

4.4 Electrical safety

01. 0625_s22_qp_41 Q: 5

Fig. 5.1 shows a kitchen tap that supplies instant boiling water.

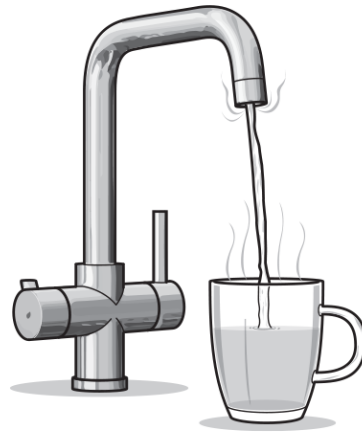


Fig. 5.1

Cold water passes over an electric immersion heater inside the tap.

The boiling point of water is $100\text{ }^{\circ}\text{C}$.

(a) State what is meant by boiling point.

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

(b) The immersion heater is powered by the mains at a voltage of 230 V . When the tap is opened, the heater switches on and the current in the heater is 13 A .

(i) Calculate the thermal energy produced by the heater in 60 s .

thermal energy = [2]

(ii) The specific heat capacity of water is $4200\text{ J}/(\text{kg }^{\circ}\text{C})$. The cold water that enters the tap is at $22\text{ }^{\circ}\text{C}$.

Calculate the rate at which water at its boiling point emerges from the tap.

rate = [4]

(c) The metal tap is earthed and there is a fuse in the cable that connects the heater to the mains.

1. Explain how the earth wire protects the user.

.....
.....

2. Explain how the fuse protects the circuit.

.....
.....

[3]



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4.4. ELECTRICAL SAFETY

02. 0625_w21_qp_43 Q: 8

- (a) Fig. 8.1 shows two charged metal plates with a gap between them. The plates are parallel to each other. The top plate is negatively charged and the bottom plate is positively charged.

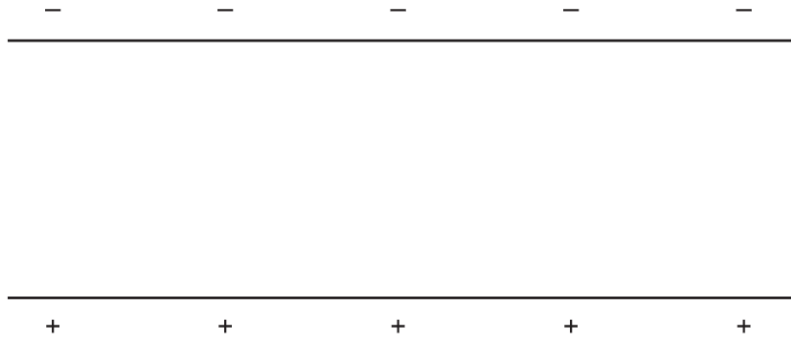


Fig. 8.1

On Fig. 8.1, draw **five** electric field lines between the two plates. [2]

- (b) An electric iron has a power of 2400W. The potential difference (p.d.) of the mains supply is 220V.

(i) Calculate the electric current in the iron.

current = [2]

- (ii) Calculate the electric charge which flows through the iron in 15 minutes.

charge = [2]

- (iii) Fuse ratings of 3A, 5A, 10A, 13A and 30A are available.

State which of these fuse ratings is suitable for use in the iron.

fuse rating [1]

03. 0625_w20_qp_41 Q: 8

(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. 8.1 shows the circuit.

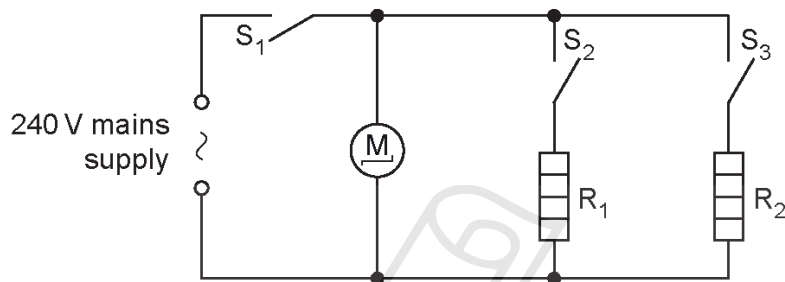


Fig. 8.1

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

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 .

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current = [1]

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

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power = [2]

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

Switches S_1 , S_2 and S_3 are closed.

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

.....

 [2]

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2. The current in the motor is 0.10A. The cable from the electric heater to the plug for the mains socket is safe when the current in it is less than 20A.

Suggest and explain a suitable fuse rating for this circuit.

