NAME: ....
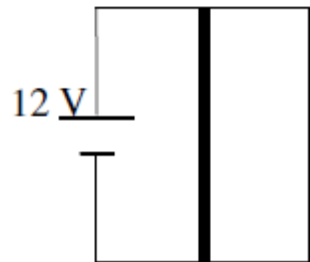
HEATING EFFECT OF ELECTRIC CURRENT

1. A car heater has two identical heating elements. The car battery can send 15000 C through the circuit in an hour.
(i) What is the current in each heating element?

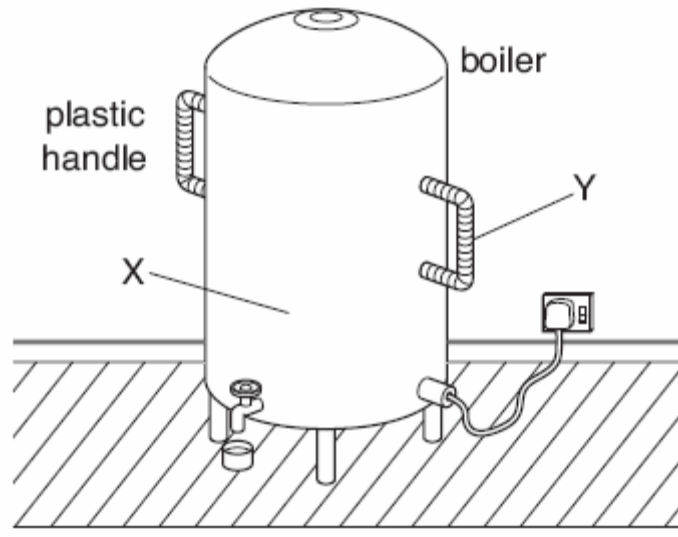(ii) How much heat is generated by the circuit in an hour?

[3m]

2. Calculate the amount of energy possessed by 1.25×10^{-19} electrons at a point where the electric potential is 3.20 volts.

[2m]

3. The Fig. below shows an electric boiler in a school kitchen.

The boiler contains 35 kg of water at 22 °C. The specific heat capacity of water is 4200 J / (kg °C).

(a) (i) Calculate the thermal energy (heat) needed to raise the temperature of the water from 22 °C to its boiling point.

[3]

(ii) The water in the boiler is heated with a 2600 W immersion heater. Calculate the minimum time for the heater to bring the water to its boiling point.

[2]

(iii) Suggest **one** reason why the actual time is greater than the time calculated in **(ii)**.

[1]

(b) (i) The immersion heater is placed in the water at the bottom of the boiler. Explain in detail how this ensures that the thermal energy (heat) is transferred throughout the water.

[4]

(ii) The boiler is made of steel and has two large plastic handles. When the water is boiling, the steel surface at X is hot while the plastic handle at Y is cool. Explain why.

[2]

(c) Before the water reaches boiling point, water vapour is seen escaping from the boiler.
(i) State the name of the process that produces this water vapour.

[1]

(ii) State **two** differences between this process and boiling.

[2]

4. Andrew is set the task of measuring the current-voltage (I-V) characteristics of a filament lamp. The following equipment and information are available.

	Information
Battery	emf = 3.0 V, negligible internal resistance
Filament lamp	marked "3 V, 0.2 A"
Voltmeter	resistance = 30 kW, reads values between 0.0 and 3.0 V
Ammeter	resistance = 0.1 W, reads values between 0.0 and 0.5 A
Potentiometer	resistance = 100 W

(a) For the filament lamp operating at normal brightness, calculate

   (i) its resistance;

   ....

   ....

(1)

   (ii) its power dissipation.

   ....

   ....

