

SINGAPORE SPORTS SCHOOL PRELIMINARY EXAMINATIONS SECONDARY 4 EXPRESS

CANDIDATE
NAME

CLASS

4B

Physics

6091/02

Paper 2 Structured and Free Response

28 Aug 2026

Candidates answer on the Question Booklet.

1 hour 45 minutes

No Additional Materials are required.

Reminder on Academic Honesty

All student-athletes are expected to complete this assessment independently.
Do not share, discuss, or seek information about this assessment with others who have yet to complete it.
Any student-athlete who gives, receives, or attempts to obtain unfair assistance will be considered to have breached academic integrity and will face disciplinary action.
As a school, we uphold the value of **Integrity**. Every student-athlete is expected to demonstrate honesty, fairness, and responsibility in all assessments.

READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Section A

Answer **all** questions.

Write your answers in the spaces provided.

Section B

Answer **one** question.

Write your answers in the spaces provided.

Candidates are reminded that all quantitative answers should include appropriate units.

Candidates are advised to show their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **19** printed pages and **1** blank page.

For Examiner's Use	
Q1	7
Q2	7
Q3	5
Q4	9
Q5	8
Q6	7
Q7	7
Q8	10
Q9	10
Q10 or Q11	10
Total	80

- 1 A U-shaped tube of constant cross-sectional area contains water of density 1000 kg/m^3 . Both sides of the U-tube are open to the atmosphere.

Fig. 1.1 shows that the water levels in the two sides of the tube are equal.

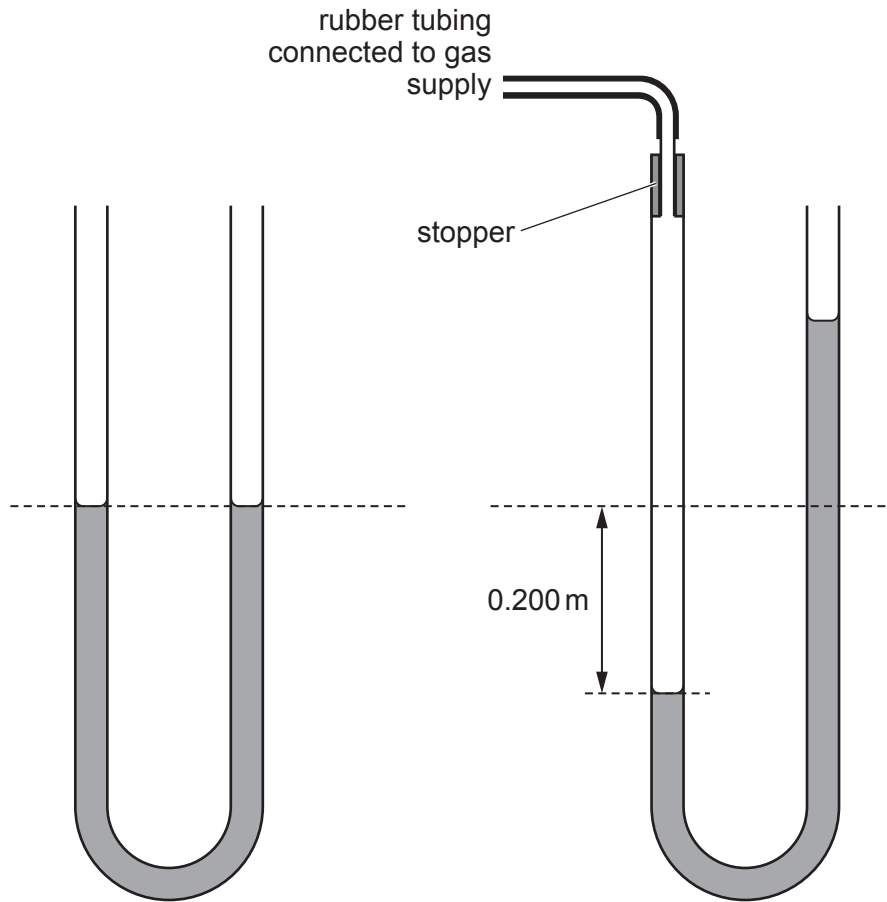


Fig. 1.1

Fig. 1.2

The atmospheric pressure is $1.00 \times 10^5 \text{ Pa}$.

