Mark schemes

(a) last box ticked

(b) (i) use hotter water (than 60 °C)
   accept use boiling water
   accept use water at any stated temperature above 60 °C

   or
   add ice cubes
   accept add water at any stated temperature below 12 °C
   use different temperatures is insufficient

   (ii) the current increases as the temperature increases

   (iii) 0.02 (A)

   (iv) 5 (V)

   or
   their (b)(iii) \times 250 correctly calculated
   allow 1 mark for correct substitution ie \( V = 0.02 \times 250 \)
   or
   \( V = \text{their (b)(iii)} \times 250 \)

   (v) the resistance increases

(b) correct symbol drawn in series with other components
   symbol must have upper case A
(c) (i) \[ 9 + 3 = 12 \text{V} \]

*reason only scores if this mark scored*

pd of battery is shared between the variable resistor and fixed resistor

accept \[ V_1 + V_2 = \text{pd of the battery} \]

accept p.d. is shared in a series circuit

accept voltage for p.d.

(ii) 600

*reason only scores if this mark scored*

p.d. of supply shared equally when resistors have the same value

or

ratio of the p.d. is the same as the ratio of the resistance

(iii) 0.015

or

their (c)(i) ÷ (their (c)(ii) + 200) correctly calculated

allow 2 marks for correct substitution ie \[ 12 = I \times 800 \]

or

their (c)(i) = \[ I \times (\text{their (c)(ii) + 200}) \]

allow 1 mark for total resistance = \[ 800 \, (\Omega) \] or their (c)(ii) + 200

or

allow 1 mark for a substitution of \[ 12 = I \times 200 \]

or

their (c)(i) = \[ I \times 200 \]

or

alternative method using the graph

\[ V = 3 \, V \] (1)

\[ 3 = I \times 200 \] (1)


(a) pin

made from brass because it is (hard and) a (good electrical) conductor

accept copper for brass

metal is insufficient

heat conductor on its own negates

outer case

plastic/rubber because it is a (good electrical) insulator

heat insulator on its own negates
(b) (i) live

(ii) makes it hot/warm

\[ \text{melts is insufficient} \]

(iii) 8.7

accept an answer that rounds to 8.7

allow 1 mark for correct substitution ie \[ 2000 = 230 \times I \]

an answer of 0.0087 or 0.009 or 3.0(4) or 5.65 or 5.7 gains 1 mark

(c) a (large) current goes from the live wire to the earth wire

accept metal case for live wire

accept a current goes from live to earth

do not accept electricity for current

(which causes) the fuse to (overheat and) melt

accept blow for melt

break is insufficient

do not accept snap / blow up for melt

(d) reduce chance of an electric shock

accept to reduce the risk of an accident

accept prevent electric shock

accept prevent electrocution

accept prevent or reduce the risk of an (electrical) fire

accept an electric shock can kill you

accept it can kill you

accept so you can use it safely

(a) charge

(b) (i) blue

(ii) earth wire

fuse
(c)  (i)  case is non-metal / non-conducting / plastic / insulator
   must refer to case / outside of appliance
   do not accept plastic coating / covering

   (ii)  earth (wire)

(d)  (i)  60 (W)
   \[ P = 3 \times 20 \text{ gains 1 mark} \]
   provided no subsequent step shown

   (ii)  15
   \[ 300 = 20 \times Q \]
   or
   \[ 20 = \frac{300}{Q} \text{ gains 1 mark} \]

   C / coulombs
   must clearly be upper case C accept J / V or As

(a)  filament bulb
(b) (i) 6 V

(ii) 3 Ω or their \( \frac{(i)}{2} \) correctly calculated
   
   \[ 6 = 2 \times R \]
   
   or their (i) = 2 \times R

(iii) 1 A

(iv) 6 Ω or their (i) / their (iii) correctly calculated

(v)

<table>
<thead>
<tr>
<th>Decrease</th>
<th>Stay the same</th>
<th>Increase</th>
</tr>
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<tbody>
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<td></td>
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(a) field

   correct order only

   current

   force

   accept motion

   accept thrust
(b) (i) arrow pointing vertically downwards 1

(ii) increase current / p.d.

