Mark schemes

1   (a)   current that is always in the same direction

1

(b)   total resistance = 30 (Ω)

1

$V = 0.4 \times 30$

1

12 (V)

1

*allow 12 (V) with no working shown for **3** marks*
*an answer of 8 (V) or 4 (V) gains **2** marks only*

(c) $P = 0.4 \times 12 = 4.8$

1

5 (W)

1

*allow 5 (W) with no working shown for **2** marks*
*allow 4.8 (W) with no working shown for **1** mark*

[6]

2   (a)   battery, lamp and ammeter connected in series with variable resistor

1

voltmeter in parallel with (filament) lamp

1

(b)   **Level 2 (3–4 marks):**
A detailed and coherent description of a plan covering all the major steps is provided.
The steps are set out in a logical manner that could be followed by another person to
obtain valid results.

Level 1 (1–2 marks):
Simple statements relating to relevant apparatus or steps are made but they may
not be in a logical order. The plan would not allow another person to obtain valid results.

0 marks:
No relevant content

Indicative content
- ammeter used to measure current
- voltmeter used to measure potential difference
- resistance of variable resistor altered to change current in circuit **or** change
  potential difference (across filament lamp)
- resistance (of filament lamp) calculated **or** R=V / I statement
- resistance calculated for a large enough range of different currents that would
  allow a valid conclusion about the relationship to be made

4

(c)   (as current increases) resistance increases (at an increasing rate)

1

(d) any value between 6.3 and 6.9 (Ω)

1

(e) **A**: Filament lamp

1

B: Resistor at constant temperature

1

C: Diode

1

[11]

3 (a) V = 0.10 × 45

1

4.5 (V)

1

(b) R = 12 / 0.10

1

total resistance = 120 (Ω)

1

R = 120 – 105 = 15 (Ω)

1

(c) (total) resistance decreases
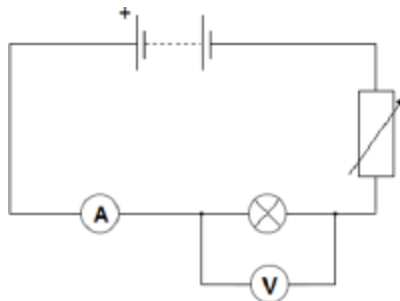
1

(so) current increases

1

[7]

4

(a)

battery in series with bulb and ammeter

1

voltmeter in parallel with bulb

1

variable resistor

or

variable power pack

or

potentiometer

1

(b)   A is brighter because it has a higher current (than lamp B at any p.d.)

1

(therefore A has a) higher power output (than bulb B)
    accept higher energy output per second

1

(c)   lower current (than lamp A) for the same potential difference
    accept answer in terms of R = V / I

1

lower gradient (than lamp A)

1

(d)   0 – 2 Volts
    allow a range from 0 V up to any value between 1 and 2 V.

1

(for an ohmic conductor) current is directly proportional to potential difference
    allow lines (of best fit) are straight and pass through the origin

1

(so) resistance is constant

1
[10]

5   (a)   (because the) potential of the live wire is 230 V

1

(and the) potential of the electrician is 0 V

1

(so there is a) large potential difference between live wire and electrician

1

charge / current passes through his body
    allow voltage for potential difference

1

(b)   diameter between 3.50 and 3.55 (mm)
    *allow correct use of value of cross-sectional area of 9.5 to 9.9
    (mm^2) with no final answer given for **1** mark*

2

(c)   18000 = I × 300

1

I = 18000 / 300 = 60

1

13 800 = (60²) × R

1

R = 13 800 / 60²

1

3.83 (Ω)

1

*allow 3.83(Ω) with no working shown for **5** marks*
answer may also be correctly calculated using P = IV and V = IR if
230 V is used.

