

Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 2: Physics

For Examination June 2023

(2 hours)

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

INSTRUCTIONS:

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Objective section consists of 25 questions, and it is essential that you attempt all of them.
- Each question has four options labelled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple choice answer sheet using a soft pencil.
- Attempt all the questions from subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- You are allowed to use a calculator if needed.

INFORMATION:

- This paper has a total of 100 marks.
- In objective section there are 25 questions, each carries one mark. There is no negative marking for incorrect responses.
- In subjective section, 45 marks are for extended theory and 30 marks for practical component.

The number of marks assigned for every question or its parts is indicated within brackets []

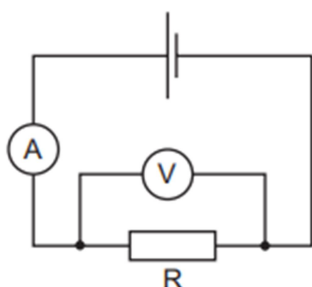
OBJECTIVE SECTION (MCQ)**[25 marks]****Question 1**

Which row of the table is correct for both force and velocity?

	Force	Velocity
a)	Scalar	Scalar
b)	Scalar	Vector
c)	Vector	Scalar
d)	Vector	Vector

Question 2

A student sets up a circuit to determine the resistance of a resistor R. The meter readings are 5.0 A and 10.0 V.



What is the resistance of the resistor R?

- A. 0.5 Ω B. 50.0 Ω C. 2.0 Ω D. 5.0 Ω

Question 3

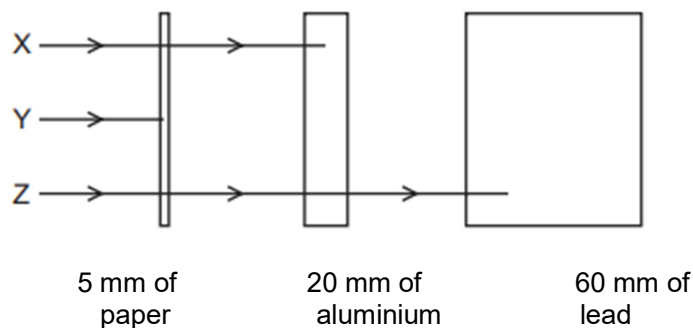
A student uses a piece of metallic wire as a resistor. From the same material, he then makes a second resistor.

The student wants the second resistor to be **higher in resistance** than the first, what should they ensure in the second wire?

- A. It is shorter and thicker
B. It is longer and thinner
C. It is longer and thicker
D. It is shorter and thinner

Question 4

The diagram below shows the different paths of various types of radiation (X, Y and Z).



In the table below, which row correctly matches X, Y and Z?

	X	Y	Z
A	α -rays	β -rays	γ -rays
B	α -rays	γ -rays	β -rays
C	γ -rays	α -rays	β -rays
D	β -rays	α -rays	γ -rays

Question 5

A radioactive rock sample contains 500mg of a radioactive isotope that emits α -rays.

The half-life of this isotope is ten days.

What mass of this isotope would you be expect to have after twenty days?

- A. 500 mg B. 250 mg C. 125 mg D. 60.25 mg

Question 6

Which instrument shown in the table below has the greatest ranges of frequencies?

Instrument	Lowest Frequency (Hz)	Highest Frequency (Hz)
A) Flute	40	2500
B) Piano	30	4100
C) Trumpet	60	1900
D) Saxophone	130	4800