The left-hand side of the tube is now connected to a gas supply using a length of rubber tubing. This causes the level of the water in the left-hand side of the tube to drop by 0.200 m , as shown in Fig. 1.2.

- (a) Calculate the pressure of the gas supply. Give your answer to 3 significant figures.

pressure = [3]

(b) Fig. 1.3 shows that the gas supply is now connected to a cylinder that contains a piston.

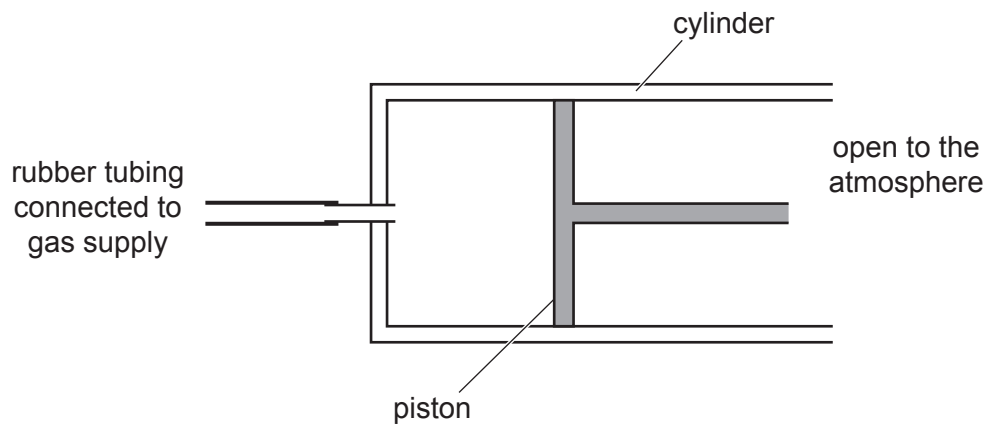


Fig. 1.3

The pressure of the gas moves the piston to the right.

- (i) The area of the piston in contact with the gas is 0.025 m^2 .

Calculate the resultant force on the piston.

resultant force = [2]

- (ii) The pressure of the gas causes the piston to move a distance of 0.50 m to the right.

Calculate the work done by the gas from the supply on the piston.

work done = [2]

[Total: 7]

[Turn over]

- 2 A large test-tube contains a liquid at room temperature. An electric heater is immersed in the liquid and is switched on. Thermal energy is supplied to the liquid by the heater. The temperature of the liquid increases until it reaches its boiling point. The liquid then starts to change into gas.

(a) Describe, in terms of molecules and their motion, how a liquid differs from a gas.

.....

.....

.....

.....

..... [2]

(b) Describe what happens to molecules of the liquid as its temperature begins to increase.

.....

.....

..... [1]

(c) (i) Explain, in terms of molecules, why a supply of thermal energy is needed to change the liquid into a gas.

.....

..... [1]

(ii) The density of the liquid in the test-tube is 0.86 g/cm^3 . The volume of liquid in the test-tube is 50 cm^3 .

The liquid reaches its boiling point. It now absorbs $18\,000 \text{ J}$ of thermal energy and all of the liquid changes into a gas.

Calculate the specific latent heat of vaporisation of this liquid.

specific latent heat = [3]

[Total: 7]

- 3** A metal container is used to cook food. The metal container has thick walls. Hot cooking oil at a temperature of 120°C is poured into the container.

- (a)** The outside surface of the container gets hot. Some thermal energy passes through the metal because vibrating atoms in the metal collide with neighbouring atoms and transfer energy to them.

Explain how the rest of the thermal energy is conducted through the metal container to the outside surface by another process.

.....

.....

.....

..... [2]

- (b)** The outside surface of the container is brightly polished and shiny.

Explain how this allows the container to keep the oil hot for a long time.

.....

.....

.....

.....

..... [2]

- (c)** The metal container is spherical. The spherical container has a smaller surface area than a long, thin container of the same volume.

Explain the advantage of using a spherical container.

.....

.....

..... [1]

[Total: 5]

4 (a) A student wants to demagnetise a permanent bar magnet. She suggests these steps:

1. Place the magnet in a long coil.
2. Switch on a large alternating current in the coil.
3. Switch off the current.
4. Remove the bar from the coil.

State and explain whether the steps will always be able to demagnetise the magnet.

.....

.....

.....

