

SECONDARY SCHOOL ANNUAL EXAMINATIONS 2002
Educational Assessment Unit - Education Division

FORM 4

PHYSICS

TIME: 1 hr 30 min

NAME: _____

CLASS: _____

Answer all the questions in the spaces provided on the Examination Paper. All working must be shown. The use of a calculator is allowed.

Where necessary take the acceleration due to gravity, $g = 10 \text{ m/s}^2$.

You may find some of these formulae useful.

Area of a triangle = $\frac{1}{2}$ (base x height) Area of trapezium = $\frac{1}{2} h$ (sum of parallel sides)

$v = s / t$ $v = u + at$ $s = \frac{1}{2} a t^2$ $W = mg$ $F = ma$

momentum = mass x velocity Pressure = force / area $P = h \rho g$

Heat energy = mass x specific heat capacity x temperature change

$V = IR$ $P = VI$ $P = I^2 R$ $R = R_1 + R_2 + R_3$

Section A: Answer all questions in this section in the spaces provided. This section carries 55 marks.

1. A student built a circuit consisting of twelve 1.5 V bulbs all joined in series. After connecting the ends of the circuit to a 12 V d.c. supply, the student noticed that all the bulbs lit up but were very dim.

a) What is wrong with the student's circuit?

[2]

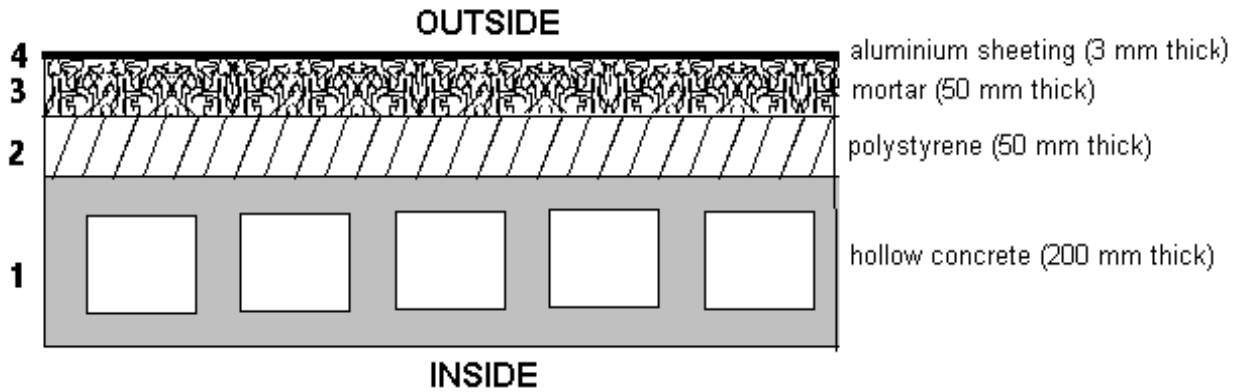
b) How many bulbs may be used on the 12 V supply?

[2]

c) Give one advantage of using a constant 12 V d.c. supply instead of a 12 V battery.

[1]

2. A roof is made up from four layers of different materials.
 Layer 1 consists of hollow concrete sections, 200 mm thick.
 Layer 2 consists of polystyrene sheets, 50 mm thick.
 Layer 3 consists of mortar which is a mixture of sand and cement, 50 mm thick.
 Layer 4 consists of aluminium sheets, 3 mm thick.



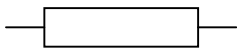
Layer 4 is a thin aluminium sheet, only 3 mm thick.

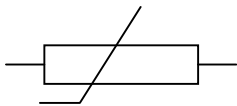
- a) Why is the thin aluminium sheet placed outermost, that is in position 4?
 _____ [2]
- b) Give two advantages of using hollow concrete sections instead of one block of solid concrete.
 Advantage 1: _____ [2]
 Advantage 2: _____ [2]
- c) Why is it necessary to use only a thin layer of aluminium in layer 4, but a fairly thick layer of polystyrene in layer 2?

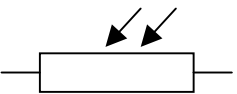
 _____ [3]
- d) If during construction, the polystyrene layer (layer 2) is left out, and the roof is made up only of layers 1, 3 and 4, how would the inside temperature be affected during a hot summer's day?

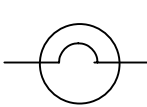
 _____ [1]

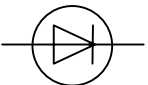
3. a) Write down what each of the following symbols signifies.