   accept voltage for p.d.

   increase strength of magnetic field

   accept move poles closer together 1

(iii) reverse (poles of) magnets 1

   reverse battery / current 1

(c) (i) 1.5 or 150%

   efficiency = \frac{120}{80} \times 100
gains 1 mark

   an answer of 1.5 % or 150
gains 1 mark 2

(ii) efficiency greater than 100%

   or

   output is greater than input

   or

   output should be 40 (W) 1

(iii) recorded time much shorter than actual time

   accept timer started too late

   accept timer stopped too soon 1
(a) increases

accept reaches highest value
do not accept increases and decreases

(b) (i) increases

(ii) increases

(c) 18

allow 1 mark for correct substitution i.e. 12 × 1.5 provided no subsequent step

watt

accept W

answer may be indicated in the list

(a) (i) (3-pin) plug

do not accept plug socket

(ii) live and neutral

(iii) double

(b) direct current (d.c.) only
(c) (i) live

(ii) too great a current flows
     accept a surge of current
     accept too great a power
     accept an electrical fault
     do not accept voltage / energy / electricity too high

(iii) can be reset
     accept does not need replacing

(disconnects circuit) faster
    cheaper is insufficient
    does not melt is insufficient
    quicker to fix / replace is insufficient

(a) (i) p.d. is (directly) proportional to current
       or
       gradient / slope is constant
       or
       the lines show constant resistance
       accept lines are straight / diagonal

(ii) C

    reason only scores if C is chosen

    for the same p.d. the current is the smallest
    accept lowest gradient and the gradient = 1 / R
(b) (i) ohm

    accept correct symbol Ω
    accept an answer written in the table if not given in answer space

(ii) K and L

    reason only scores if both K and L are chosen

    only length varies
    accept type of metal and the diameter are the same

(iii) measure the resistance of more wires made from different metals

    accept test more (types of) metals
    measure the resistance of more wires is insufficient
    they only use two metals is insufficient

(c) (i) voltmeter symbol correct and drawn in parallel with the wire

    ![Voltmeter Diagram]

    accept voltmeter symbol correct and drawn in parallel with the battery

(ii) correct symbol drawn

    ![Rectangular Symbol]

    symbol must be rectangular
(a)  
(i) 1.7

(ii) 51
   or
   30 \times \text{their (i) correctly calculated}

   \textit{allow 1 mark for correct substitution i.e. } 1.7 = \frac{Q}{30}

   \text{or their (i) } = \frac{Q}{30}

coulomb / C

   \textit{do not accept c}

(iii) 612
   or
   their (ii) \times 12 correctly calculated
   or
   their (i) \times 360 correctly calculated

   \textit{allow 1 mark for correct substitution i.e. } E = 12 \times 51

   \text{or } 12 \times \text{their (ii)}

   \text{or their (i) } \times 360

(b) ions vibrate faster
   or
   ions vibrate with a bigger amplitude

   \textit{accept atoms for ions throughout}
   \textit{accept ions gain energy}
   \textit{accept ions vibrate more}
   \textit{ions start to vibrate is insufficient}

   electrons collide more (frequently) with the ions
   or
   (drift) velocity of electrons decreases

   \textit{electrons start to collide is insufficient}

   \textit{there are more collisions is insufficient, unless both electrons and ions are implied}

(a)  
(i) 150

(ii) transferred to the surroundings by heating

   \textit{reference to sound negates mark}
(iii) \( 0.75 \)

\[
\frac{450}{600} \text{ gains } 1 \text{ mark}
\]

accept 75% for 2 marks

maximum of 1 mark awarded if a unit is given

(iv) \( 20 \) (s)

correct answer with or without working gains 2 marks

correct substitution of \( \frac{600}{30} \) gains 1 mark

(b) (i) to avoid bias

(ii) use less power and last longer

1 LED costs £16, 40 filament bulbs cost £80

or

 filament costs (5 times) more in energy consumption

(iii) any one from:

• availability of bulbs
• colour output
• temperature of bulb surface