FORM 4	PHYSICS	TIME: 1 hr 30 min

NAME: _____   **CLASS:** _____

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

Where necessary take the acceleration due to gravity, g = 10 m/s^2 .

You may find some of these formulae useful.

Area of a triangle = ½ (base x height)   Area of trapezium = ½ h (sum of parallel sides)

$v = s / t$ $v = u + at$ $s = ½ a t^2$ $W = mg$ $F = ma$

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

Heat energy = mass x specific heat capacity x temperature change

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

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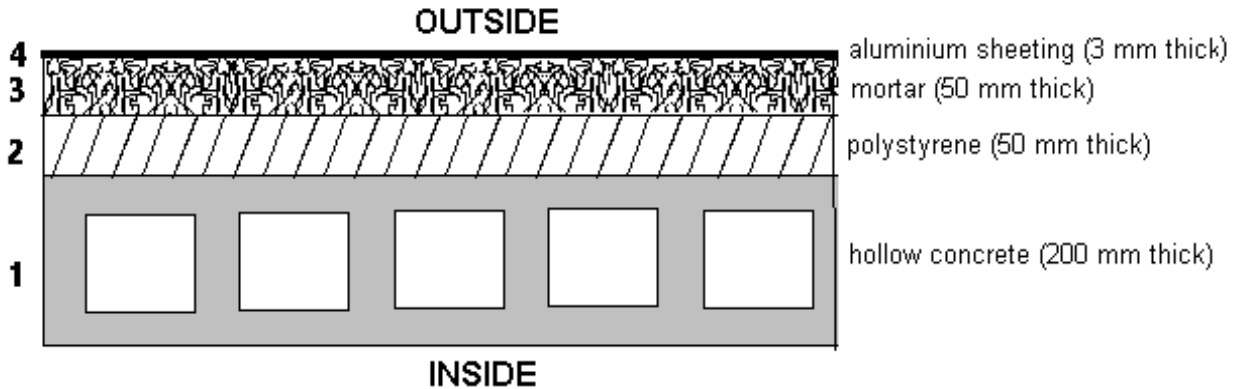
a) What is wrong with the student's circuit?

_____ [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.

OUTSIDE

4 — aluminium sheeting (3 mm thick)
3 — mortar (50 mm thick)
2 — polystyrene (50 mm thick)
1 — hollow concrete (200 mm thick)

INSIDE

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.
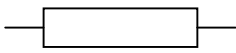
Advantage 1: _____
[2]

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?
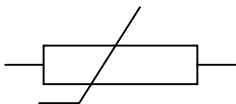
_____

_____ [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?
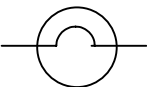
_____

_____ [1]

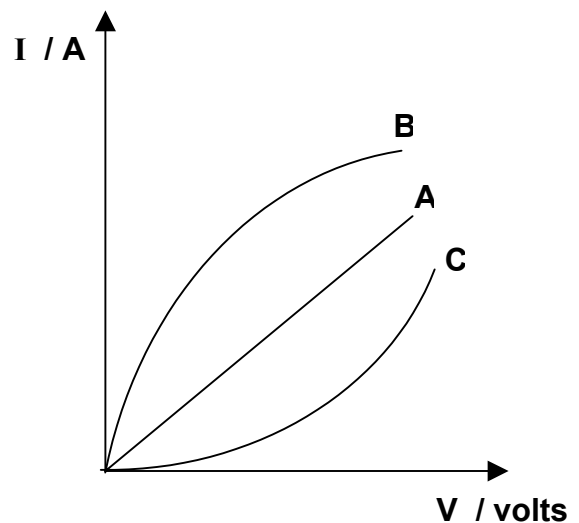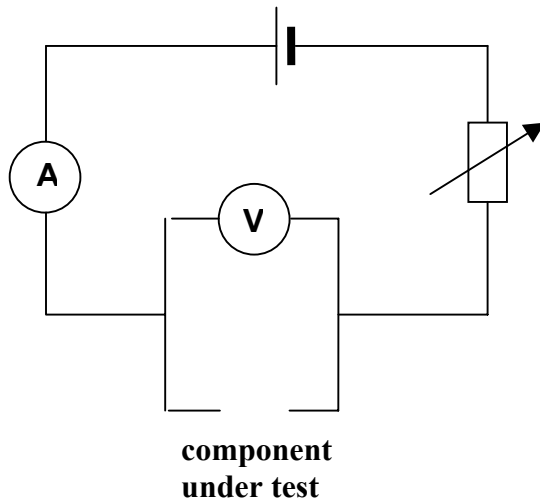**3.** a) Write down what each of the following symbols signifies.

i) _____ [1]

ii) _____ [1]

iii) _____ [1]

iv) _____ [1]

v) _____ [1]

b)

component
under test

I / A

B

A

C

V / volts

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]

_____

4. a) What is the initial acceleration of the sky diver?

