

HEATING EFFECT OF ELECTRIC CURRENT

1.

(i) $I = \frac{1}{2} \times \frac{15000}{60 \times 60} \approx 2.1 \text{ A}$

(ii) *Heat generated in an hour*
 $= QV = 15000 \times 12 = 1.8 \times 10^5 \text{ J}$

[3m]

2.

The total amount of charge of 1.25×10^{19} electrons
 $= (1.60 \times 10^{-19}) (1.25 \times 10^{19}) = 2.00 \text{ C}$
Energy $= QV = 2.00 \times 3.20 = 6.4 \text{ J}$

3.

- (a) (i) 100 - 22 or 78 C1
(Q =) $mc\Delta T$ or $35 \times 4200 \times 78$ C1
1.1/1.1466/1.15 $\times 10^7$ J A1
(ii) (t =) E/P or $P = E/t$ or $1.15 \times 10^7/2600$ C1
4.4/4.41/4.42 $\times 10^3$ s A1
(iii) heat escapes/lost (to kitchen) or heat to heat the boiler/heater
or not all heat ends up in water or heat to cause evaporation
or used as latent heat (not heat wasted) B1 [6]
(b) (i) hot/warm water expands (not molecules expand) B1
density (of hot/warm water) decreases B1
hot/warm water rises B1
convection current/circulation or cold water sinks B1
mixes water (max 4) B1
(ii) metal/steel is (good) conductor/poor insulator or plastic is poor conductor/
insulator B1
more heat transferred through steel/less through plastic or heat transferred more
quickly through steel/less quickly through plastic B1 [6]
(c) (i) evaporation OR condensation B1
(ii) any two points
only occurs at surface boiling needs heat/
occurs at any temperature condensation releases heat B1
produces cooling boiling: liquid to gas/
no bubbles B2 condensation: gas to liquid B1 [3]
[Total: 15]

4.

Electrical circuits

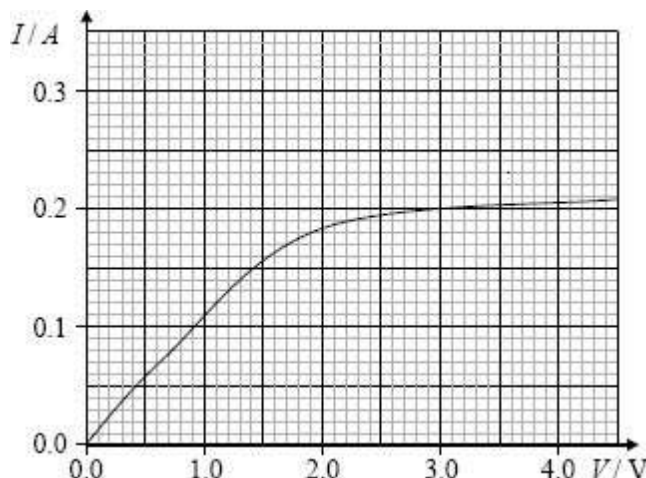
- (a) (i) resistance = 15W;

1

(ii) power = 0.6W;

1

- (b) (i) resistance of circuit too high;
 identification of high resistance component / other appropriate
 and relevant comment; 2
 Reject answers that do not explain why the lamp does not light eg
 award [0] for “the voltmeter should be in parallel” as this is not
 sufficient.
- (ii) voltmeter reads 3V; (accept just below 3V)
 because most of the pd is across the voltmeter / resistance is too high
 / there is no current in the circuit; 2
 Award [1 max] if candidate attempts to calculate the precise value of
 the pd using the total resistance of the circuit.
- (c) correct location of ammeter in series with bulb;
 correct location of voltmeter in parallel with bulb; 2
- (d) line is initially practically straight;
 and then curves;
 in the right direction;
 goes through the points (0,0) and (3.0V, 0.2 A); 4



Award [2 max] for a straight-line if it goes through (3.0V, 0.2 A). Omit
 part of the graph from 3.0 volts but do not penalize if there.

- (e) resistance of filament increases as temperature increases;

$$\text{so } \frac{I}{V} \text{ decreases with increasing } V \text{ / OWTTE;}$$
 2

Allow ecf for a straight-line in (d) only if followed by
 “temperature is constant” so “I is proportional to V / so
 ohm’s law is obeyed”.

5.

(a) power supply with ammeter and heater in series B1
voltmeter in parallel with heater/ power supply B1 [2]

(b) (i) $P = VI$ in any form C1

or 4.2×12

50(.4) W A1

(ii) $E = Pt$ i.e. any power \times any time e.g. $50(.4) \times 8$ C1

8/60 C1

or 0.13(3) seen

or division by 1000 seen anywhere

0.0067(2) (kWh) A1 [5]

(c) (i) molecules escape (from surface/leave water) / become gas or vapour / break bonds C1

fast(er) moving / high energy/ energetic molecules escape A1

(ii)

change	M1	explanation	A1
wind / draught / breeze		wind knocks molecules away	
or larger surface area		more chance/possibility of escape/more space to escape or more molecules come to/near/at surface	
or decrease humidity / drier air		fewer molecules return/from air	
or decrease atmospheric pressure		fewer air molecules to hit during escape	

(iii) evaporation occurs at surface and boiling inside liquid/bubbles
evaporation occurs at any temperature (accept room temperature)
and boiling occurs at boiling point/100 $^{\circ}$ C/ fixed / specific temperature
evaporation increased by draughts/higher temp/more area and boiling is not
OR increase in pressure stops boiling but only reduces evaporation
any two B2 [6]

(d) water heats air (by conduction) B1

or water loses heat/energy (to cup or air)

or air gains heat/energy (from water)

hot / heated air / particles rise B1 [2]

or cold air / particles sink

or hot air is less dense

or cold air is more dense

[Total: 15]

6.

(a) (i) fuse symbol correct B1

in live wire before junction of two elements B1

(ii) the (metal) case/outside B1

(iii) 1. live wire touches case; live touches person B1

2. current goes to earth; current does not go through the person B1

fuse blows B1

(b) (i) most of the energy output is useful/heat; little energy is wasted; B1

(ii) hot air rises (not heat rises) B1

density of hot air is lower B1

convection current mentioned OR hot air rises and cold air falls B1

(c) (i) 1500 W B1

(ii) 1. conversion to kW seen on any power; 2.1 (kW) seen C1

5.25; 5.2; 5.3 (kW h) A1

2. $E = P \times t$ in any form, algebraic or using any power or time e.g. 600×2.5 ,

600×150 C1

1.89×10^7

(J) OR $3.6 \times 10^6 \times (c)(ii)1$. A1 [15]