NAME:		( )		CLASS:	

YISHUN TOWN SECONDARY SCHOOL

G3

PRELIMINARY EXAMINATION 2025

SECONDARY 4

G3 PHYSICS

(6091/2)

DATE	**:**	**19 Aug 2025**	**DAY**	**:**	**Tuesday**
DURATION:		**1 hr 45 min**	**MARKS:**		**80 marks**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

Section A
Answer **all** the questions. Write your answers in the spaces provided.

Section B
Answer **one** question. Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

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

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

You may use an approved calculator.

Section A	/70
Section B	/10
TOTAL	/80

Section A

Answer **all** questions.

1 Fig. 1.1 shows one method of measuring the diameter of a beaker.

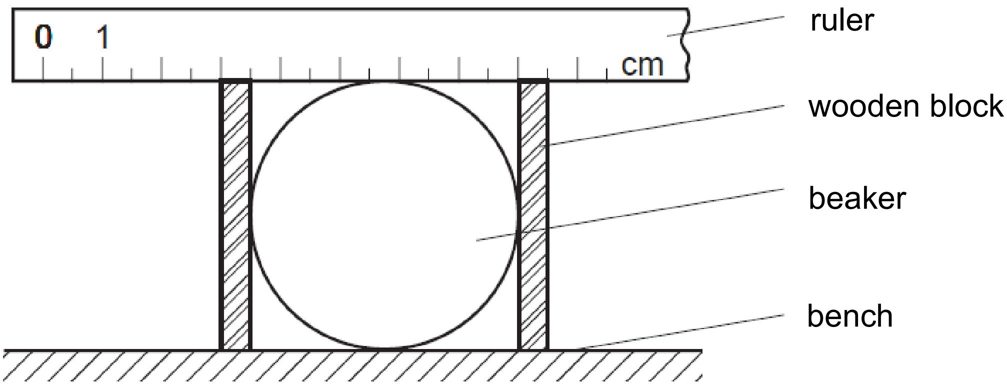

Fig 1.1

(a) State the diameter of the beaker.

.... [1]

(b) Suggest an instrument that could measure the diameter of the beaker more precisely.

.... [1]

(c) Student A makes use of the readings taken in **(a)** to calculate the base area of the beaker.

Student B makes use of the instrument in **(b)** and tells student A that his calculated area is more accurate.

State if you agree with student B and explain your answer.

....

....

....

.... [2]

2 Fig. 2.1 shows a ball being released from rest from its initial position above the ground. The ball falls vertically and rebounds.

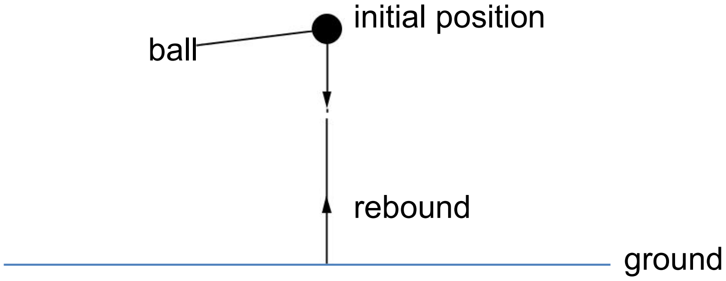

Fig. 2.1

Fig 2.2 shows how the velocity of the ball varies with time.