Question 7

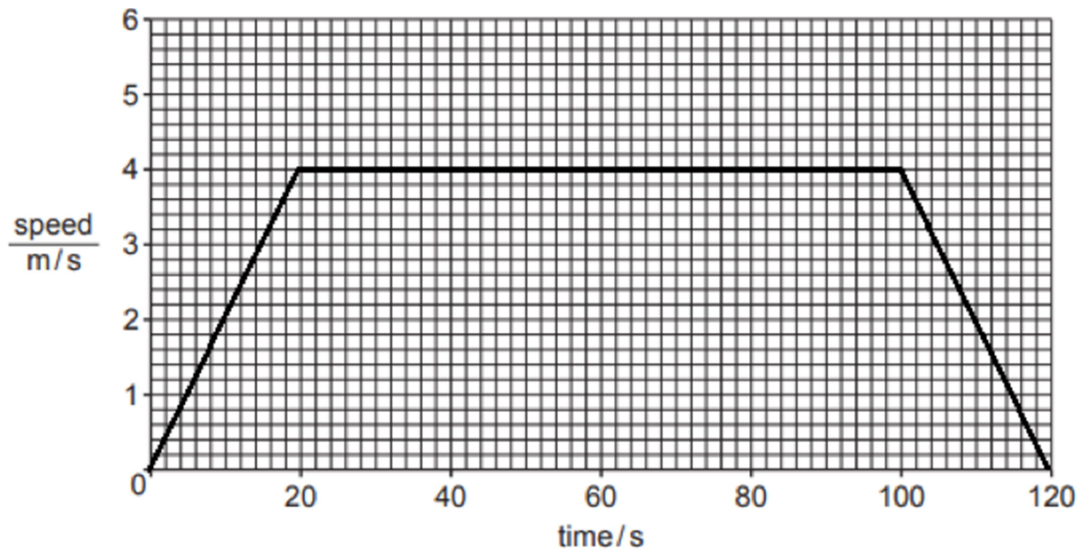
The saxophone is made of a brass alloy. The volume of the alloy that is needed to make the saxophone is 1000 cm^3 . The density of the alloy used to make the saxophone is calculated to be 9 g/cm^3 .

What mass of brass alloy was used in producing the saxophone?

- A) 0.009 g
- B) 111 g
- C) 9000 g
- D) 991 g

Questions 8-10

The graph below shows the journey of a boy jogging along a straight road.



Using the graph, answer the following questions:

Question 8

At what time did the boy start running at a constant speed?

- A) 10 s B) 20 s C) 60 s D) 100 s

Question 9

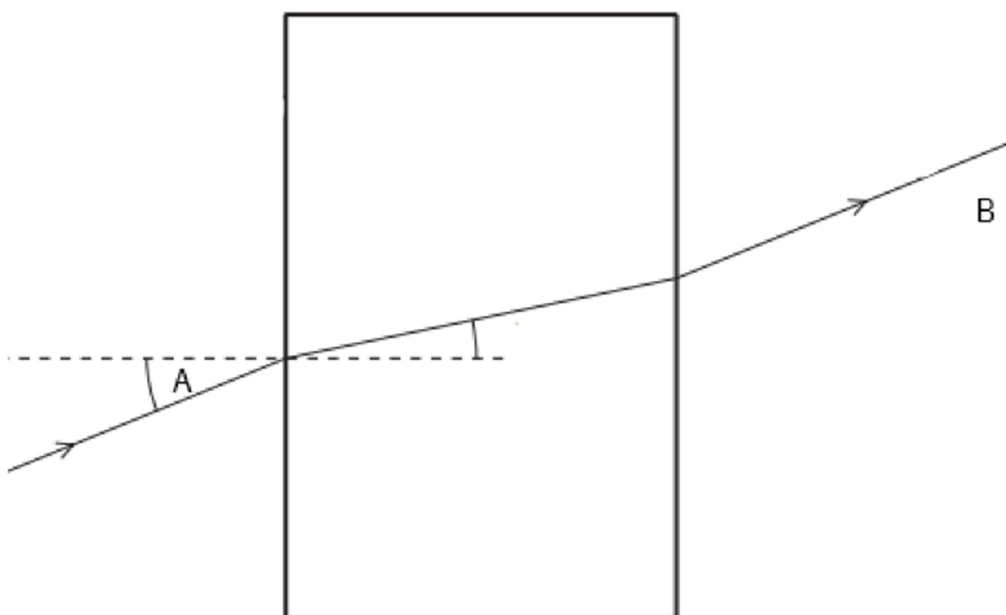
What distance did the boy travel from $t=20$ s to $t=100$ s?

- A) 80 m B) 120 m C) 320 m D) 60 m

Question 10

What was the total distance the boy travelled in his journey?

- A) 460 m B) 240 m C) 400 m D) 80 m



Question 11

A light ray travels through a Perspex block as shown.

The angle shown at A is called

- A) The normal B) The angle of incidence C) The angle of dispersion
- D) The angle of refraction

Question 12

The light ray at B is called....

- A) The incidence ray
- B) The normal
- C) The dispersed ray
- D) The refracted ray

Question 13

A toy car has a mass of 0.20 kg and accelerates at 4.0 m/s^2 . What is the amount of force required to produce this acceleration?