_____ [1]

R

b) Complete:

   i)   W means _____

   ii) R means _____

   iii) Both forces are measured in _____ [3]

c) As the sky diver accelerates downwards

   i. Which of the two forces is greater? _____ [2]

   ii. Which of the above two forces increases as he
       speeds down? _____ [2]

d) Eventually the sky diver moves down at a constant
   speed.

W

   i)   What is, now, the resultant (net) force acting on the sky diver?

_____ [1]

   ii) Underline below the correct relationship between the forces R and W
       as the sky diver falls at constant speed.

           R > W   R = W   R < W [1]

5.

dome

A   B

sensitive ammeter
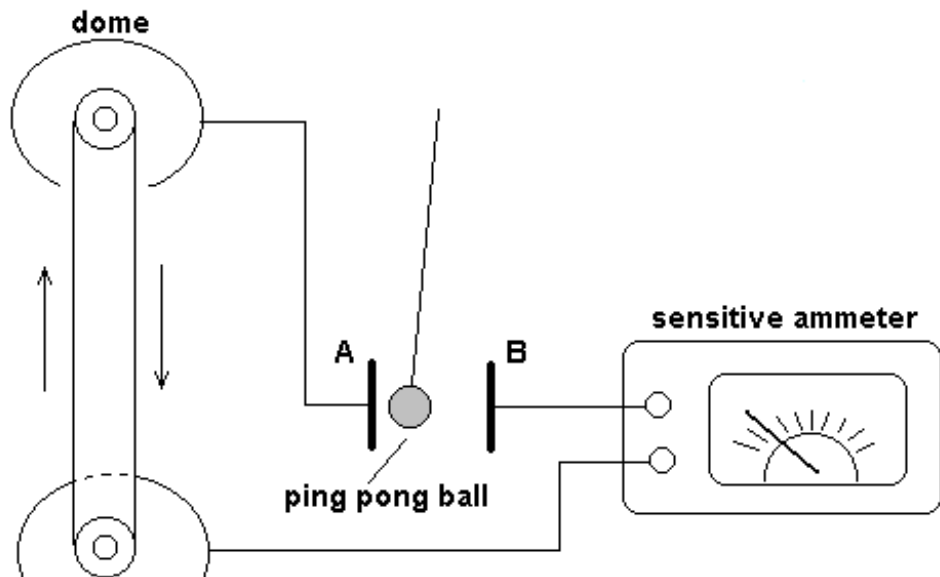
ping pong ball

As the experiment is set going the charge that collects on the dome moves
to plate A and the metal covered   ping-pong ball swings between the 2
plates. The sensitive current meter shows a weak electric current flowing.

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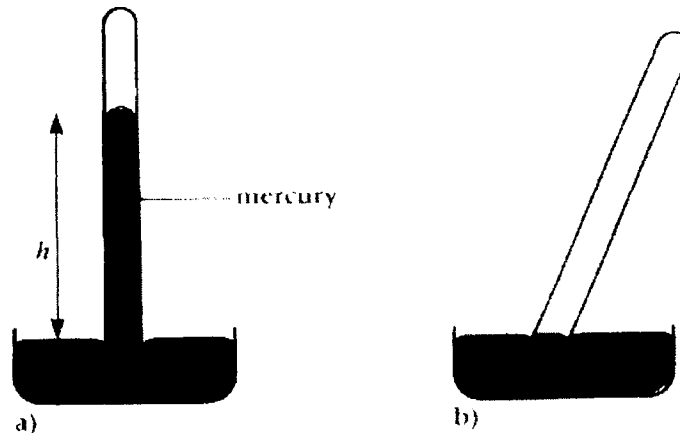
b) The sensitive meter show a weak electric current.
    i This shows that an electric current is a flow of _____
                                                                                     [1]
    ii Say how the charge on plate A produced a positive charge on B.

   _____
                                                                                     [2]

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

   _____

   _____
                                                                                     [2]

6.

mercury

h

a)   b)

This instrument is used to measure atmospheric pressure.

a i It is called _____

   ii Pressure is measured in N/m^2 and in _____   [2]
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.
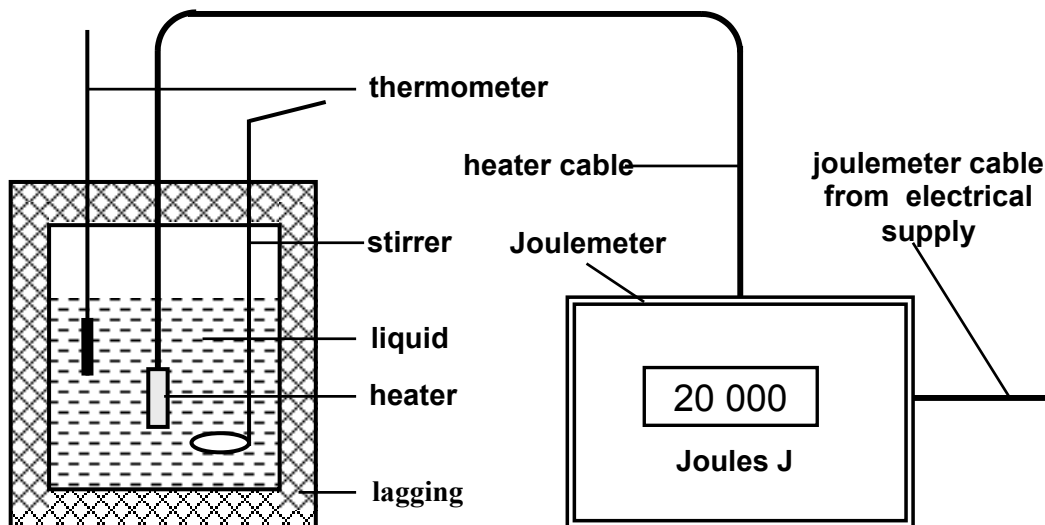

The heater is switched on and the following results are obtained.