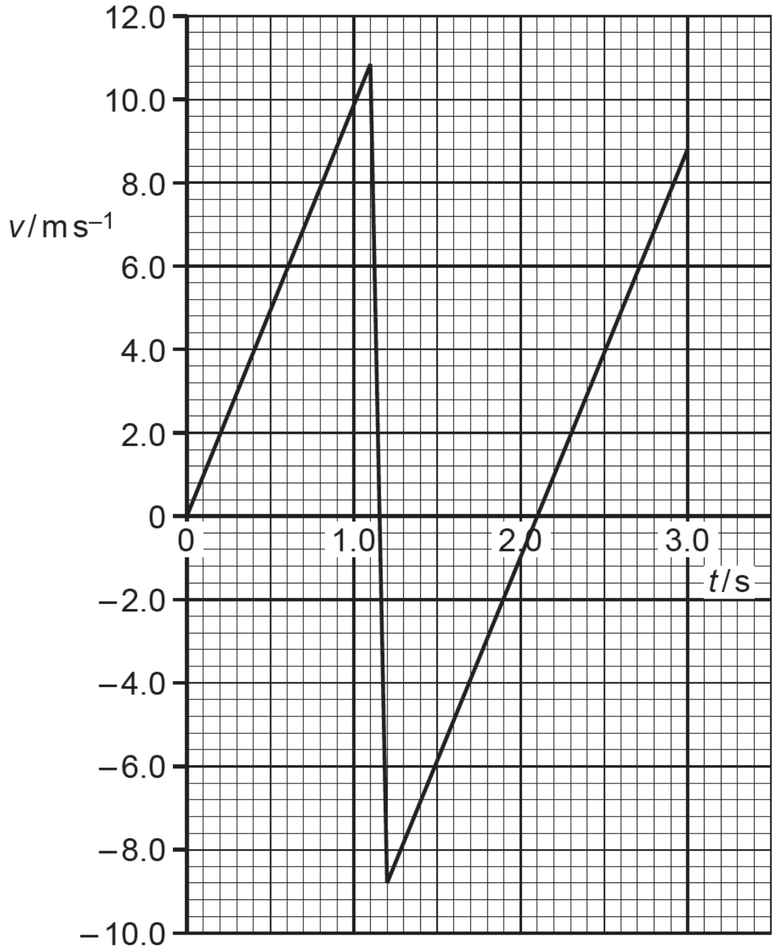

Fig. 2.2

(a) Using the information from the graph, calculate:

(i) the acceleration of the ball after it rebounds.

acceleration = ...[2]

(ii) the initial height the ball was released.

height = ...[2]

(iii) the displacement from the initial position after the ball has reached its maximum height after the first rebound.

displacement = ...[2]

(b) Explain how Fig. 2.2 shows that the effect of air resistance on the ball is negligible.

……………………………………………………………………………………………….

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

3 Fig. 3.1 shows a wheelbarrow and its load, which has a total mass of 15 kg. This is supported by a vertical force F at the end of its handles. The centre of gravity of the wheelbarrow is marked, c.g. on Fig. 3.1.

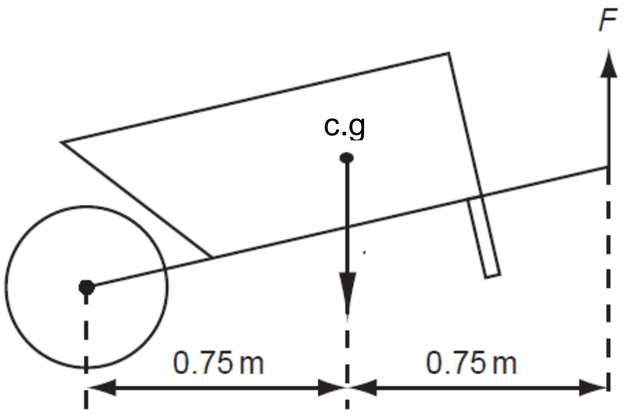

Fig. 3.1

(a) **(i)** State the Principle of Moments.

....

....

....

....[2]

(ii) Hence, determine the vertical force, F, to keep the wheelbarrow in equilibrium.

F = ...[2]

(b) The force, F in **(a)(ii)** is found to have a different value from 150 N. A student says that the wheelbarrow cannot be in equilibrium since the upward forces are not equal to the downward forces.

Explain why the student is incorrect. You may draw on Fig. 3.1 to further substantiate your answer to show how the wheelbarrow is in equilibrium.

....

....