- A) 8.0 N B) 4.2 N C) 3.8 N D) 0.8 N

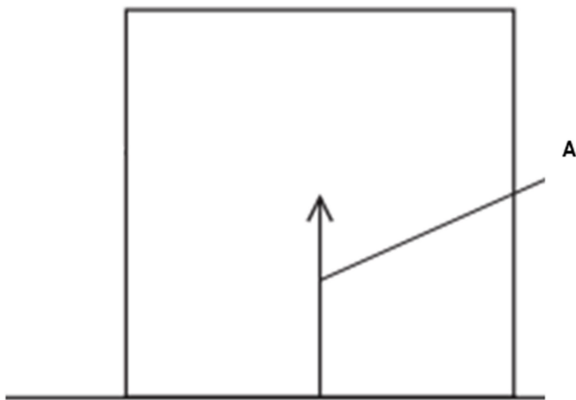
Question 14

A sound wave travels a distance of 260 m in a time of 0.6 seconds. What is the speed of the sound wave?

- A) 433 m/s B) 156 m/s C) 260 m/s D) 510 m/s

Question 15

A box is sitting on a floor with one of the forces acting on it labelled A.



What is producing this force?

- A) The 'normal' force
B) The frictional force
C) The force of the floor pushing on the box
D) The force of gravity

Question 16

A student during an experiment does work by pulling a wooden box across a horizontal floor.

They then repeat the experiment and pull a second box along the same floor.

Identify the correct row that shows that the student is now doing twice as much work.

	Force used to pull box	Distance the box is pulled
(A)	Stays the same	Is doubled
(B)	Stays the same	Is halved
(C)	Is doubled	Is doubled
(D)	Is doubled	Is halved

Question 17

On a warm, summer day, a student places a bottle of soft drink on the ground and then covers it with a wet cloth.

Why does this help reduce the temperature of the soft drink?

- (A) The water has a very thermal capacity
- (B) The water is always cooler than the air surrounding it
- (C) The water helps to insulate the soft drink from the warm air around it
- (D) Some water evaporates from the cloth so that the water remaining becomes colder

Question 18

A student decides to do an experiment and melt some ice. The student melts 500 g of ice at 0°C . The student finds out that the specific latent heat of fusion of ice is $3.34 \times 10^4 \text{ J/kg}$.

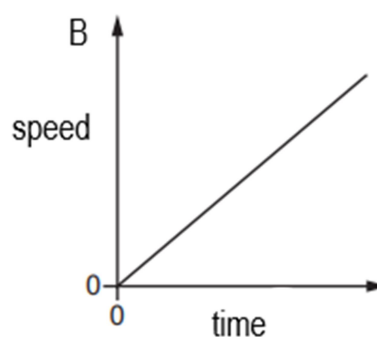
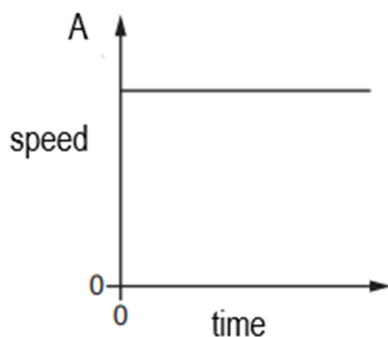
What is the amount of thermal energy required to melt all of the ice at 0°C ?

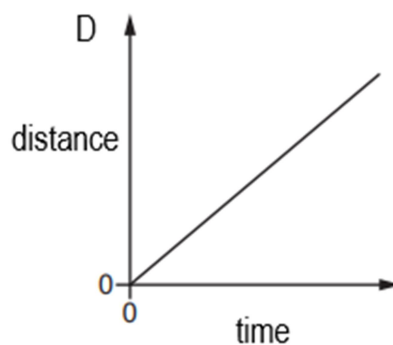
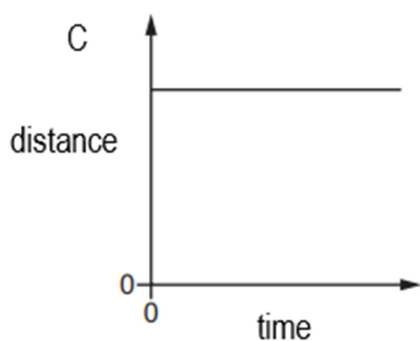
- A) $3.34 \times 10^4 \text{ J}$
- B) $1.17 \times 10^4 \text{ J}$
- C) $1.67 \times 10^5 \text{ J}$
- D) $1.17 \times 10^5 \text{ J}$