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. What do you notice about your graph that shows that the plastic container is well-lagged? [1]

d. The joulemeter in the diagram shows the reading **before** the heater is switched on. The reading on the joulemeter when the temperature of the liquid is 40°C is 50 000J. Calculate the energy supplied by the heater. [1]

e. Find the time **in seconds** during which the heater is switched on. [1]

f. Calculate the power of the heater in J/s or watts, W. [1]

g. Calculate the specific heat capacity **c** of the liquid. [3]

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

An electrician wishes to connect a heater and a toaster on the same circuit. He includes two switches (one for each appliance) and a fuse in the circuit.

live

250 V supply

neutral

heater

1200 W

toaster

800 W
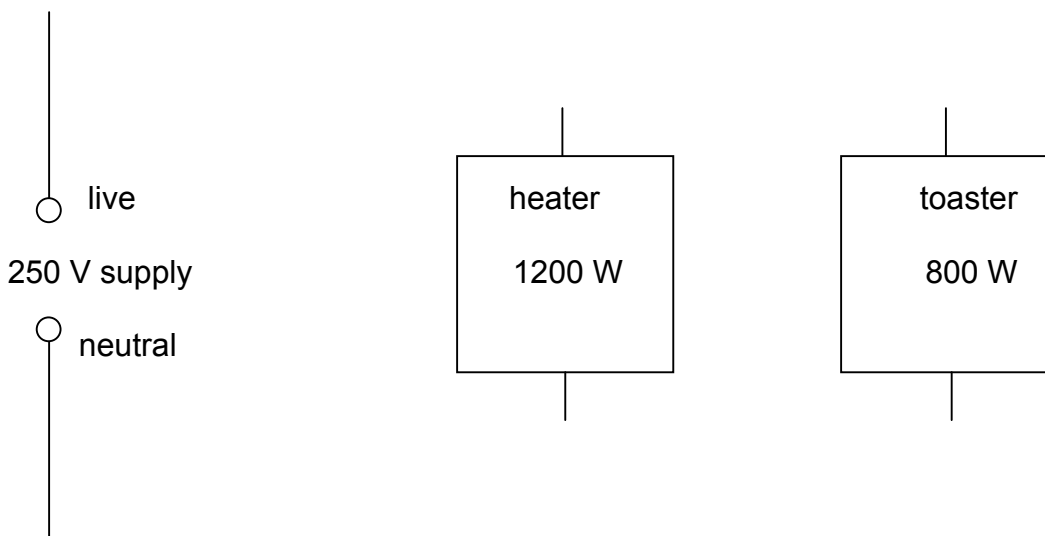
a. Copy the diagram on your answer sheet and complete the circuit to show how the heater and toaster could be connected so that they can be switched on and off separately. Include the fuse and switches in your circuit. [4]

b. The fuse he uses is rated 5 A. When either heater or toaster is switched on, they work correctly. However, when both are switched on, the fuse melts. Explain why this happens showing any necessary calculations.

[4]

c. He has another replacement 5A fuse wire besides the first one.   How can he connect the two fuses together to allow both appliances to be switched on at the same time?

[2]

d. The heater is switched on for 10 hours while the toaster is switched on for 1 hour during a certain week. How much electrical energy in kWh is consumed by the heater and toaster together during this week?

[3]

e. What is the cost of using these two appliances during this week, if electrical energy costs 5 c per unit.

[2]

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

a) A clown pulled off the table cloth with a jerk from a table prepared for dinner. The utensils on it did not fall off.   Explain why.   [3]

b) The clown was travelling home in a car of <u>total</u> mass 800 kg at 36 km/h. At a crossing, he brought the car to rest in 10 seconds.   [1]
Find: i)   the initial speed in m/s.   [1]
ii) the average retardation   [1]
iii) the average braking force.

c) Later, the clown went fishing in his small boat. While jumping from his boat onto the pier, he missed and fell into the water. Why do you think did this   [3] happen?

d) It rained in the afternoon and he noticed that raindrops fell at a constant speed to the ground even when they are pulled down by the force of gravity ?   [3] Could this be true? Why?

e) In one of his performances, the clown, of mass 80 kg jumped off his skateboard of mass 3 kg at a speed of 2.4 m/s. Work out the recoil speed of   [3] his skateboard which goes in the opposite direction.