[11]

6 (a) last box ticked

1

(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

1

(ii) the current increases as the temperature increases

1

(iii) 0.02 (A)

1

(iv) 5 (V)

or
their **(b)(iii)** × 250 correctly calculated

*allow **1** mark for correct substitution ie V = 0.02 × 250*
or
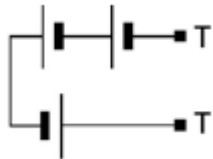*V = their **(b)(iii)** × 250*

2

(v) the resistance increases

1

[7]

7 (a) 3rd box from the left ticked

1

(b) correct symbol drawn in series with other components

symbol must have upper case A

1

(c) (i) 9 + 3 = 12V

reason only scores if this mark scored

1

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

accept $V_1 + V_2$ = pd of the battery

accept p.d. is shared in a series circuit

accept voltage for p.d.

1

(ii) 600

reason only scores if this mark scored

1

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

1

(iii) 0.015

or

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

*allow **2** marks for correct substitution ie 12 = I × 800*

or

their (c)(i) = I × (their (c)(ii) + 200)

*allow **1** mark for total resistance = 800 (Ω) or their (c)(ii) + 200*

or

*allow **1** mark for a substitution of 12 = I × 200*

or

their (c)(i) = I × 200

or

alternative method using the graph

V = 3 V (1)

3 = I × 200 (1)

3

[9]

8 (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

    1

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

        heat insulator on its own negates

    1

(b) (i) live

    1

(ii) makes it hot/warm

        melts is insufficient

    1

(iii) 8.7

        accept an answer that rounds to 8.7

        *allow **1** mark for correct substitution ie 2000 = 230 × I*

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

    2

(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

    1

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

        accept blow for melt

        break is insufficient

        do not accept snap / blow up for melt

    1

(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

    1

    [9]

9 (a) filament bulb

    1

(b) (i) 6 V

1

(ii) 3 Ω or their $\frac{(i)}{2}$ correctly calculated

allow 1 mark for correct substitution ie

$6 = 2 \times R$

or their (i) = 2 × R

2

(iii) 1 A

1

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

1

(v)

Decrease	Stay the same	Increase
	✓	
✓		
✓		

1
1
1

[9]

10 (a) increases

accept reaches highest value

*do **not** accept increases and decreases*

1

(b) (i) increases

1

(ii) increases

1

(c) 18

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

2

watt

accept W

answer may be indicated in the list

1

[6]

11 (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

1

(ii) C

     reason only scores if C is chosen

1

for the same p.d. the current is the smallest

     *accept lowest gradient **and** the gradient = 1 / R*

1

(b) (i) ohm

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

1

(ii) K and L

     reason only scores if both K and L are chosen

1

only length varies

     accept type of metal and the diameter are the same

1

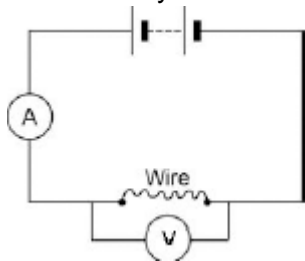(iii) measure the resistance of more wires made from different metals

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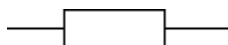   *they only use two metals is insufficient*

1

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

   accept voltmeter symbol correct and drawn in parallel with the battery

                     1

(ii) correct symbol drawn

   symbol must be rectangular

                      1

                      [9]

12 (a) (i) 1.7

                      1

(ii) 51
or
30 × their (i) correctly calculated

   *allow **1** mark for correct substitution i.e. 1.7 $= \dfrac{Q}{30}$*

   or their (i) $= \dfrac{Q}{30}$

                      2

coulomb / C
   *do **not** accept c*

                      1

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

   *allow **1** mark for correct substitution i.e. E = 12 × 51*

   or 12 × their (ii)

   or their (i) × 360

                      2

(b) ions vibrate faster

or

ions vibrate with a bigger amplitude

accept atoms for ions throughout

accept ions gain energy

accept ions vibrate more

ions start to vibrate is insufficient

1

electrons collide more (frequently) with the ions

or

(drift) velocity of electrons decreases

electrons start to collide is insufficient

there are more collisions is insufficient, unless both electrons and ions are implied

1

[8]

13 (a) (i) any **six** from:

- switch on
- read both ammeter and voltmeter

  allow read the meters
- adjust variable resistor to change the current
- take further readings
- draw graph
- (of) V against I

  allow take mean
- R = V / I

  allow take the gradient of the graph

6

(ii) resistor would get hot if current left on

1

so its resistance would increase

1

(iii) 12 (V)

*0.75 × 16 gains **1** mark*

2

(iv) 15 (Ω)

1

16 is nearer to that value than any other

1

(b) if current is above 5 A / value of fuse

1

fuse melts

allow blows / breaks

*do **not** accept exploded*

1

breaks circuit

1

[15]

14 (a) *attempt to draw four cells in series*

1

correct circuit symbols

circuit symbol should show a long line and a short line, correctly joined together

example of correct circuit symbol:

1

(b) (i) 6 (V)

*allow **1** mark for correct substitution, ie*

$V = 3 \times 2$ *scores **1** mark*

provided no subsequent step

2

(ii) 12 (V)

ecf from part (b)(i)

18 − 6

or

*18 − their part (b)(i) scores **1** mark*

2

(iii) 9 (Ω)

ecf from part (b)(ii) correctly calculated

3 + their part (b)(ii) / 2

or

*18 / 2 scores **1** mark*

provided no subsequent step

2

(c) (i) need a.c.

1

battery is d.c.

1

(ii)　3 (A)

*allow **1** mark for correct substitution, ie*

$18 \times 2 = 12 \times I_s$ *scores **1** mark*

2

[12]

15　(a)　(i)　live

1

(ii)　react faster

1

(iii)　live and neutral

1

(b)　(i)　ammeter

1

to measure current

accept to measure amps

1

plus any **one** from:

- *variable* resistor (1)
  to vary current (1)
  accept variable power supply
  accept change or control

- *switch* (1)
  to stop apparatus getting hot / protect battery
  or
  to reset equipment (1)

- fuse (1)
  to break circuit if current is too big (1)

2

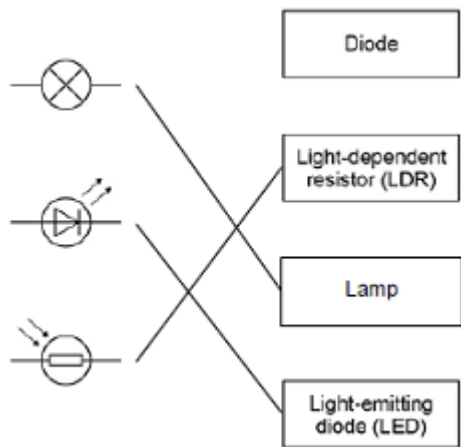(ii)　any **two** from:

- use smaller mass(es)
- move mass closer to pivot
- reduce gap between coil and rocker
- more turns (on coil) *coil / loop*
- <u>iron</u> core in coil
  accept use smaller weight(s)

2

[9]

16 (a)

*allow **1** mark for each correct line if more than one line is drawn
from any symbol then all of those lines are wrong*

3

(b) (i) half

1

(ii) 3(V)

1

(iii) V_1

1

(c) (i) potential difference / voltage of the power supply

accept the power supply

accept the voltage / volts

accept number of cells / batteries

accept (same) cells / batteries

do not accept same ammeter / switch / wires

1

(ii) bar drawn – height 1.(00)A

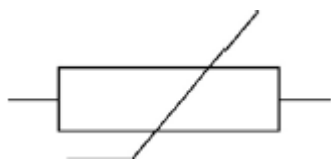*ignore width of bar*

*allow **1** mark for bar shorter than 3rd bar*

2

(iii) as the number of resistors increases the current decreases

1

[10]

17 (a) (i)

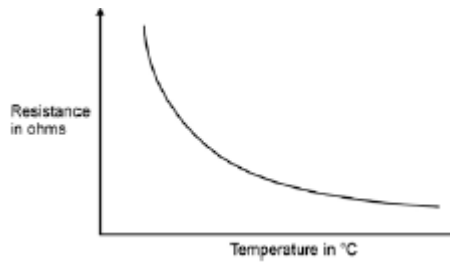

1

(ii)   360

        *allow **1** mark for correct substitution, ie 9 = 0.025 × R*

2

(iii)   sketch graph of correct shape, ie

1

(iv)   An automatic circuit to switch a heating system on and off.