.... [2]

4 Fig. 4.1 shows a manometer attached to a gas cylinder.

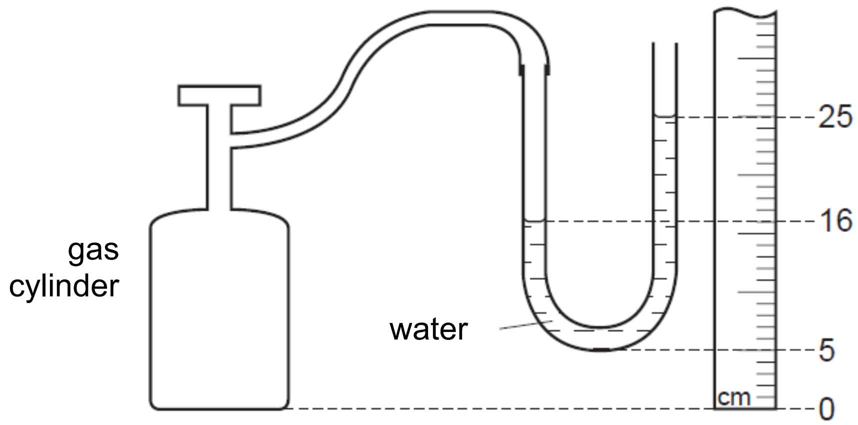

Fig. 4.1

(a) **(i)** The density of water is 1000 kg/m^3 and the gravitational field strength is 10 N/kg. Calculate the pressure difference in Pa as shown by the manometer.

pressure difference = ...Pa [2]

(ii) The water is replaced with an equal volume of oil with a density of 900 kg/m^3. Determine the liquid level of the left and right arm of the manometer.

liquid level on right arm = ……………………………….

liquid level on left arm = ……………………………[2]

(b) An engineer decides to evacuate the air and seal the open end of the manometer in Fig. 4.1. State if the manometer can still be used to measure the gas pressure. Explain your answer.

....

....

....

....

....[2]

5 Fig. 5.1 shows a transverse wave travelling along a rope. The positions of the wave at the time intervals t = 0 s and t = 2.0 s are shown.

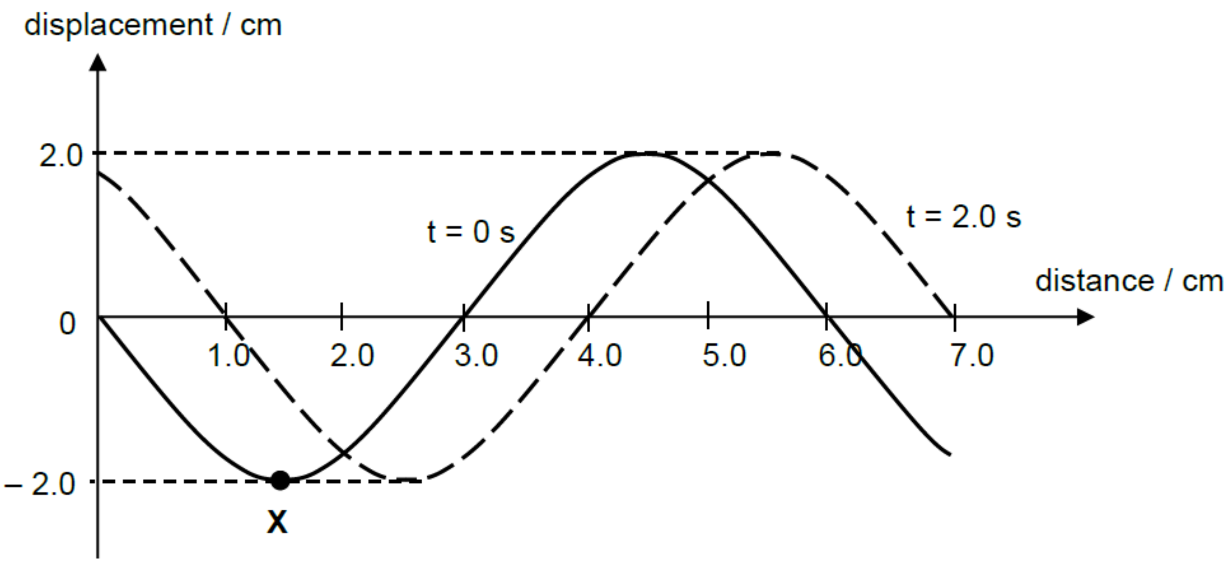

Fig. 5.1

(a) Explain what is meant by a transverse wave.