.....[3]

(b) (i) Fig. 4.1 shows a coil supplied with current using a split-ring commutator.

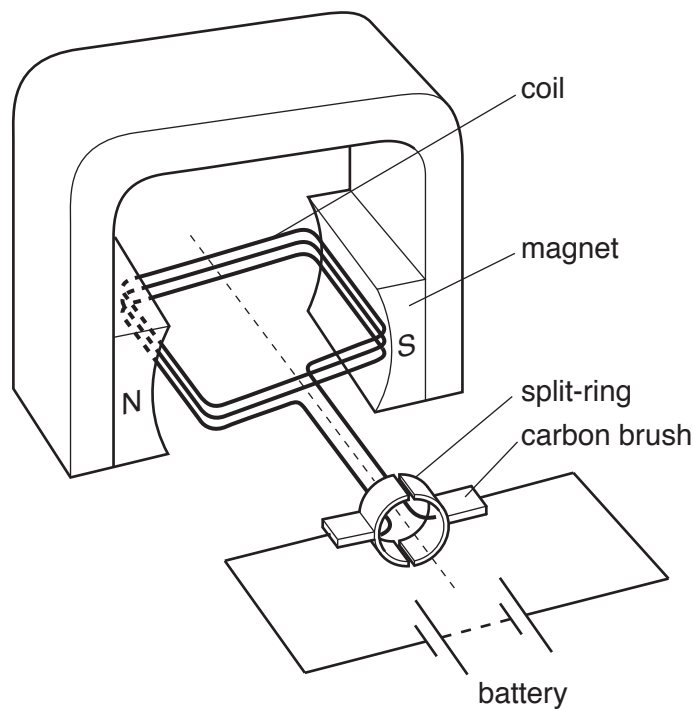


Fig. 4.1

State and explain any motion of the coil.

.....

.....

.....

.....

.....[3]

- (ii) The coil in Fig. 4.1 consists of three turns of wire. The magnetic field strength of the magnet is M . With a current of 2.0 A in the coil, the coil experiences a turning effect T .

The first row of Table 4.1 shows this data.

Table 4.1

number of turns	current in the coil / A	magnetic field strength	turning effect
3	2.0	M	T
3	8.0	M	
6	2.0	M	
3	2.0	$\frac{M}{2}$	

Complete Table 4.1 to give the turning effect for the changes made to the arrangement shown in Fig. 4.1. Choose your answers from the box.

$\frac{T}{8}$	$\frac{T}{4}$	$\frac{T}{2}$	T	$2T$	$4T$	$8T$
---------------	---------------	---------------	-----	------	------	------

[3]

[Total: 9]

[Turn over

- 5 (a) A permanent magnet is made from only one material.

Underline the material from which it is possible to make a permanent magnet.

aluminium copper soft iron mercury plastic steel uranium

[1]

- (b) An electron source produces a narrow beam of electrons. All the electrons travel at the same speed.

The electron source is placed in a vacuum and the beam of electrons travels vertically downwards. Fig. 5.1 shows the beam of electrons before it passes between the N-pole and the S-pole of a magnet.

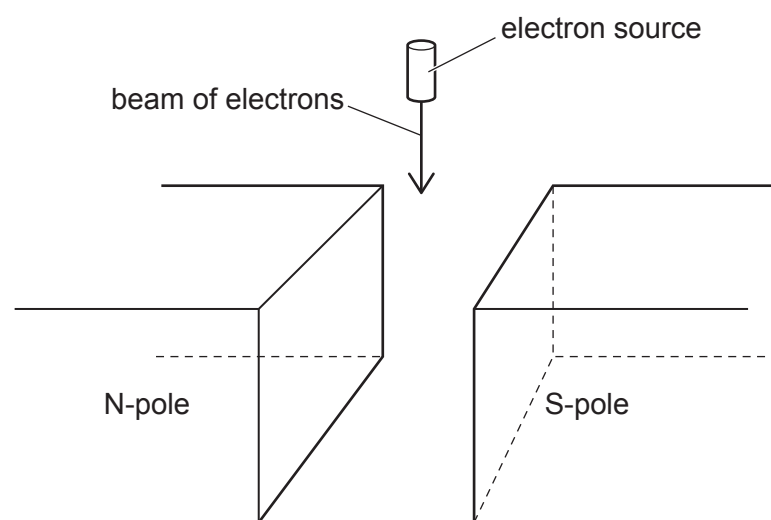


Fig. 5.1

- (i) State the direction of the magnetic field between the two poles in Fig. 5.1.