(1)

Andrew sets up the following incorrect circuit.
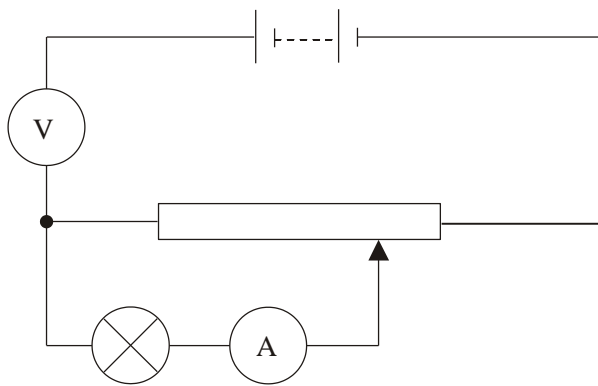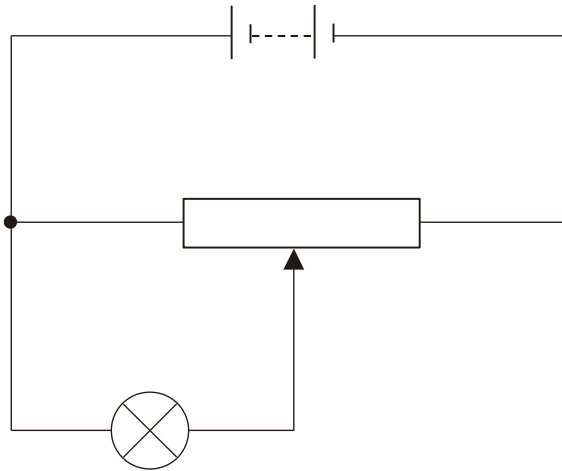
(b) (i) Explain why the lamp will not light.

....

....

....

(2)

(ii) State the approximate reading on the voltmeter. Explain your answer.

....

....

....
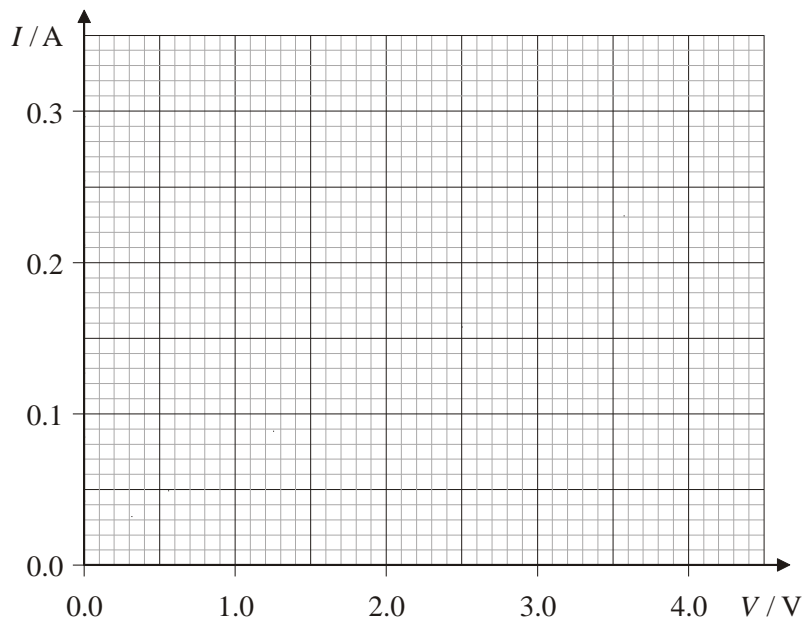
(2)

(c) On the circuit diagram below, add circuit symbols to show the correct position of the ammeter and of the voltmeter in order to measure the I-V characteristics of the lamp.

(2)

(d)   On the axes below draw a sketch graph to show the I-V characteristics for this filament lamp.

(4)

(e)   Explain the shape of the graph that you have drawn in (d).

....

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....