....

.... [1]

(b) Calculate the speed of the wave.

speed = ...[1]

(c) Determine the period of the wave.

period = ... [2]

(d) X is a particle on the wave at t = 0 s.

On Fig. 5.1, mark the new position of X at t = 6.0 s. Label this position Y. [1]

6 The device shown in Fig. 6.1 uses the reflection of ultrasound to measure distances.

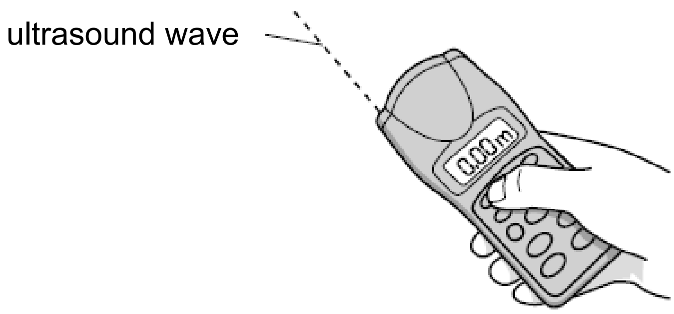

Fig. 6.1

(a) State what is meant by ultrasound.

....

.... [2]

(b) Fig. 6.2 shows a contractor using the device to measure the width of a room.

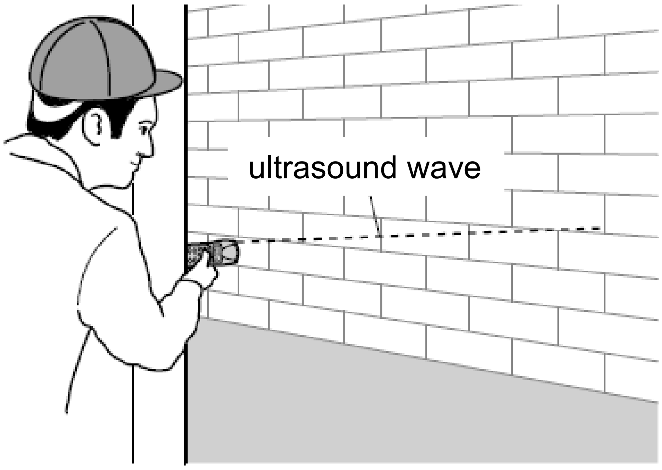

Fig. 6.2

The ultrasound device is placed against one side of the wall and it emits an ultrasound wave that reflects back from the opposite side of the wall. The time between sending out the ultrasound wave and receiving the reflection is 30 ms. The speed of ultrasound in air is 340 m/s.

Calculate the distance between the device and the opposite wall.

distance = ... [2]

7 When light passes from one optical medium to another, one physical quantity changes while the other remains constant.

(a) State the physical quantity that changes and the one that remains constant. [1]

changes: ……………………………………..

remains constant: ……………………………...

(b) Fig. 7.1 shows the path of a light ray in a glass prism, ABC. The refractive index of the glass prism is 1.80.

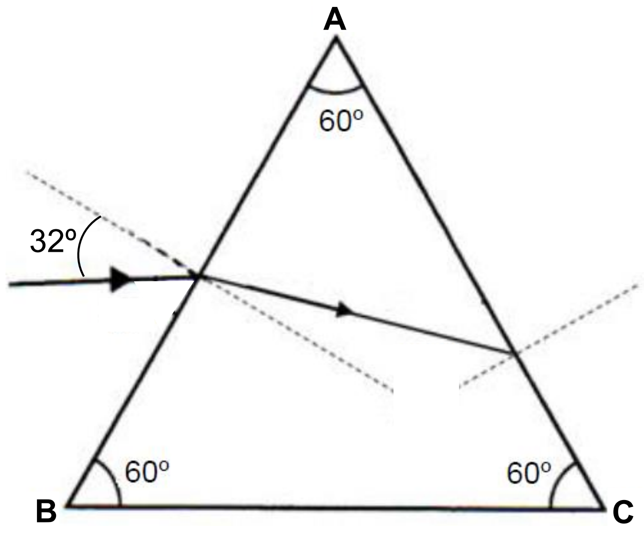

Fig. 7.1

Calculate the angle in which the light ray deviates from its original path on surface AB.