.....

 [1]

- (ii) Describe and explain what happens to the beam of electrons when it travels between the poles of the magnet in Fig. 5.1.

.....

.....

.....

..... [3]

- (c) A beam consists of α -particles, β -particles and γ -rays.

Explain how a uniform magnetic field may be used to separate the α -particles, the β -particles and the γ -rays.

.....

.....

.....

..... [3]

[Total: 8]

[Turn over

- 6 (a) Explain why the voltage of the supply to the primary coil of a transformer must be alternating.

.....

.....

.....

.....[2]

- (b) Fig. 6.1 shows a transformer.

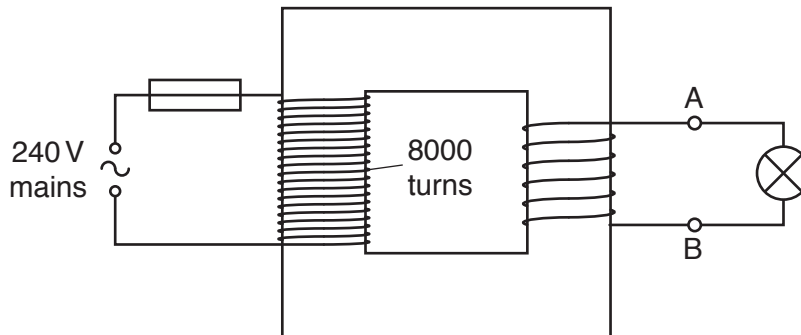


Fig. 6.1

There are 8000 turns in the primary coil of the transformer. The primary coil is connected to a 240 V mains supply. A 6.0 V lamp connected to the secondary coil operates at full brightness.

- (i) Calculate the number of turns in the secondary coil,

number of turns =[2]

- (ii) The current in the lamp is 2.0 A. The transformer operates with 100% efficiency.

Calculate the current in the primary circuit.

current =[2]

- (iii) The primary circuit contains a 2 A fuse.

Calculate the maximum number of lamps, identical to the lamp in (ii), that can be connected in parallel in the secondary circuit without blowing the fuse.

number of lamps =[1]

[Total: 7]

- 7 A radiation detector is placed on the bench in a laboratory. It detects a background count rate of 40 counts/minute.

(a) State what is meant by background radiation. Suggest one source for it.

.....
.....
..... [2]

- (b) A sample containing atoms of the radioactive isotope polonium-208 is removed from a lead container and brought close to the detector. The average count rate increases to 890 counts/minute.

When two sheets of paper are inserted between the sample and the detector, the average count rate returns to 40 counts/minute.

Polonium-208 is represented by the symbol $^{208}_{84}\text{Po}$. It decays to an isotope of lead (Pb).

- (i) Deduce the type of radiation emitted by polonium-208. Explain your answer.

.....
.....
.....
..... [2]

- (ii) Write down the nuclide equation for the decay of polonium-208.

[3]

[Total: 7]

[Turn over]

- 8 (a) A ray of light in air is incident on a glass block. The light changes direction.

State

- (i) the name of this effect,

.....[1]

- (ii) the cause of this effect.

.....[1]

- (b) Fig. 8.1, drawn to full scale, shows a thin converging lens of focal length 3.5 cm.

