Energy and Mains Electricity

Total marks:22

Q1.

(i) Figure 11 shows an electric kettle.
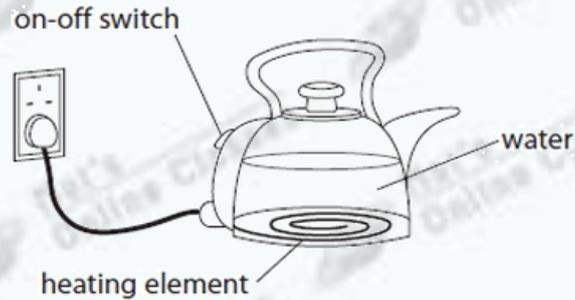

on-off switch

water

heating element

Figure 11

The kettle contains 1.5 kg of water.
The kettle is switched on.
Calculate the energy needed to raise the temperature of the water by 50 °C.
Specific heat capacity of water = 4200 J/kg °C
Use the equation

$$\Delta Q = m \times c \times \Delta\theta$$

(2)

energy needed = ... J

(ii) The amount of energy, E, needed to bring the water to boiling point is 670 000 J.

The kettle has a power of 3500 W.
Calculate the time, t, it takes to bring the water to boiling point.
Use the equation

$$P = \frac{E}{t}$$

(3)

time to bring the water to boiling point = ... s

(Total for question = 5 marks)

Q2.

A lamp is connected to a potential difference of 0.24 V.

The current in the lamp is 0.12 A.

(i) Calculate the power of the lamp.

Use the equation
$P = I \times V$

(2)

power of the lamp = ... W

(ii) The potential difference is changed to 0.30 V.

The current in the lamp is now 0.13 A.
The lamp is switched on for 35 s.
Calculate the energy that is transferred in this time.
Select an equation from the list of equations at the end of this paper.

(2)

energy transferred = ... J

(iii) The current in the lamp stays at 0.13 A.

Calculate the charge that flows through the lamp in 35 s.
Use the equation
$Q = I \times t$

(2)

charge = ... C

(Total for question = 6 marks)

Q3.

Figure 4 shows the inside of a mains plug.

earth wire

live wire

fuse

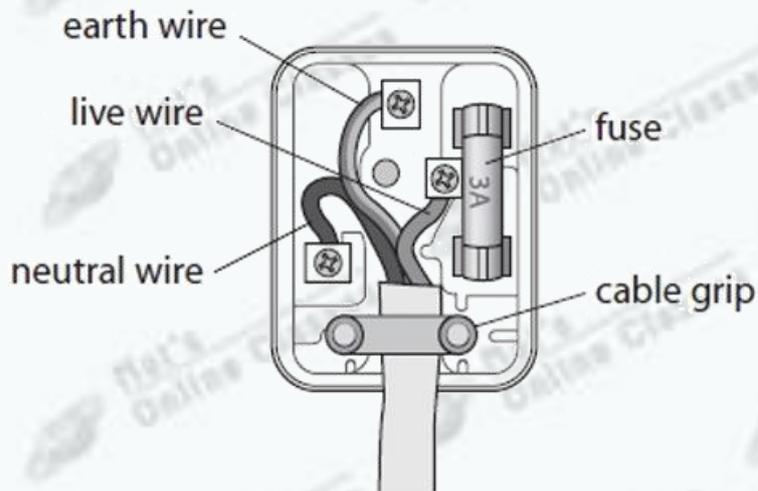neutral wire

cable grip

3 A

Figure 4

The mains plug has three safety features.

One of these safety features has been ticked in the table.

Put **two** more ticks in the table to show the other two safety features.

(2)

part of plug	safety feature
cable grip	✓
earth wire	
fuse	
live wire	
neutral wire	

(Total for question = 2 marks)

Q4.

A student investigates resistors connected in series in an electrical circuit.

The student has

- a 3.0 V battery
- a 22 Ω resistor
- a resistor marked X. The student does not know the value of the resistor marked X.

The student decides to measure the potential difference (voltage) across resistor X.

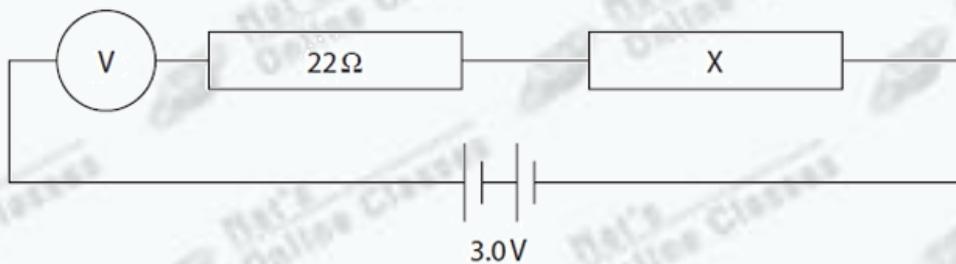Figure 15 shows the circuit that the student connected.

3.0 V

Figure 15

The circuit is connected incorrectly.

The student corrects the mistake.

The voltage across resistor X is 2.1 V.

The circuit is connected to a 3 V battery.

(i) State the value of the voltage across the 22 Ω resistor.

(1)

voltage across 22 Ω resistor = ... V

(ii) The current in resistor X is 0.041 A.

The voltage across resistor X is 2.1 V.
Show that the resistance of resistor X must be about 50 ohms.
Use the equation

$$V = I \times R$$

(2)

(iii) Calculate the power in resistor X when the voltage across X is 2.1 V and the current in resistor X is 0.041 A.

(2)

power = ... W

(iv) Calculate the overall resistance of the 22 ohm resistor and resistor X.

(2)

overall resistance = ... Ω

(v) The current in the circuit is 0.041 A.

The voltage across the battery is 3.0 V.
Calculate the energy transferred in 2 minutes.
Use the equation

$$E = I \times V \times t$$

(2)

energy = ... J

(Total for question = 9 marks)