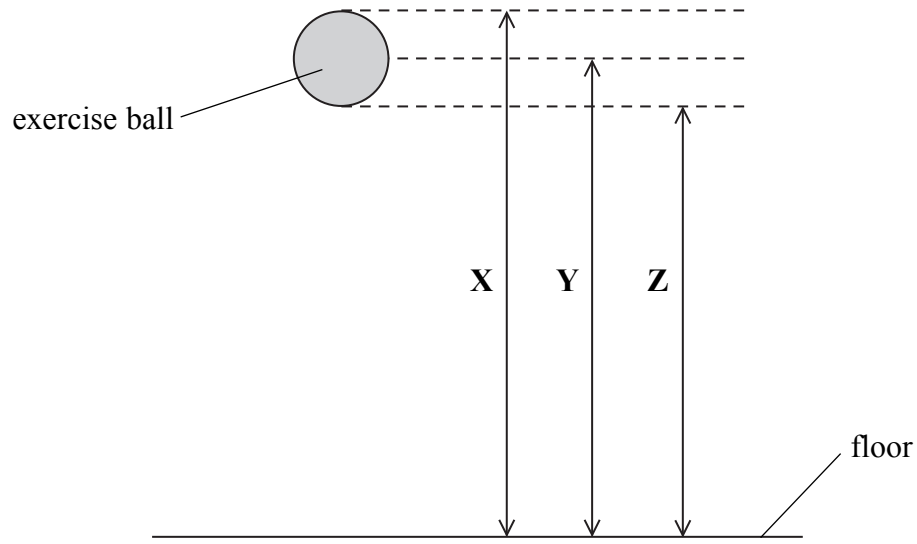
Q13

(Total 8 marks)

Leave blank

14. An exercise ball of mass 0.50 kg falls through a distance of 3.8 m onto the floor of a gym.

Three distances **X**, **Y** and **Z** are shown.



(a) (i) Show that the loss in gravitational potential energy of the ball is 19.0 J.

.....

.....

.....

(2)

(ii) Which distance **X**, **Y** or **Z** represents 3.8 m on the diagram?

.....

(1)

Leave blank

(b) On the way down 3.0 J of energy is transferred from gravitational potential energy to heat energy.

(i) Calculate the kinetic energy, in joules, of the ball just before it reaches the floor.

.....

Kinetic energy = ... J
(2)

(ii) Calculate the speed, in m/s, of the ball just before it reaches the floor.

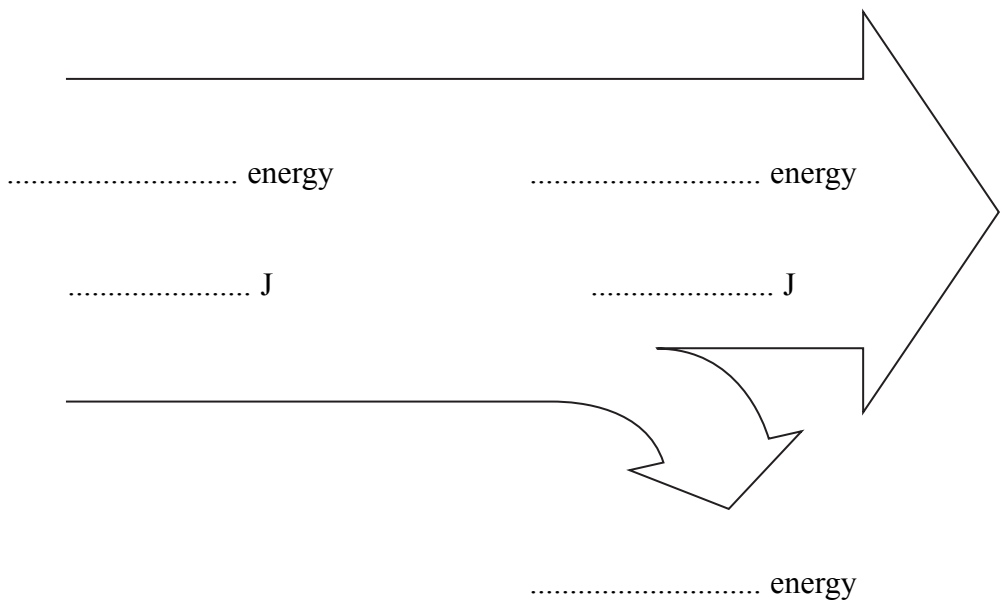
.....