Question 19

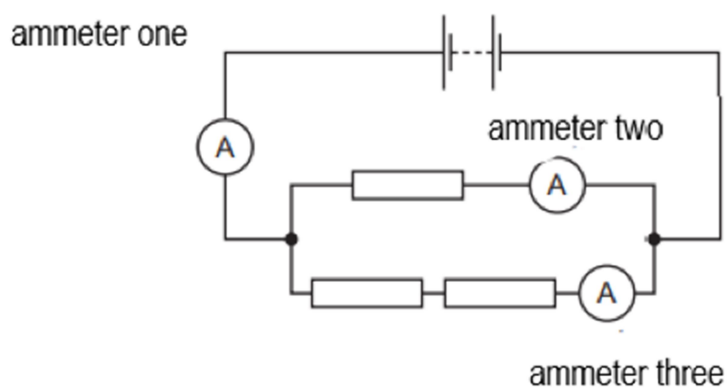
A bicycle is travelling along a straight, level road, with a constant acceleration.

Which graph below shows the motion of the bicycle?





Question 20



Rank the magnitude of readings on the three ammeters from smallest to biggest.

	Smallest	Middle	Largest
(a)	Ammeter 3	Ammeter 2	Ammeter 1
(b)	Ammeter 1	Ammeter 3	Ammeter 2
(c)	Ammeter 2	Ammeter 3	Ammeter 1
(d)	Ammeter 1	Ammeter 2	Ammeter 3

Question 21

An engineer is interested in finding a device that changes the voltage of an electrical supply from 240 V a.c. down to 20 V a.c.

What type of device should they use?

- (A) A voltmeter
- (B) A relay
- (C) A transformer
- (D) A generator

Question 22

Which of the following below statements about electromagnetic induction is correct?

- (A) The effect can only occur when a magnet is moved towards a conductor
- (B) The effect can only occur when a magnet is moved away from a nearby conductor
- (C) A strong magnet held stationary close to a stationary conductor results in a greater effect than a weak magnet
- (D) The effect can only occur when a magnet and a conductor are both moved with the same speed and in the same direction

Question 23

A physics student decides to measure the potential difference across a device and the current in the device.

Which calculation below gives the resistance of the device?

- (A) Potential difference \times current
- (B) Potential difference \div current
- (C) Current \div potential difference
- (D) Current $+$ potential difference

Question 24

Which metal is commonly used for the core of an electromagnet?

- (A) Steel
- (B) Magnesium
- (C) Copper
- (D) Iron

Question 25

As a liquid is heated, it starts to expand.

How does this result in the formation of a convection current?