1

(b)   so ammeter reduces / affects current as little as possible

        accept so does not reduce / change the current (it is measuring)

        accurate reading is insufficient

        not change the resistance is insufficient

1

(c)   gives a common understanding

        accept is easier to share results

        accept can compare results

        do not need to be converted is insufficient

        prevent errors is insufficient

1

(d)   replace Bunsen (and water) with a lamp

        accept any way of changing light level

1

   replace thermometer with light sensor

        accept any way of measuring a change in light level

        datalogger alone is insufficient

1

[9]

18   (a)   decreases

1

(b)   a filament bulb

        allow bulb

1

   an LED

1

(c)   Marks awarded for this answer will be determined by the Quality of Communication (QoC) as well as the standard of the scientific response.

0 marks
No relevant content.

Level 1 (1−2 marks)
There is a basic description of the method. This is incomplete and would not lead to any useful results.

Level 2 (3−4 marks)
There is a description of the method which is almost complete with a few minor omissions and would lead to some results.

Level 3 (5−6 marks)
There is a detailed description of the method which would lead to valid results.
To gain full marks an answer including graph, or another appropriate representation of results, must be given.

examples of the physics points made in the response:

- read V and I
- read temperature
- apply heat

    allow hot water to cool
- read V and I at least one other temperature
- determine R from V / I
- range of temperatures above 50 °C

extra detail:
- use thermometer to read temperature at regular intervals of temperature
- remove source of heat and stir before taking readings
- details of attaining 0 °C or 100 °C
- last reading taken while boiling
- graph of R against T
- at least 3 different temperatures

6

(d)   (i)   Q

1

(ii)   (80, 3.18)

1

(iii)   any **one** from:

- measurement of V too small
- measurement of I too big
- incorrect calculation of R
- thermometer misread

    allow misread meter

    ignore any references to an error that is systematic

1

(iv) any **two** from:

- not portable

  allow requires a lot of equipment allow takes time to set up
- needs an electrical supply
- cannot be read directly

  accept it is more difficult to read compared to liquid-in-glass

2

[14]

19 (a) (i) to obtain a range of p.d. values

accept increase / decrease current / p.d. / voltage / resistance

accept to change / control the current / p.d. / voltage / resistance

to provide resistance is insufficient

a variable resistor is insufficient

*do **not** accept electricity for current*

1

(ii) temperature of the bulb increases

accept bulb gets hot(ter)

accept answers correctly

expressed in terms of collisions between (free) electrons and ions / atoms

bulb gets brighter is insufficient

1

(iii) 36

*allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown*

2

watt(s) / W

accept joules per second / J/s

*do **not** accept w*

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)
There is a clear comparison of either the cost aspect or energy efficiency aspect
OR
a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)
There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy
  simply giving cost figures is insufficient

- 6 halogen lamps cost the same as one LED

- LEDs last longer

- need to buy 18 / more halogen lamps to last the same time as one LED

- 18 halogens cost £35.10

- costs more to run a halogen than LED

- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency

- LED works using a smaller current

- LED wastes less energy

- LEDs are more efficient

- LED is 22% more energy efficient

- LED produces less heat

- LED requires smaller input (power) for same output (power)

6

[11]

20 (a) 35

> *an answer with more than 2 sig figs that rounds to 35 gains **2** marks*
>
> *allow **2** marks for correct method, ie $\frac{230}{6.5}$*
>
> *allow **1** mark for I = 6.5 (A) **or** R = $\frac{230}{26}$*
>
> *an answer 8.8 gains **2** marks*
>
> *an answer with more than 2 sig figs that rounds to 8.8 gains **1** mark*

3

(b) (maximum) current exceeds maximum safe current for a 2.5 mm² wire

> *accept power exceeds maximum safe power for a 2.5 mm² wire*

or
(maximum) current exceeds 20 (A)

