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 =)mcÄT or 35 × 4200 × 78 C1
1.1/1.1466/1.15 × 107 J A1
(ii) (t =)E/P or P = E/t or 1.15 × 107/2600 C1
4.4/4.41/4.42 × 103 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

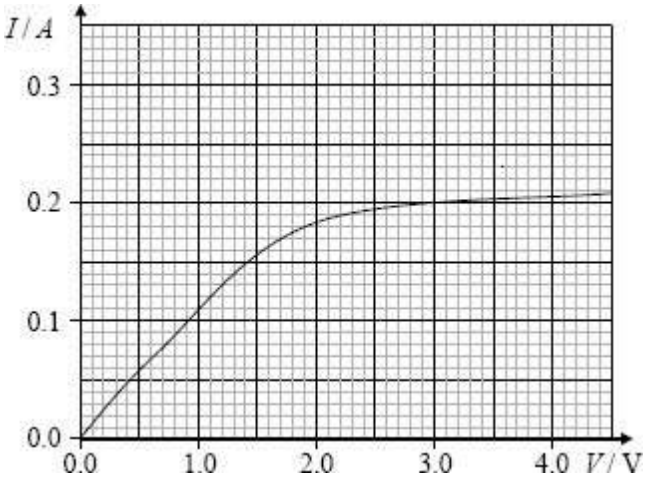
(ii) power = 0.6W; 1

(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;

so $\frac{I}{V}$ decreases with increasing V / 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". [14]

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 •~ any time e.g. 50(.4) •~ 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 ‹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]