angle of deviation = ... [3]

(c) On Fig. 7.2, draw a ray diagram to show how a converging lens is used in a photocopier producing identical copies of the same document. [2]

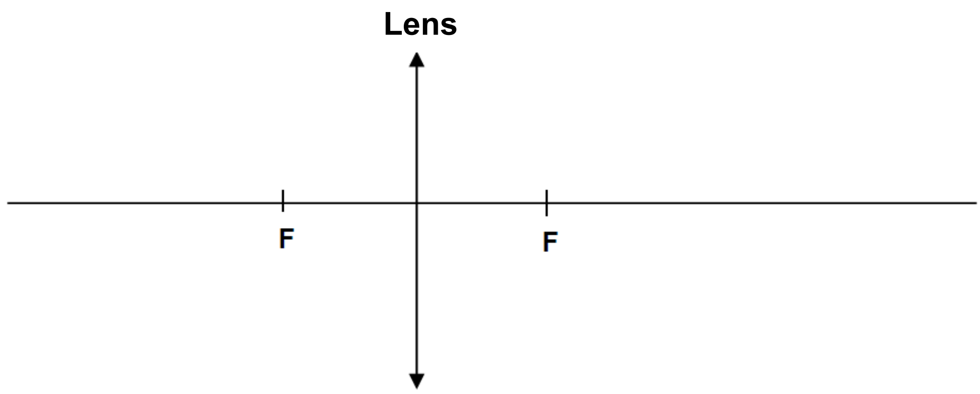

Fig. 7.2

8 Fig. 8.1 shows two uncharged conducting spheres, K and L, mounted on two insulating stands. A positively charged insulating rod is held next to K.

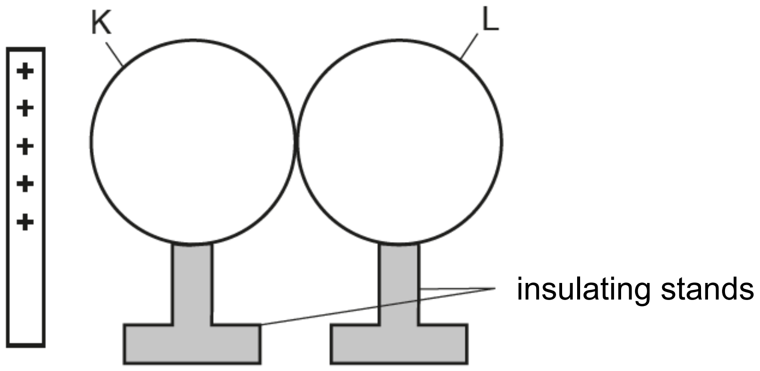

Fig 8.1

(a) On Fig. 8.1, draw the charges on K and L. [1]

(b) Sphere L is moved to the right, a long distance from sphere K. The positively charged rod is moved away.

State what happens to the charge on K.

....

....[1]

(c) An earth wire is then connected to the rod. State and explain what happens to the charge on the rod.

....

....

....[2]

(d) State a method to discharge the positively-charged rod.

....

....[1]

9 Sodium-24 and sodium-23 are two isotopes of sodium. Sodium-24 is a radioactive isotope that emits beta-particles and gamma-rays as it decays.

(a) The nuclide notation for the isotope sodium-24 is $^{24}_{11}Na$.

(i) State what is meant by an isotope.