> *(maximum) current = 26 (A) is insufficient*

1

a 2.5 mm² wire would overheat / melt

> *accept socket for wire*
>
> *do **not** accept plug for wire*

1

(c) a.c. is constantly changing direction

> *accept a.c. flows in two directions*
>
> *accept a.c. changes direction*
>
> *a.c. travels in different directions is insufficient*

1

d.c. flows in one direction only

1

[7]

21 (a) 25(Ω)

1

(b) (i) 2(V)

> *allow **1** mark for showing a correct method, ie 6 / 3*

2

(ii) equal to

1

[4]

22 (a) (i) 50 (Hz)

1

(ii) 2760 (W)

1

(b)   12

*allow **1** mark for correct substitution, ie 2400/200*

or

*allow **1** mark for 2760/230 provided no subsequent step shown*

2

amps

1

(c)   the charge is <u>directly</u> proportional to the time switched on for

*accept for **1** mark the longer time (to boil), the greater amount of charge*

***or** positive correlation*

***or** they are proportional*

2

[7]

23   (a)   (i)   symbol for a diode

accept

1

symbol for a variable resistor
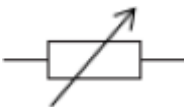
1

(ii)   voltmeter is in series **or** voltmeter is not in parallel

1

ammeter is in parallel **or** ammeter is not in series

accept an answer in terms of how the circuit should be corrected

voltmeter and ammeter are wrong way around is insufficient

1

(b)   (i)   0.2 (V)

accept any value between 0.20 and 0.21 inclusive

1

(ii)   37.5

*allow **1** mark for I = 0.008*

or

*allow **2** marks for correct substitution, ie 0.3 = 0.008 × R*

or

*allow **1** mark for a correct substitution using I = 0.8 **or** I = 0.08*

***or** I = 0.009*

or

*allow **2** marks for answers of 0.375 **or** 3.75 **or** 33(.3)*

3

(c) (i) 25

*allow **1** mark for obtaining period = 0.04(s)*

2

(ii) diode has large resistance in reverse / one direction

1

so stops current flow in that / one direction

allow diodes only let current flow one way / direction

*allow **1** mark for the diode has half-rectified the (a.c. power) supply*

1

[12]

24 (a) (i) 50(Hz)

ignore any unit given

1

(ii) any **two** from:

- (some) current flows to Earth

  accept ground for Earth

- current flows through copper braid

  accept current flows through the earth wire

  accept electricity for current in either the first or second marking point but not both

- RCCB detects difference between <u>current</u> in live and neutral wire

2

(iii) can be reset

accept does not need replacing

or

faster acting

accept switches circuit off faster

1

(b) (i) 79 200

*allow **1** mark for correct substitution, ie* $11 = \dfrac{Q}{2 \times 3600}$

*an answer 22 gains **1** mark*

2

coulombs / C

*do **not** accept c*

1

(ii)   18 216 000

        *accept for **2** marks 18 216 kJ **or** 18.216 MJ*

or

230 × their (b)(i) correctly calculated

        *allow **1** mark for correct substitution, ie 230 × their (b)(i) **or***
        *allow **1** mark for power calculated as 2530(W)*

2

(c)   increases temperature of thermistor

1

changes resistance (of thermistor)
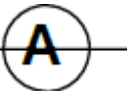
        *do **not** accept increases resistance (of thermistor)*
        *an answer decreases resistance (of thermistor) gains **2** marks*

1

[11]
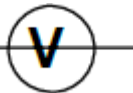
25   (a)   (i)   ammeter symbol correct and drawn in series

        accept

        *do **not** accept lower case a*

1

voltmeter symbol correct and drawn in parallel with the material

        *do **not** accept*

1

(ii)   adjust / use the variable resistor

        accept change the resistance

or
change the number of cells

        accept battery for cell
        accept change the pd / accept change the voltage
        accept increase / decrease for change

1

(b)   (i)   37.5 (Ω)

        accept answer between 36 and 39 inclusive

1

(ii)   5.6(25) **or** their (b)(i) × 0.15

        *allow **1** mark for correct substitution ie 37.5 **or** their (b)(i) × 0.15*
        provided no subsequent step shown