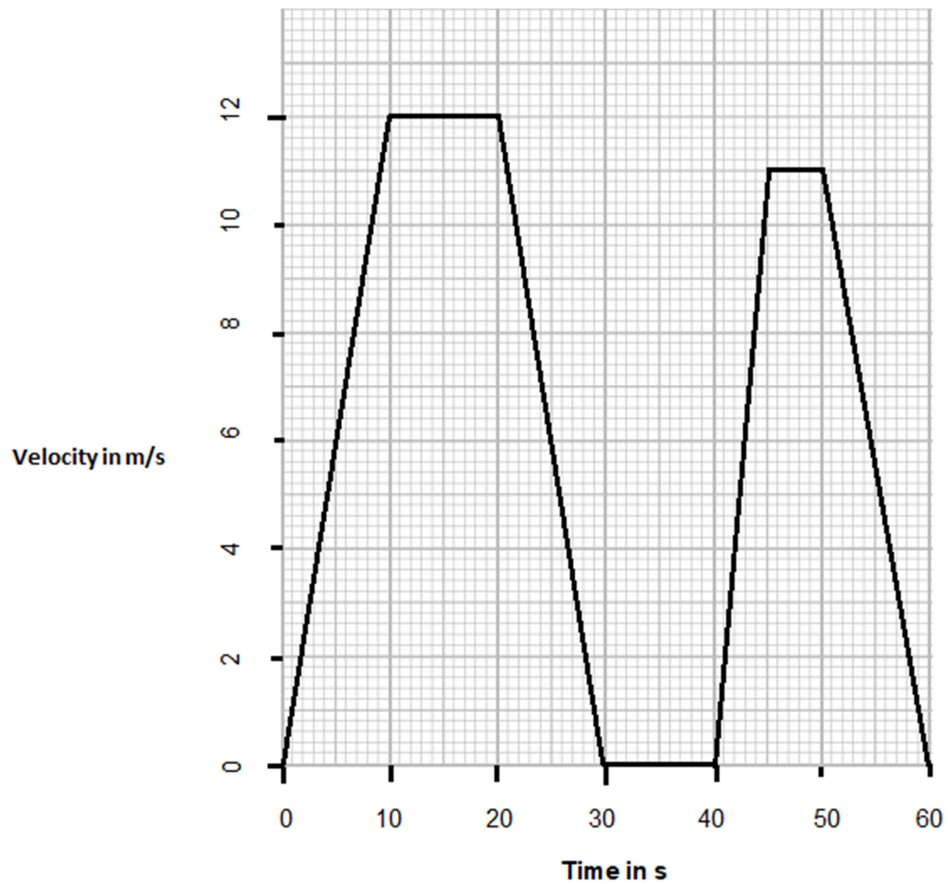
- (A) The density of the heated liquid increases
- (B) The density of the heated liquid decreases
- (C) The mass of the heated liquid molecules increases
- (D) The mass of the heated liquid molecules decreases

Part B (65 marks total)

Question 1

A car travels on a straight road on a bright and sunny day.

The graph shows how the velocity of the car changes throughout its journey.



- a) i) Determine the velocity of the car after 25 s

Velocity = m/s

(1 mark)

- ii) How long does the car remain stationary throughout the entire journey?

Time = s

(1 mark)

- b) i) Write down the equation linking the change in velocity, time taken, and acceleration.

(1 mark)

Equation

- ii) Calculate the acceleration of the car from $t=0$ to $t=10$ s. Make sure you include the unit for acceleration.

Acceleration Unit

(2 marks)

- c) i) State the equation that relates time taken, distance travelled and the average speed.

Equation

(1 mark)

- c) ii) The car travels a total distance of 400 m during the entire journey.

Calculate the car's average speed over the entire journey.

Average speed = m/s

(2 marks)

- c) iii) Passengers in the car report that it travelled further in the first 30 seconds of the journey than it did during the last 30 seconds.

Explain the passenger's statement using the graph.

.....
.....
.....
.....

(2 marks)

[Total = 10 marks]

Question 2

The Moon takes about 27 days to fully orbit the Earth.

- (a) Explain the differences between the orbit of a planet and the orbit of a moon.

.....

.....

.....

.....

(2 marks)

- (b) The radius of the orbit of the Moon is approximately 384 000 km.

Calculate the orbital speed of the Moon as it orbits the Earth. Provide a suitable unit.

Orbital speed = unit

(3 marks)

- (c) Golf was the first sport played on the moon. An astronaut named Alan Shepard reportedly hit a golf ball for 'miles and miles'.

The golf ball had a mass of approximately 50 g and he transferred 60 J of energy to it.

- i) State the equation that links mass, velocity and kinetic energy.

Equation

(1 mark)

- ii) Using this equation, calculate the initial velocity of the ball.

Initial velocity = m/s

(3 marks)

- d) On its journey, as the ball reached its highest point it had gained 15 J of potential energy.

- i) Calculate the kinetic energy of the ball at its highest point.

Kinetic energy = J

(1 mark)

- ii) State the equation that links mass, g (gravitational field strength), gravitational potential energy and height together.

(1 mark)

Equation

- iii) Calculate the maximum height that the ball can reach.
(Assume the gravitational field strength of the moon, $g=1.6 \text{ N/kg}$).

Maximum height of the ball = m

(2 marks)

e) Suggest why the ball that the astronaut hit travelled further on the moon than it would have had he hit it on Earth.

.....

.....

.....

.....

.....

.....

.....

.....

(2 marks)

[Total = 15 marks]

Question 3

A group of students are investigating whether the distance that a toy car will travel along a horizontal floor, before it comes to a stop, depends on its mass.