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

04. 0625_w20_qp_42 Q: 8

- (a) State and explain why electrical sockets and plugs used outside in a garden need to be different from those that can be used safely in a room inside a house.

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

- (b) State and explain why fuses and circuit breakers are installed in electrical circuits connected to the mains supply.

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

05.0625_s19_qp_43 Q: 8

Fig. 8.1 shows a 240 V mains supply connected to an air-conditioning unit and a freezer. A fuse X is placed in the circuit as shown.

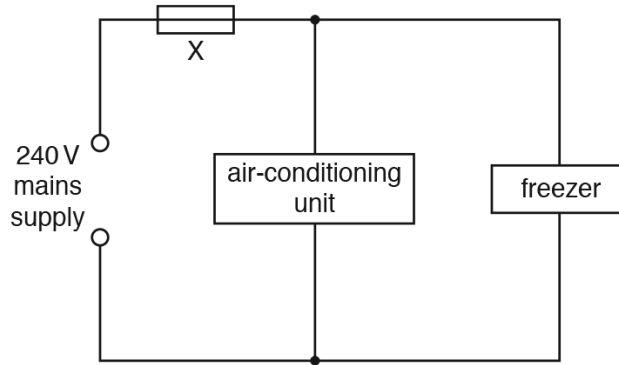


Fig. 8.1

The freezer has an operating power of 700 W.

(a) Calculate the current in the freezer.

current = [2]

(b) The maximum operating current of the air-conditioning unit is 7.5 A.

Fuses of current rating 1 A, 3 A, 5 A, 10 A, 13 A and 30 A are available.

Suggest a suitable rating for fuse X. Give **two** reasons for your answer.

fuse rating

Reason 1

.....

.....

Reason 2

.....

..... [3]

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(c) A fuse is made out of a short length of wire.

Explain why fuses of a higher rating are made of thicker wire.

.....
.....
.....
.....
..... [3]

(d) Electrical energy can be obtained from renewable and non-renewable sources of energy.

(i) State **two** renewable sources of energy.

Source 1

Source 2 [2]

(ii) State **one** social, economic or environmental disadvantage of one of your answers to (d)(i).

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

[Total: 11]

06.0625_w19_qp_41 Q: 6

Fig. 6.1 shows a shower that takes in cold water. The water passes through an electric water heater and emerges from the showerhead at a higher temperature.

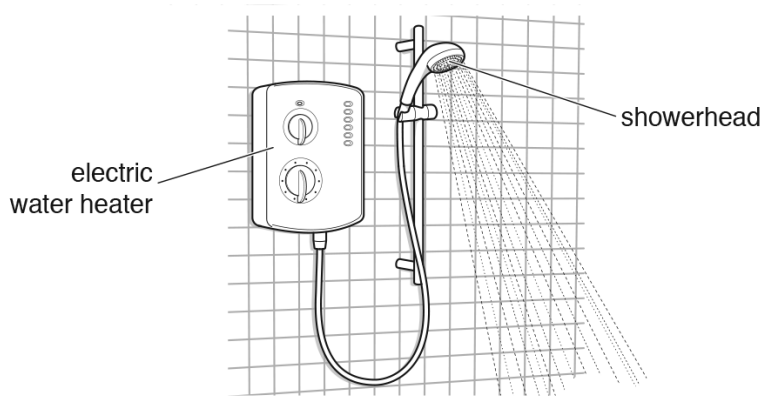


Fig. 6.1

The power of the heater is 9000W.

(a) The shower is powered by a 230V electricity supply.

(i) Calculate the current in the heater when it is switched on.

current = [2]

(ii) Suggest a suitable rating for the fuse in the heater circuit.

fuse rating = [1]

(b) The specific heat capacity of water is 4200 J/(kg °C). The initial temperature of the cold water is 16 °C.

Determine the maximum mass of water that can be heated to a temperature of 35 °C in 1.0 s.

mass = [4]

(c) A safety control in the shower switches off the shower when the water becomes dangerously hot. The control uses a thermocouple thermometer to measure the temperature of the heated water.

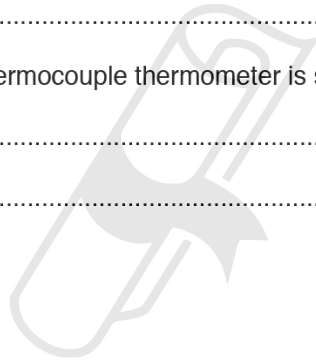
(i) Describe the structure of a thermocouple thermometer. Include a diagram in your answer.

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

(ii) Suggest **one** reason why a thermocouple thermometer is suitable for this purpose.

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

[Total: 10]



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