2

(c) (i) the thick**er** the putty the low**er** the resistance
                answer must be comparative
                accept the converse

                                                                1

     (ii) any **one** from:

           •   measuring length incorrectly
                accept may be different length

           •   measuring current incorrectly
                *do **not** accept different currents*

           •   measuring voltage incorrectly
                *do **not** accept different voltage*

           •   ammeter / voltmeter incorrectly calibrated

           •   thickness of putty not uniform
                *do **not** accept pieces of putty not the same unless qualified*

           •   meter has a zero error
                *do **not** accept systematic / random error*
                accept any sensible source of error eg putty at different temperatures
                *do **not** accept human error without an explanation*
                *do **not** accept amount of putty not same*

                                                                1
                                                               [8]

26 (a) (i) 2
                *allow **1** mark for correct substitution i.e. 0.8 × 2.5 provided no further step shown*

                                                            2

     (ii) straight line drawn from origin to 2, 0.8
           or
           their (a)(i), 0.8

                                                            1

           curve from 2, 0.8 to 12,2
           or
           their (a)(i) 0.8 to 12,2
                accept curve from 2, 0.9 to 12,2
                or
                their (a)(i) 0.9 to 12,2
                'convex' curve required
                accept a curve that flattens between 10 and 12V

                                                            1

(iii) filament / lamp gets hot

    accept temperature increases

                              1

(b) 108

    *allow **1** mark for correct substitution i.e. 1.5 × 72 provided no further step shown*

                              2

                              [7]

27 (a) (i) 15

                              1

   (ii) 4.5 or their (a)(i) x 0.3 correctly calculated

    *allow **1** mark for correct substitution, ie 0.3 x 15/their (a)(i), provided no subsequent step*

                              2

   (ii) decrease

                              1

  (b) **Y**

    accept any correct indication

    *reason only scores if **Y** is chosen*

    accept voltage for p.d.

                              1

  (only one that) shows a direct current / p.d.
  or
  a battery / cell gives a direct current

    *accept both **X** and **Z** are a.c.*

  or
  a battery/cell gives a constant current/p.d.
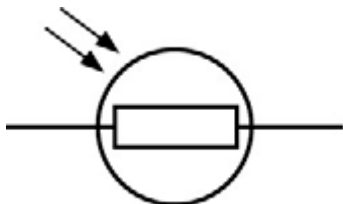
    accept it's a constant current/p.d.

    it is not changing is insufficient

                              1

                              [6]

28 (a) (i) correct symbol ringed

                              1

(ii)   accept any suggestion that would change light intensity, eg:

- torch on or off
  accept power of torch
  *do **not** accept watts / wattage of torch*

- distance between torch and LDR

- lights in room on or off

- shadow over the LDR

1

(b)   resistance decreases

1

from 600 kΩ to 200 kΩ
accept by 400 kΩ

1

(c)   (i)   no numbers for light intensity
or
light intensity is categoric / a description / not continuous
not enough results is insufficient

1

(ii)   YES
mark is for the reason

both show that resistance increases with decreasing (light)
intensity / brightness
accept they both get the same results / pattern

1

(d)   A circuit that automatically switches outside lights on when it gets dark.

1

[7]

29   (a)   electric current
(rate of) flow of (electric) charge / electrons

accept $I = \dfrac{Q}{t}$

with Q and t correctly named

1

potential difference
work done / energy transferred per coulomb of charge
(that passes between two points in a circuit)

accept $V = \dfrac{W}{Q}$

with W and Q correctly named

1

(b)   metals contain free electrons (and ions)

accept mobile for free

1

as temperature of filament increases ions vibrate faster /
with a bigger amplitude

accept atoms for ions

accept ions/atoms gain energy

accept vibrate more for vibrate faster

do not accept start to vibrate

1

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

do not accept start to collide

*accept increasing the p.d. increases the temperature (**1** mark)*

and

*(and) resistance increases with temperature (**1** mark) if no other marks scored*