The following equipment is available to the group:

A wooden ramp

Toy car

A selection of masses

Blocks to help support the ramp (shown below in the diagram)

Other items of common equipment from a physics laboratory

Task: To plan an experiment to investigate whether the distance the toy car travels along a horizontal floor before coming to a stop depends on its mass.

You should include in your plan:

- a brief explanation how you would carry out the investigation
- list any equipment that you would need to use that is not included in the list above
- state the key variables that you would need to control
- draw a table, or tables, with column headings to show how you would display your readings and measurements (readings/measurements are **not** required to be entered in the table)

You may add to the diagram below to help your description.



.....

.....

.....

.....

.....

.....

.....

.....

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dotted lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

[6 marks total]

Question 4

Radon-222 is radioactive. It can be represented as $^{222}_{86}\text{Rn}$

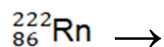
(a) For a neutral atom of radon-222, state the following:

- i) The number of protons,
- ii) The number of neutrons,
- iii) The number of electrons,

(3 marks)

(b) A radon-222 nucleus decays by α -particle emission to a polonium (Po) nucleus.

Complete the equation for the decay of radon-222.



(1 mark)

(c) Radon-222 has a half-life of approximately 3.8 days.

At a point in time, the radioactive sample contains 6.4×10^6 radon-222 nuclei.

Determine the number of α -particles emitted by the radon nuclei after a further 7.6 days.

(3 marks)

[7 marks total]

Question 5

Nuclear fission is a process that is used in nuclear power stations to release large amounts of thermal energy.

(a) Describe how the thermal energy that is released is then used to generate electricity.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

(b) Describe two environmental problems that result in using nuclear power stations.

1.....

.....

.....

2.....

.....

.....

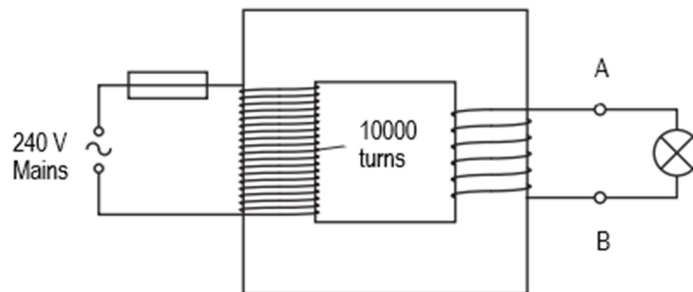
.....

(2 marks)

[5 marks total]

Question 6

A transformer belonging to an engineer is shown below.



There are 10000 turns in the primary coil of the transformer. The primary coil is connected to a 240 V mains supply. A 8.0 V lamp is connected to the secondary coil is operating at full brightness.

- (a) Calculate the number of turns in the secondary coil.

.....

.....

(2 marks)

- (b) i) The current in the lamp is 2.0 A. Assume the transformer is operating with a 100% efficiency.

Determine the current in the primary circuit.

.....

.....

(2 marks)

- b) ii) The primary circuit contains a 2.0 A fuse.
Calculate the maximum number of lamps that can be joined in parallel in the secondary circuit without blowing the fuse. Assume that the lamps are identical to the lamp in (b).

.....

.....

.....

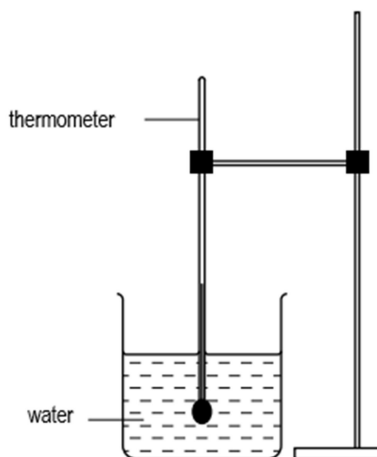
.....

(2 marks)
[6 marks total]

Question 7

A student performs an experiment to investigate water cooling and sets it up as shown below.

A student places a thermometer into a beaker containing 200 cm³ of hot water.



- (a) (i) Record the temperature of the hot water (θ_H) as shown on the thermometer. Write your value in the table below for time $t = 0\text{ s}$ (labelled (a) i)).