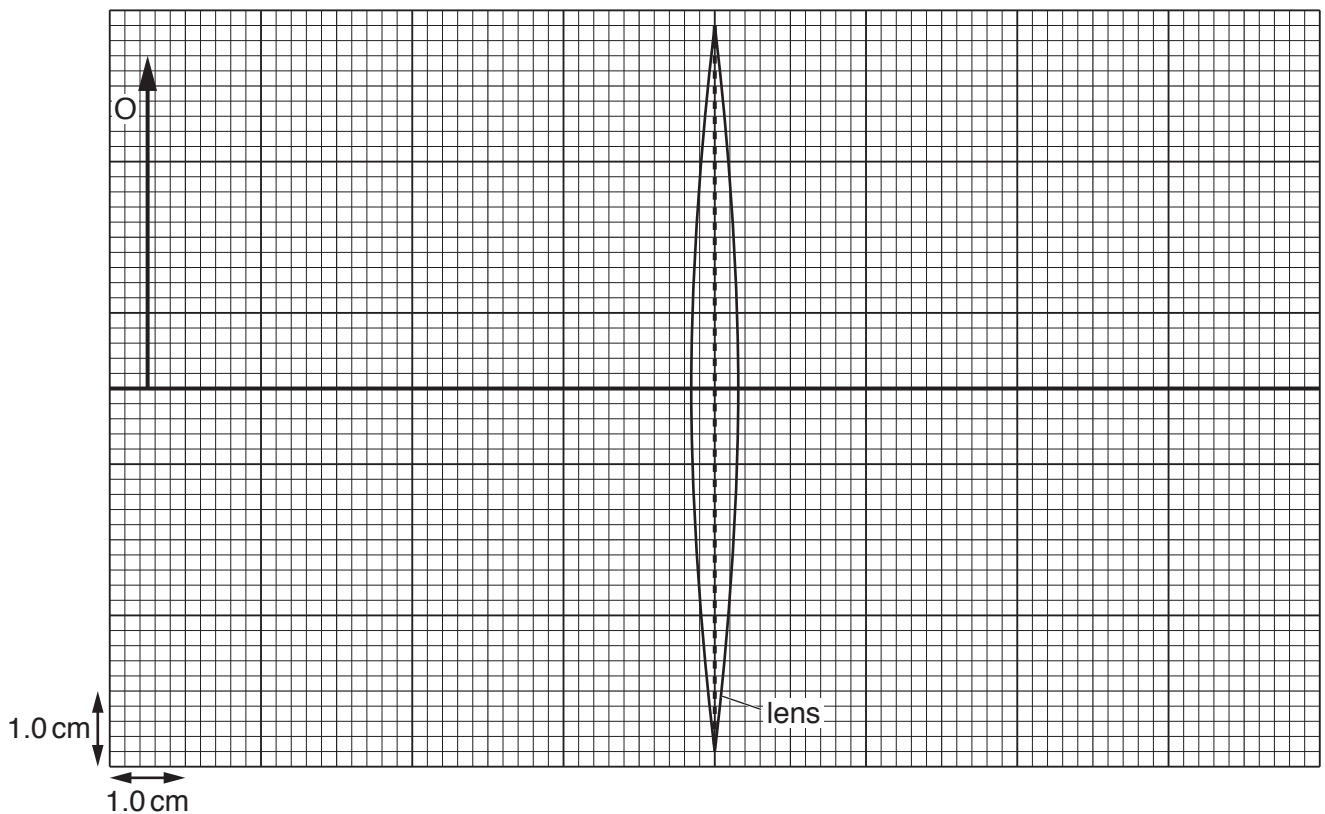


Fig. 8.1

- (i) On Fig. 8.1, mark each of the two principal focuses and label each with the letter F. [1]
- (ii) An object O of height 4.4 cm is placed a distance of 7.5 cm from the lens.
On Fig. 8.1, draw rays from the tip of the object O to locate the image. Draw and label the image. [3]
- (iii) Determine the height of the image.

height of the image =[1]

(iv) Describe the image formed by the lens.

.....

.....

.....

.....[3]

[Total: 10]

[Turn over

9 Typhoons create waves on the surface of the ocean.

Fig. 9.1 gives data on the speed and wavelength of some water waves. The waves travel in deep water of depth 4000m or in shallow water of depth 10m.

depth 4000m	wavelength/m	10	40	100	200	300	400	500	600
	speed m/s	4.0	7.9	12.5	17.7	21.6	25.0	27.9	30.6

depth 10m	wavelength/m	10	40	100	200	300	400	500	600
	speed m/s	4.0	7.6	9.3	9.7	9.8	9.9	9.9	9.9

Fig. 9.1

(a) For the range of wavelengths in Fig. 9.1, state

(i) a similarity in the speed of water waves in deep and shallow water,

..... [1]

(ii) a difference between the speed of water waves in deep and shallow water.

..... [1]

(b) A typhoon, 2000 km away from a stationary ship, forms quickly. It generates water waves for a short period of time.

The waves, with wavelengths between 10 and 600 m, travel across an ocean of depth 4000m to the ship.