………………………………………………………………………………………...………

………………………………………………………………………………………………[1]

(ii) State how the composition of a nucleus of sodium-24 differs from the composition of a nucleus of sodium-23.

………………………………………………………………………………………...………

………………………………………………………………………………………………[1]

(b) When a nucleus of sodium-24 emits a beta-particle, it decays to an isotope of magnesium.

(i) State the name of the particle that is identical to a beta-particle.

………………………………………………………………………………………………[1]

(ii) Complete the nuclide equation for the emission of a beta particle by sodium-24. [2]

$$^{24}_{11}Na \rightarrow \,^{\cdots\cdots}_{\cdots\cdots}\beta + \,^{\cdots\cdots}_{\cdots\cdots}Mg$$

(c) Sodium-24 is sometimes used in diagnosing medical conditions. The half-life of sodium-24 is 15 hours.

Explain why a half-life of 15 hours makes the isotope suitable for use in the human body.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………[2]

10 In an experiment, different sized metal pellets are fired from an air rifle towards an 8.0 kg block of plastic suspended from the top of a ceiling. The initial position of the block is shown in Fig 10.1, and when the pellet hits the plastic block, the block is displaced as shown in Fig 10.2.

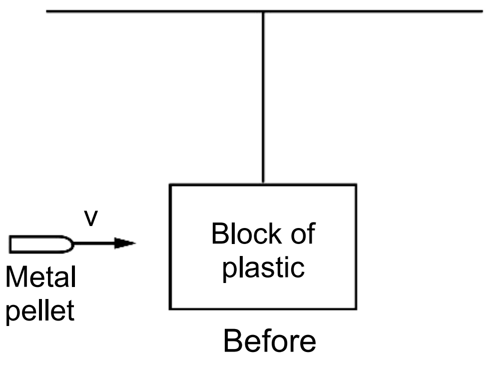

Fig. 10.1

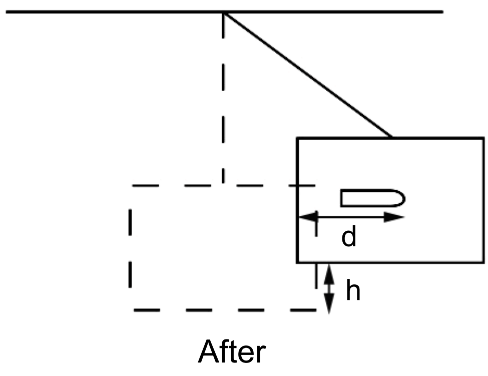

Fig. 10.2

The information obtained from the experiment is shown in the table below.

mass of pellet, m/g	speed of pellet just before it hits plastic block, v / m/s	depth of penetration by pellet, d/m	time taken for pellet to come to a stop, t / ms	maximum increase in height of plastic block, h / m
50	40	0.15	25	0.348
25	56	0.12	20	0.292
20	62	0.11	18	0.274

Take gravitational field strength as 10 N/kg.

(a) Calculate the kinetic store of the 25 g pellet just before it hits the block of plastic.

kinetic store = ... [2]

(b) Calculate the deceleration and hence, the resistive force acting on the 25 g pellet.

deceleration = ...[2]

resistive force = ...[1]

(c) Calculate the work done by the 25 g pellet against friction.

work done = ...[2]

(d) Show that there is a discrepancy between the experimental and theoretical values for the increase in height of the plastic block. [3]

11 A potential divider circuit is set up as shown in Fig. 11.1.

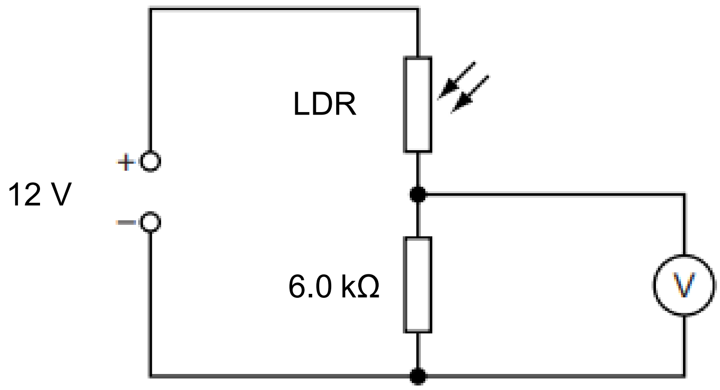

Fig. 11.1

When light shines on the LDR, the resistance of the LDR is 2.0 kΩ

(a) **(i)** Calculate the reading of the voltmeter when light is shining on the LDR.