1

(c)   7.8

*allow **1** mark for obtaining value 1.3 from graph*

***or** allow **1** mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive*

2

[7]

30   (a)   (i)   50 000

*allow **1** mark for correct substitution, ie*

6 = 0.00012 × R

***or** 6 = 0.12 × R*

***or** answers of 25 000 or 50 gain **1** mark*

***or** allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current*

2

ohm / Ω

*an answer 50kΩ gains **3** marks*

1

(ii) (body) resistance changes

or

body fat/resistance affected by (many) factors

accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat / resistance

1

(iii) gives misleading / wrong/inaccurate value

do not credit if specifically linked to a change in mass / weight

1

(because) high water content changes body resistance

accept a specific change to resistance

water changes body mass is insufficient

1

(b) (i) RCCB – detects difference between current in live and neutral (wires)

accept RCCB can be reset

1

fuse – (overheats and) melts

accept blows for melts

1

(ii) switches the circuit / hedge trimmers off within 60 milliseconds

*allow for **1** mark the RCCB / it is (very) fast.*

do not accept the bigger the current the faster the RCCB switches off

2

[10]

31 (a) (i) 6

1

(ii) variable resistor

1

(iii) voltmeter

1

(b) (i) point at 3 V ringed

1

(ii) The student misread the ammeter.

1

(iii)   1 (volt)

accept every volt

1

(c)   as one increases so does the other
or
directly proportional
or
positive correlation

accept a numerical description, eg when one doubles the other also doubles

1

[7]

32   (a)   (i)   circuit not complete

accept circuit is broken

accept switch / s are open / off

1

(ii)   9

*allow **1** mark for correct substitution, ie 0.5 × 18 provided no subsequent step shown*

2

(iii)   36

1

(b)   can be switched on / off from top or bottom of stairs

1

(c)   (i)   (electric) shock

accept fitting becomes live

accept answers giving a possible consequence of electric shock, eg death

1

(ii)   connect the <u>earth</u> wire

1

[7]

33   (a)   (i)   also double

increases is insufficient

1

(ii)   <u>variable</u> resistor

accept rheostat / potentiometer

1

(b) (i) the data / results / variables are continuous

accept data / results / variables are not categoric / discrete

1

(ii) misreading the ammeter

*do **not** accept misreading the meter / results*

*do **not** accept misreading the ammeter and / or voltmeter*

reading / human error is insufficient

1

(iii) straight line <u>from the origin</u> drawn passing close / through
points at 1 V, 5 V, 6 V and ignoring anomalous point

*do **not** accept line drawn 'dot-to-dot'*

1

(iv) yes

mark is for the reason

supports prediction
or
(straight) line passes through the origin

accept a mathematical argument, eg when p.d. went from 2 to 4 the
current went from 0.3 to 0.6

it's directly proportional is insufficient

1

[6]

34 (a) (i) (connect) 30 (cells)

1

in series

1

(ii) current always flows in the same direction
or
current only flows one way

1

(iii) 36 000

*allow **1** mark for correctly converting 2 hours to 7200 seconds*

*answers 10 or 600 score **1** mark*

2

coulombs / C

*do **not** accept c*

1

(b) (i) 2160

*allow **1** mark for correct substitution, ie ½ × 120 × 6²*
*answers of 1620 or 540 score **1** mark*

2

(ii) reduce it

1

any **one** from:

- draws a larger current (from battery)

- motor draws greater power (from battery)
  accept energy per second for power
  accept more energy needed to move the bicycle

- greater resistance force (to motion) / air resistance / drag / friction
  accept less streamlined
  more mass to carry is insufficient

1

[10]

35 (a) (i) 4.5

1

(ii) 2.25 or their (a)(i) ÷ 2 correctly calculated

1

(iii) V_2

1

(b) (i) 30

1

(ii) 8

*allow **1** mark for correct substitution*
ie 0.4 × 20
*allow **1** mark for answers of 4 or 12*

2

(iii) **Y**

1

[7]