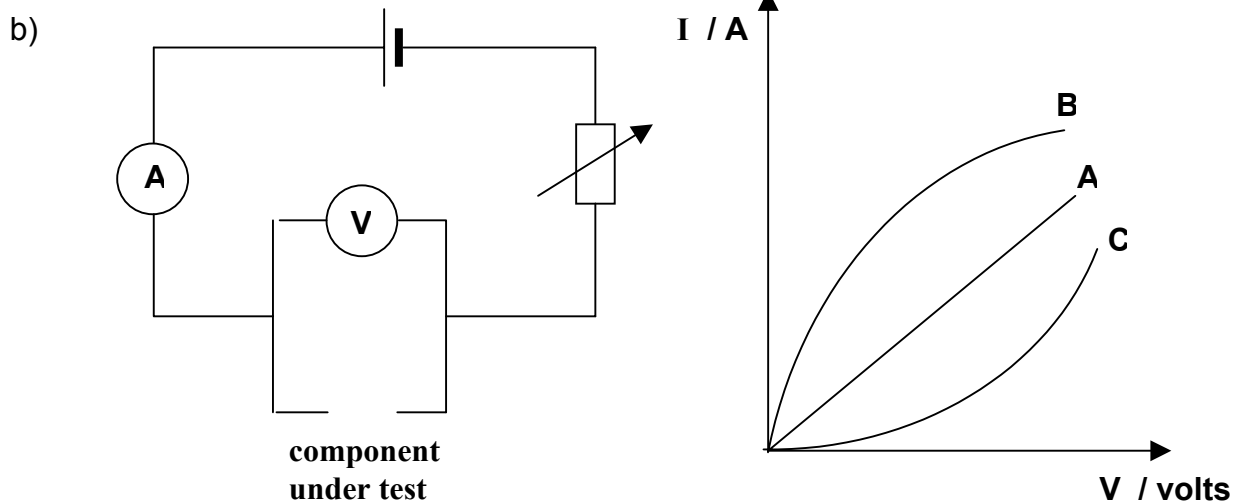
i)  _____ [1]

ii)  _____ [1]

iii)  _____ [1]

iv)  _____ [1]

v)  _____ [1]



The circuit above is used to find how the current flowing through an electrical component varies with the voltage across its ends. The graphs known as characteristics show this for three particular electrical components.

Which of the graphs above is the characteristic of the electrical component represented by symbol :

- i) a. i. _____ [1]
- ii) a. ii. _____ [1]
- iii) a. iv _____ [1]

c) Which of the three components, (i) diode, (ii) resistor, (iii) filament lamp has a resistance which does not change when the supply voltage is increased?

_____ [2]

When a freely suspended negatively charged polythene rod is brought close to the metal dome, the rod is repelled.

- a) i Mark + or - to show the charge on the dome [1]
 ii Mark the charge on plate A [1]
 iii When the ball touches plate A it gets charged and swings to plate B where it loses this charge. Name the particle that carries this charge.

_____ [1]

iv. Why is the ball covered with very light aluminium film?

_____ [2]

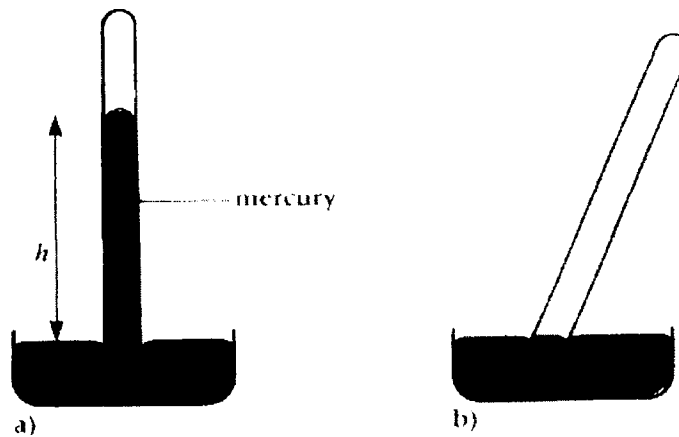
- b) The sensitive meter show a weak electric current.
 i This shows that an electric current is a flow of _____ [1]
 ii Say how the charge on plate A produced a positive charge on B.

_____ [2]

- c) If the electric meter shows a current of 1 microampere (10^{-6}A) and the apparatus has been switched on for 1000 seconds (10^3s), what quantity of charge flowed in the circuit?

 _____ [2]

6.



This instrument is used to measure atmospheric pressure.

- a) i It is called _____ [2]
 ii Pressure is measured in N/m^2 and in _____

- b) The density of mercury is 13600 kg/m^3 . If the height h of the mercury column is 0.75 m and the acceleration due to gravity is 10 m/s^2 .

i Calculate the atmospheric pressure.

[2]

ii If the density of water is 1000kg/m^3 calculate the height of water required to equal the atmospheric pressure calculated in (i) above.

[2]

iii Why is mercury used in the above instrument and not water?

[2]

c The tube is now tilted as shown in position B

Mark on the diagram above the new level of the mercury in the tube.