voltmeter reading = ...[2]

(ii) Determine the current in the LDR.

current = ...[2]

(b) The brightness of the light on the LDR decreases.

State and explain what happens to the reading on the voltmeter.

....

....

....

....[2]

(c) **(i)** A filament lamp is connected in parallel to the LDR. The brightness of the lamp does not affect the LDR in any manner.

Suggest a use for such a set-up.

....

.... [1]

(ii) On Fig. 11.2, sketch a current-voltage graph for the lamp. [1]

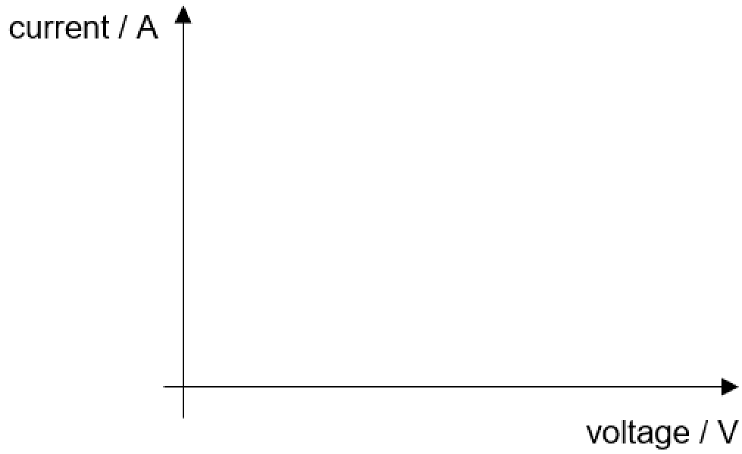

Fig. 11.2

(iii) State and explain how a current-voltage graph for a fixed resistor is different from the graph for a filament lamp.

....

....

....

.... [2]

Section B

Answer **one** question from this section.

12 Fig 12.1 shows an electric kettle.

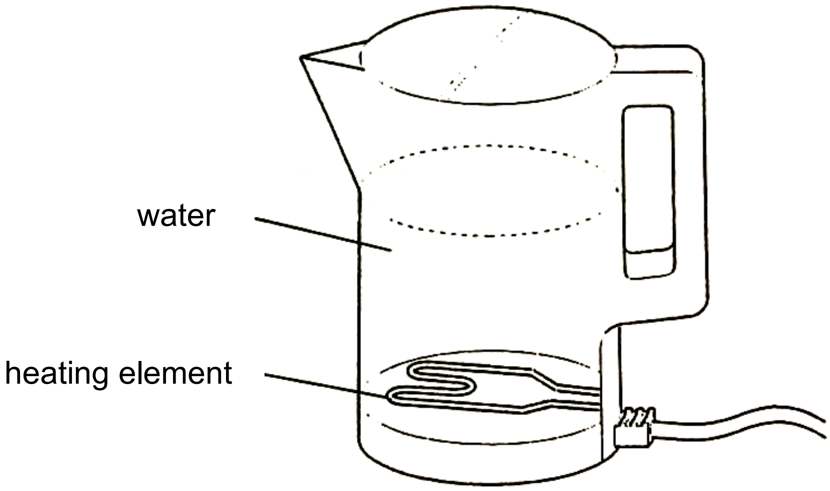

Fig. 12.1

(a) **(i)** State the main process in which thermal energy is transferred from the heating element to the water around it.

....[1]

(ii) Explain how the water in the electric kettle is heated.

....

....