36 (a) diode

accept LED

1

(b)   all symbols correct

        must include at least voltmeter and diode

                                                                                    1

 diode

        allow ecf from part (a) if the component is not identified as a diode

        allow symbol without the line through triangle

        ignore polarity of diode

        voltmeter in parallel with component added in series

        *any additional components must not affect the ability to measure **V**
        and **I** for the diode / their (a)*

                                                                                    1

(c)   (i)   0.05

                accept 50 mA

                accept between 0.048 and 0.050 inclusive

                                                                                    1

        (ii)   16

                $$\frac{0.8}{\_\_\_\_\_}$$

                their (c)(i) correctly calculated gains both marks

                *allow **1** mark for correct transformation and substitution*

                $\frac{0.8}{0.05}$ *or* $\frac{0.8}{their\ (c)(i)}$

                allow 17 if using 0.048

                                                                                    2

                                                                                    [6]

37 (a)   (i)   0.25 (A)

                                                                                    1

        (ii)   75

                *allow **1** mark for converting 5 minutes to 300 seconds*

                ***or** allow **1** mark for correct substitution*

                ie 0.25 × 300

                *allow **1** mark for an answer 1.25*

                *allow **1** mark only for their (a)(i) × 300 correctly calculated*

                                                                                    2

                coulombs or C

                *do **not** accept c*

                                                                                    1

(b)   any **two** from:

- fault not repaired
  accept if a fault was to occur

- larger current will (still) flow

- aluminium foil will not melt (if a fault)
  accept aluminium foil needs a higher current / charge to melt

- wiring will overheat / (may) cause a fire
  accept idea of fire hazard
  do **not** accept explode etc

2

[6]

38 (a)   fleece rubs against shirt
             it refers to the fleece

1

or
friction (between fleece and shirt)

(causing) <u>electrons</u> to transfer from one to the other
             accept a specific direction of transfer
             do **not** accept charge for electrons
             positive electrons negates this mark
             movement of protons negates this mark

1

(b)   Electrical charges move easily through metals.

1

An electric current is a flow of electrical charge.

1

(c)   (i)   copper
             reason only scores if copper chosen

1

       (good electrical) conductor
             accept it is a metal
             any mention of heat conduction negates this mark

1

       (ii)   lower than

1

(iii) accept any sensible suggestion,eg:

- too many variables (to control)

- lightning strikes / storms are random / unpredictable

- do not know which building will be struck

- do not know when a building will be struck

- do not know when lightning will happen

- (very) difficult to create same conditions in a laboratory

- lightning storms are not the same
    it is not safe is insufficient
    *do **not** accept lightning does not strike the same place twice*

1

[8]

39   (a)   brown

1

(b)   outside / case is plastic / an insulator
            accept is double insulated
            accept non-conductor for plastic
            *do **not** accept it / hairdryer is plastic*

1

(c)   (i)   (1) S$_1$
            and no other

1

(2) S$_1$ and S$_3$
both required, either order

1

(ii)   S$_1$ must be ON (for either heater to work)
            *do **not** accept reference to 'fan' switch*

1

S$_1$ switches the fan on

1

(d)   1495
            *allow **1** mark for correct substitution*
            ie, 6.5 × 230

2

watt(s) or W

*an answer of 1.495 kW gains **3** marks*

although the unit is an independent mark for full credit

the unit and numerical value must be consistent
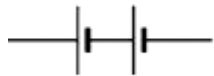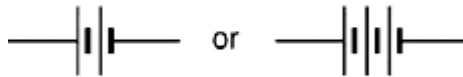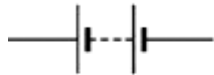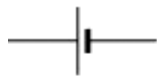
accept joules per second or J/s

1

[9]

40   (a)   (i)   ammeter and battery **in series** with the **gauge**

symbols must be correct

ignore a voltmeter drawn in series

accept

not

or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii)   d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i)   75

this answer only
*allow **1** mark for correct substitution **and** transformation,*

ie resistance = $\dfrac{3.0}{0.040}$

2

(ii)   increases

1

(iii)   elastic / strain <u>potential</u>

*do **not** accept potential*

1

[7]