.....

Speed = ... m/s
(2)

(iii) The diagram shows the energy flow for the falling ball.

Fill in the gaps in the diagram.



..... J

(2) **Q14**

(Total 9 marks)

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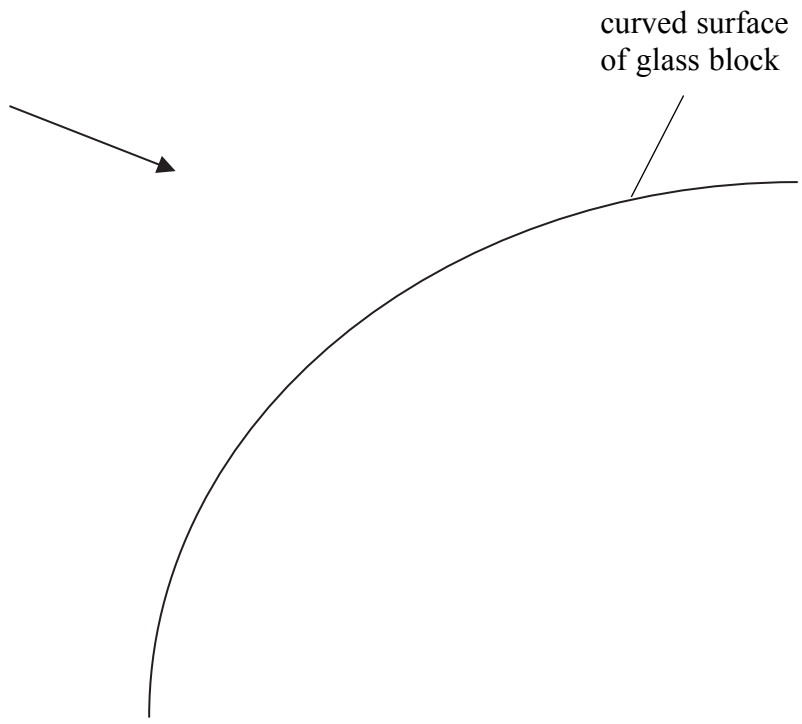
15. (a) The diagram shows a ray of light going through air towards a glass block with a curved surface.



(i) Use a ruler to draw the path of the ray as it continues towards the glass block and then goes through the glass block.

Add labels to the diagram to show the following:

- incident ray
- normal
- angle of incidence, *i*
- refracted ray
- angle of refraction, *r*

(4)

(ii) Name **two** pieces of apparatus that would be required to carry out this experiment.

1 .....

2 .....

(2)

Leave blank

(b) In an experiment a student gets the following results.

	i (degrees)	*r* (degrees)
Set 1	50	30
Set 2	5	3

(i) State the relationship between *i*, *r* and refractive index, *n*.

.....

.....

.....

(1)

(ii) Calculate a value for refractive index using Set 1.

.....

.....

.....

Refractive index = ...

(2)

(iii) State why Set 2 gives a less reliable value.

.....

.....

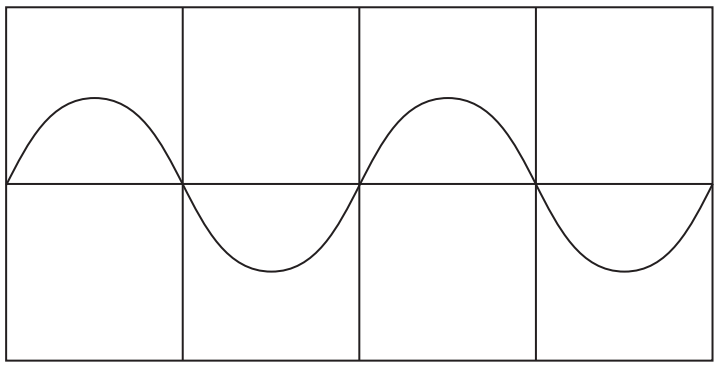
(1)

Q15

(Total 10 marks)

Leave blank

16. The diagram shows a waveform on an oscilloscope screen.



(a) The timebase is set at 0.01s per division.