5. A student places a small electrical heater inside a cup of water, as shown in Fig. 11.1.
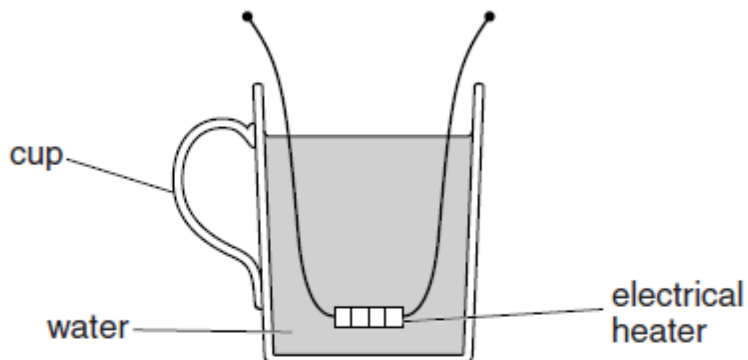

Fig. 11.1

The student determines the electrical power of the heater.
(a) In the space above the cup on Fig. 11.1, draw the electrical circuit that the student uses. Include an ammeter, a voltmeter and a power supply. [2]
(b) The voltage of the power supply is 12 V and the current is 4.2 A.
(i) Calculate the electrical power input to the heater.

Power = ... [2]

(ii) Calculate the energy input to the heater in 8.0 minutes. Give your answer in kW h.

Energy = ... kW h [3]

(c) During heating, the student notices that some of the water evaporates from the cup.
(i) Describe, using ideas about molecules of water, what happens during evaporation.

[2]

(ii) The student finds that the amount of evaporation increases when the temperature
of the water is higher.
State and explain one other change that increases the amount of evaporation.

                                                                                              [2]

(iii) State two differences between evaporation and boiling.

                                                                                              [2]

(d) The student turns off the power supply and the water cools.
Describe and explain how convection in the air causes the water to cool.

                                                                                              [2]

                                                                                         [15 Marks]

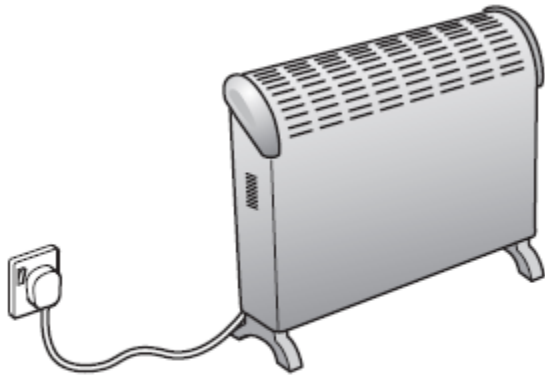**6.** Fig. 9.1a shows a room heater. Fig. 9.1b is a diagram of the electric circuit of the heater.
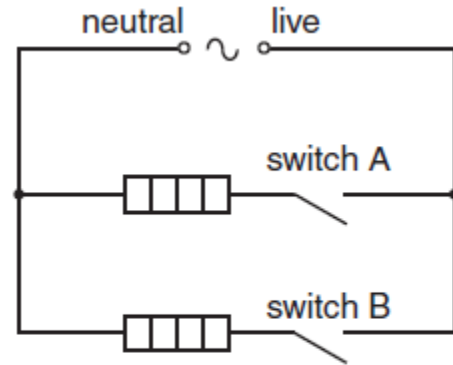
Fig. 9.1a   Fig. 9.1b

The fuse has not been drawn on the circuit diagram in Fig. 9.1b.
(a) (i) On Fig. 9.1b, draw the symbol for a fuse in the correct position. [2]
(ii) State the part of the room heater to which the earth wire is connected.

....[1]

(iii) The earth wire reduces the chance of an electric shock if a fault develops in the room heater.
1. State one fault that causes an electric shock when a person uses the room heater without an earth connection.

[1]
2. Explain how using an earth connection prevents an electric shock.

[2]

(b) (i) This type of room heater is very efficient. Explain what this means.

[1]

(ii) The room heater is a convector heater. Describe and explain how thermal energy (heat) passes around a room by convection.

[3]

(c) Fig. 9.2 shows the power output of the room heater when each switch is closed.

	power / W
switch A only closed	600
switch B only closed	
both switches closed	2100

Fig. 9.2

(i) Determine the power output of the room heater when only switch B is closed.

power output = ... [1]

(ii) The room heater is used with both switches closed for 2.5 hours.
Calculate the energy output of the room heater
1. in kilowatt-hours,

energy = ... kW h [2]

2. in joules.

energy = ... J [2]