(i) Calculate the time taken for the first wave to reach the ship.

time = [2]

(ii) Calculate the frequency of the first wave to reach the ship.

frequency = [2]

- (iii) Determine, to the nearest 100 m, the wavelength of the wave that arrives 4 hours **after** the first wave.

wavelength = [2]

- (iv) As the first waves arrive at the ship, describe

1. the motion of the ship,

.....

..... [1]

2. the effect on the ship of the increase in frequency of the waves that arrive.

.....

..... [1]

[Total: 10]

Section B

Answer either **Question 10** or **Question 11**.

- 10** A vertical tube contains a liquid. A metal ball is held at rest by a thread just below the surface of the liquid, as shown in Fig. 10.1.

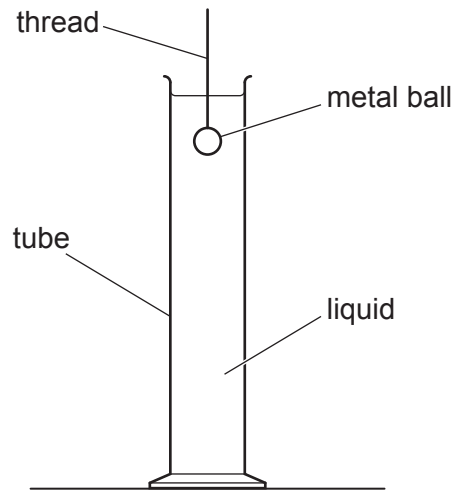


Fig. 10.1 (not to scale)

The diameter of the tube is much greater than the diameter of the ball. The ball is released and it accelerates downwards uniformly for a short period of time.

- (a)** Describe what happens to the velocity of the ball in the short period of time as it accelerates downwards uniformly.

.....
 [2]

- (b)** The ball reaches terminal velocity.

Describe and explain the motion of the ball from when it is released until it reaches terminal velocity.

.....

 [3]

- (c) The metal ball has a mass of 2.1 g. It falls a distance of 0.80 m between being released and reaching the bottom of the tube.

(i) Calculate the gravitational potential energy transferred from the ball as it falls.

gravitational potential energy transferred = [2]

- (ii) When the ball reaches the bottom of the tube, it has a speed of 1.2 m/s. Calculate the kinetic energy of the ball at the bottom of the tube.

kinetic energy = [2]

- (iii) Explain why the value calculated in (c)(i) is different from that calculated in (c)(ii).

.....
..... [1]

[Total: 10]

[Turn over]

- 11 (a) Explain what is meant by *electromotive force* (e.m.f.).

.....

 [2]

- (b) An electric heater contains two heating elements R_1 and R_2 . An electric motor operates a fan. The fan blows cool air over the heating elements.

Fig. 11.1 shows the circuit.

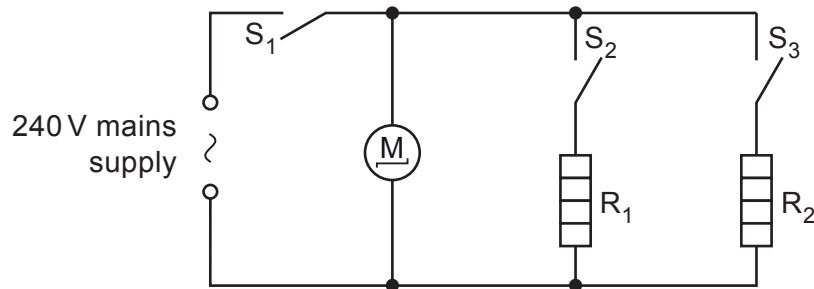


Fig. 11.1

The heater is powered by a mains supply of e.m.f. 240 V.

Switches S_1 and S_2 are closed. Heating element R_1 gets hot. The resistance of R_1 is $30\ \Omega$.

- (i) Calculate the current in heating element R_1 .

current = [1]

- (ii) Calculate the power produced in heating element R_1 .

power = [2]

- (iii) The resistance of heating element R_2 is $60\ \Omega$.

Switches S_1 , S_2 and S_3 are closed.

State and explain how the current in R_2 compares with the current in R_1 .

.....

 [2]

- (iv) The electric heater is designed to operate at high, medium and low heating.

State whether the switches S_1 , S_2 and S_3 are open or closed in their respective mode of operation

mode of heating	S_1	S_2	S_3
high			
medium			
low			

[3]

[Total: 10]

BLANK PAGE