....[2]

(iii) Suggest a colour for the outer casing of the kettle, in order for the water to be kept warm for a longer time. Explain your choice.

....

....[1]

(b) 200 g of boiling water from the electric kettle is poured into a ceramic cup.

Ice cubes with a total mass of 100 g were dropped into the cup of hot water. The ice cubes were initially all solid at 0 °C.

The specific heat capacity of water is 4200 J /kg K and specific latent heat of fusion of water is 334 000 J / kg.

Ignore any thermal energy loss to the cup and the surroundings in the calculations.

(i) Calculate the thermal energy gained by the 100 g of ice to melt completely.

thermal energy = ... [2]

(ii) The melted ice and hot water in the cup eventually reached thermal equilibrium. Calculate the final temperature of the water in the cup.

temperature = ... [2]

(iii) The electric kettle has an electrical power input of 2000 W. It took 5.0 minutes to heat the 200 g of water to its boiling point. Each kWh of electrical energy costs 26 cents.

Calculate the cost of using the kettle to heat the 200 g of water.

cost = ... [2]

13 Two coils, A and B, are placed one on top of the other, as shown in Fig. 13.1a.

Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B.

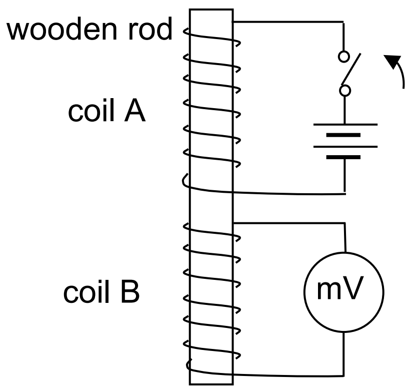

Fig. 13.1a

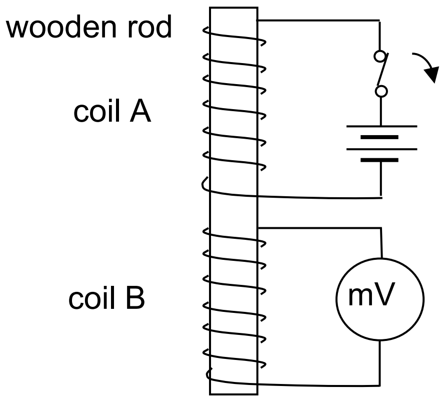

Fig. 13.1b

(a) Describe what happens to the reading in the millivoltmeter when the switch is closed in Fig. 13.1a.

....

....

....[2]

(b) **(i)** On Fig. 13.1b, draw an arrow on coil B to show the direction of the induced current in coil B when the switch was just opened. [1]

(ii) Explain the direction drawn in **(b)(i)**.

....

....

....

....

....

....

....[2]

(c) Fig 13.2 shows two coils of insulated wire wound on an iron core to make a transformer. One coil is connected to a 16 V a.c. supply. The other coil is connected to a lamp, which is rated 12 V, 24 W.

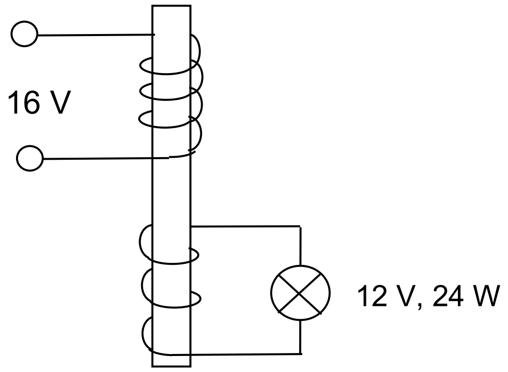

Fig 13.2

Given that the lamp is operating optimally, calculate the minimum current drawn from the 16 V supply.

minimum current = ...[2]

(d) It is found that the current drawn from the supply is 1.7 A.

(i) Calculate the input power to the transformer.

input power = ...[1]

(ii) Calculate the power loss by the transformer.

power loss = ...[1]

(iii) State one reason why a transformer is not 100% efficient.

....

....[1]