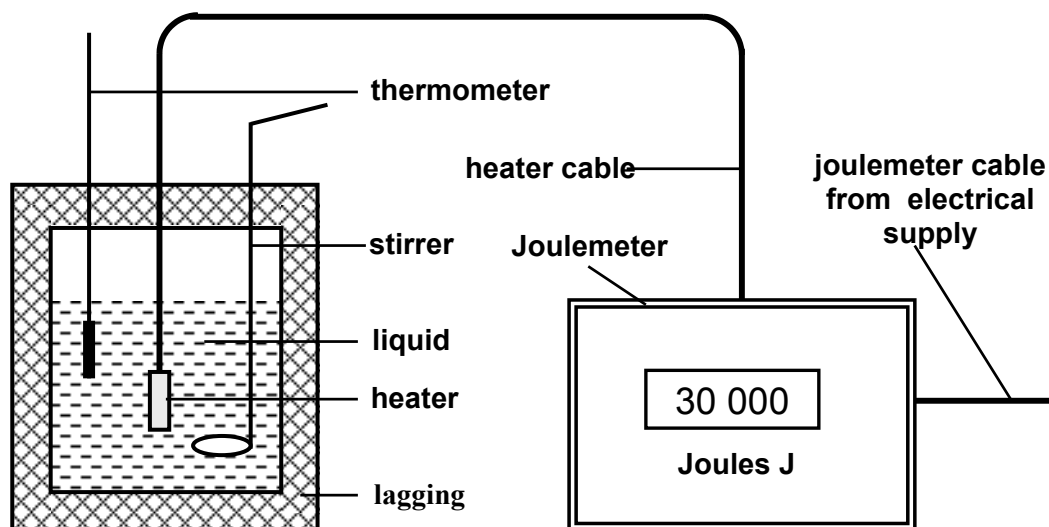
[2]

**Section B: Answer all questions in this section in the spaces provided.
This section carries 45 marks.**

7. This question is about measuring the specific heat capacity of a liquid.

A scientist is required to find the specific heat capacity c of an unknown liquid. A heater, a thermometer and a stirrer are placed in a **well-lagged covered plastic** container containing 0.5 kg of the liquid.

The heater is connected to a joulemeter.



The heater is switched on and the following results are obtained.

| | | | | | | |
|---------------------------|----|----|----|----|----|----|
| temperature θ / °C | 20 | 24 | 28 | 32 | 36 | 40 |
| time t / minutes | 0 | 1 | 2 | 3 | 4 | 5 |

a. Plot a graph of temperature (y-axis) against time (x-axis) on the graph paper provided. [7]

b. From your graph find the room temperature. [1]

c. Find the time in **seconds** during which the heater is switched on. [2]

d. The joulemeter in the diagram shows the quantity of energy required to raise the temperature of the liquid from 20 °C to 40 °C. How much energy **Q** is supplied to the liquid? [1]

e. Calculate the change in temperature $\Delta\theta$ of the liquid during the experiment. [2]

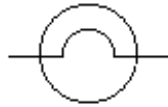
f. Calculate the specific heat capacity **c** of the liquid using the equation:

$$c = \frac{\text{Energy supplied } Q}{\text{mass of liquid } m \times \text{change in temperature } \Delta\theta}$$

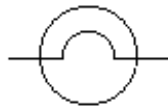
_____ [2]

8. This question is about house wiring, fuses, and electrical energy consumption.

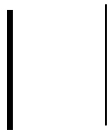
An electrician wishes to connect 2 lamps (shown below) - one in the kitchen and the other in the dining room – to the live and neutral wires connected to the mains supply. He also has two switches and a fuse which must be connected to the circuit.



kitchen lamp



dining room lamp



live neutral

a) Show how the circuit is connected, in such a way that the kitchen and dining room can be switched on and off separately using their own switch. Include the fuse in the circuit besides the two switches. [4]

b) A heater, rated 1 000 W and a hair dryer rated 500 W are connected to the same circuit in a house. The fuse in this circuit is rated at 5 A. The mains supply voltage is 250 V.

i) What is the total current used by the heater and hair dryer when both are switched on?

[2]

ii) Is the 5 A fuse suitable for this circuit? Why?

[2]

iii) If your answer to question (ii) is no, should a thinner or thicker fuse wire be used instead?

[2]

c) If the heater is switched on for 10 hours, how many kWh of electrical energy are consumed during this time?

[2]

d) Find the number of kWh consumed by the hair dryer if it is also switched on for 10 hours.

[2]

e) Find the total cost of using both appliances for 10 hours at 5 cents per kWh.

[1]

9. This question is about Newton's Laws and Momentum.

a) A clown is standing on a circus bus. What happens to him when the bus:

i) starts moving _____ [1]

ii) stops moving _____ [1]

iii) turns a corner to the right _____ [1]

b) The bus loaded with people has a total mass of 10 000 kg. It is travelling at a speed of 10 m/s. At a crossing, it decelerates at 2m/s^2 until it stops. Find the stopping force.

[3]

c) At the circus, two clowns have a tug-of-war contest, each clown pulling a rope in the opposite direction. The rope does not move. What can you say about the forces exerted by the two clowns?

[3]

d) In one of his performances the clown of mass 80 kg runs at 4.5 m/s. He jumps on to a **stationary** trolley of mass 10 kg.

i) What is the momentum of the clown **before** jumping on the trolley?

[1]

ii) What is the momentum of the trolley while at rest?

[1]

iii) What is the total mass of clown and trolley?

[1]

iv) State the principle of conservation of linear momentum.

[1]

v) Find the speed of the trolley immediately after the clown jumps on it.

[2]