(1 mark)

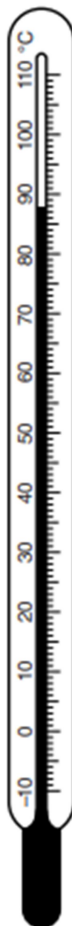


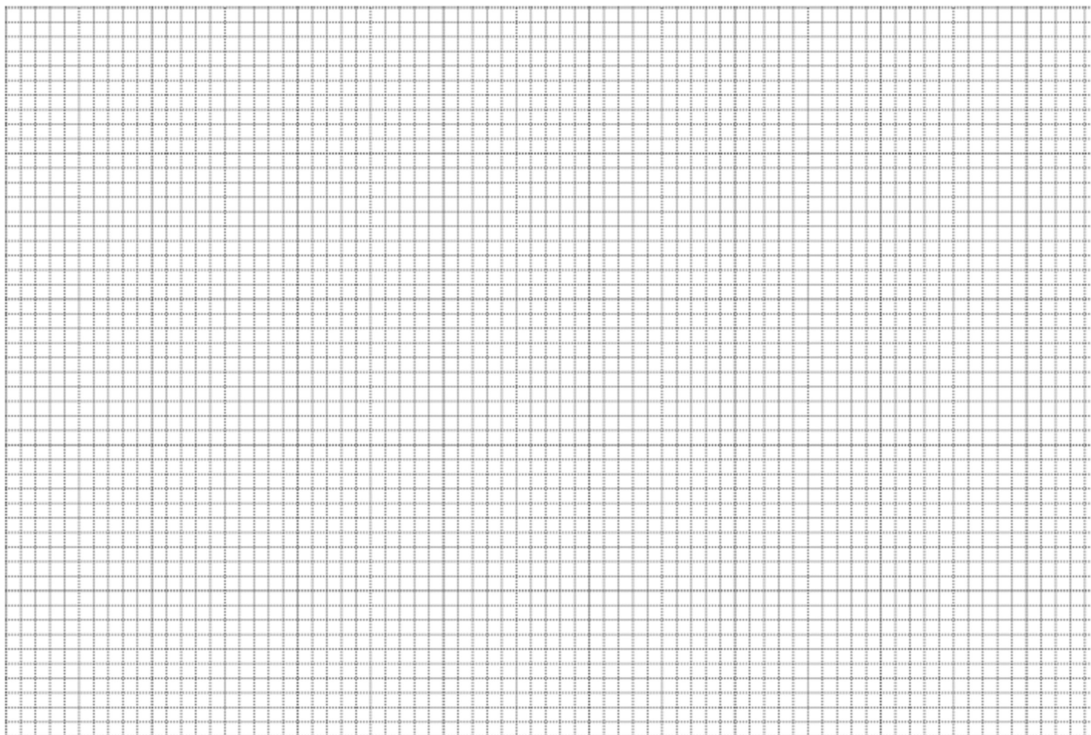
Table: Experimental results

t / _____	θ / _____
0	a)i)
30	70
60	66
90	62
120	59
150	56

Complete the heading for the columns in the table above.

(2 marks)

- (a) ii) Plot a graph of $\theta / ^\circ\text{C}$ (y-axis) against t/s (x-axis). Make sure you include a title and label the axis.



(4 marks)

- (b) i) State the shape of the best-fit graph line that you have drawn above.

.....

.....

(1 mark)

- ii) Describe what the shape of the graph line describes to you about the change, if any, in the rate of cooling of the water in the experiment.

.....

.....

.....

.....

(2 marks)

- d) Describe briefly how a student should read a measuring cylinder to obtain an accurate value for the volume of water. Add a diagram to help your response.

.....

.....

.....

.....

.....

.....

.....

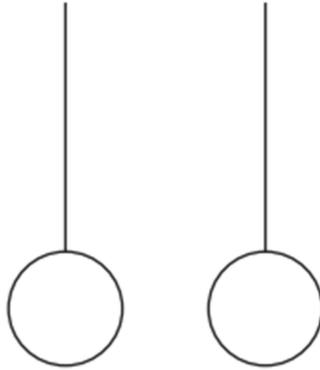
.....

(3 marks)

[13 marks total]

Question 8

Two metallic conducting spheres are hanging suspended on insulating threads (shown below).



The two spheres are now both given positive charges. In the diagram below, draw a possible resulting position of each sphere and thread.

(1 mark)

Explain the positions of the spheres and threads that you have drawn.

.....

.....

.....

.....

(2 marks)

[3 marks total]