Determine the frequency of this wave and give its unit.

.....

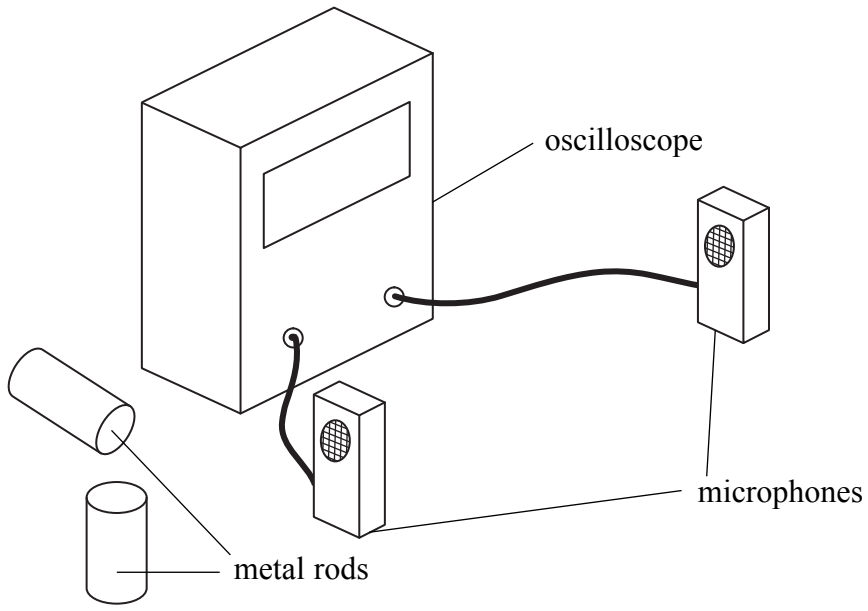
.....

.....

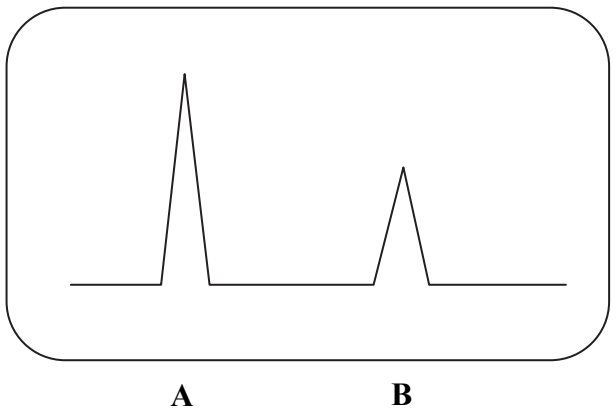
Frequency = ...

(3)

(b) A teacher demonstrated a method for determining the speed of sound.
He hit two metal rods together to produce a sound.
The sound was detected by two microphones connected to an oscilloscope.



The screen of the oscilloscope showed two signals **A** and **B** corresponding to the sound received by the two microphones.



The time between the signals was 0.002 s and the distance between the microphones was 0.680 m.

Leave blank

(i) Calculate the speed of sound in m/s.

.....

.....

Speed = ... m/s

(2)

(ii) State which property of a sound wave is represented by the amplitude of the signals.

.....

(1)

(iii) Suggest an explanation for the relative sizes of the amplitudes of **A** and **B**.

.....

.....

.....

.....

(2)

Q16

(Total 8 marks)

Leave blank

17. (a) Name a non-renewable energy resource.

.....

(1)

(b) Geothermal is a renewable energy resource used in some countries to produce large quantities of electricity.
There are advantages and disadvantages of producing electricity in this way.

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

1 .....

.....

2 .....

.....

(2)

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

1 .....

.....

2 .....

.....

(2)

(c) Name **two** renewable energy resources which depend on weather conditions.

1 .....

2 .....

(2) **Q17**

(Total 7 marks)

TOTAL FOR PAPER: 120 MARKS

END