Mark schemes

1

L

N

M

K

all four in the correct order
2 marks for 2 correct
1 mark for 1 correct

[3]

2 (a) voltmeter

and no other
*do **not** accept voltage*

1

(b) (i) variable resistor

1

(ii) 0.10 – 0.30

accept 0.1 – 0.3
accept 0.3 – 0.1
accept 0.30 – 0.10

1

(iii) 3.3 (W)

*allow **1** mark for correct data choice*
*allow **2** marks for substitution of correct*
data i.e. 0.30 × 11.0
*the following answers gain **2** marks*
0.10 / 0.30 / 0.80 / 1.75
*allow **1** mark for substitution of incorrect*
of data incorrectly calculated e.g.
*0.20 × 4.0 = 0.6 scores **1** mark*

3

(c) increases

1

[7]

3   (i)   30

*allow **1** mark for showing correct method i.e. 5 × 6 **or** 12 ÷ 0.4*

2

   (ii)   connected in <u>series</u>

insufficient they are not connected in parallel
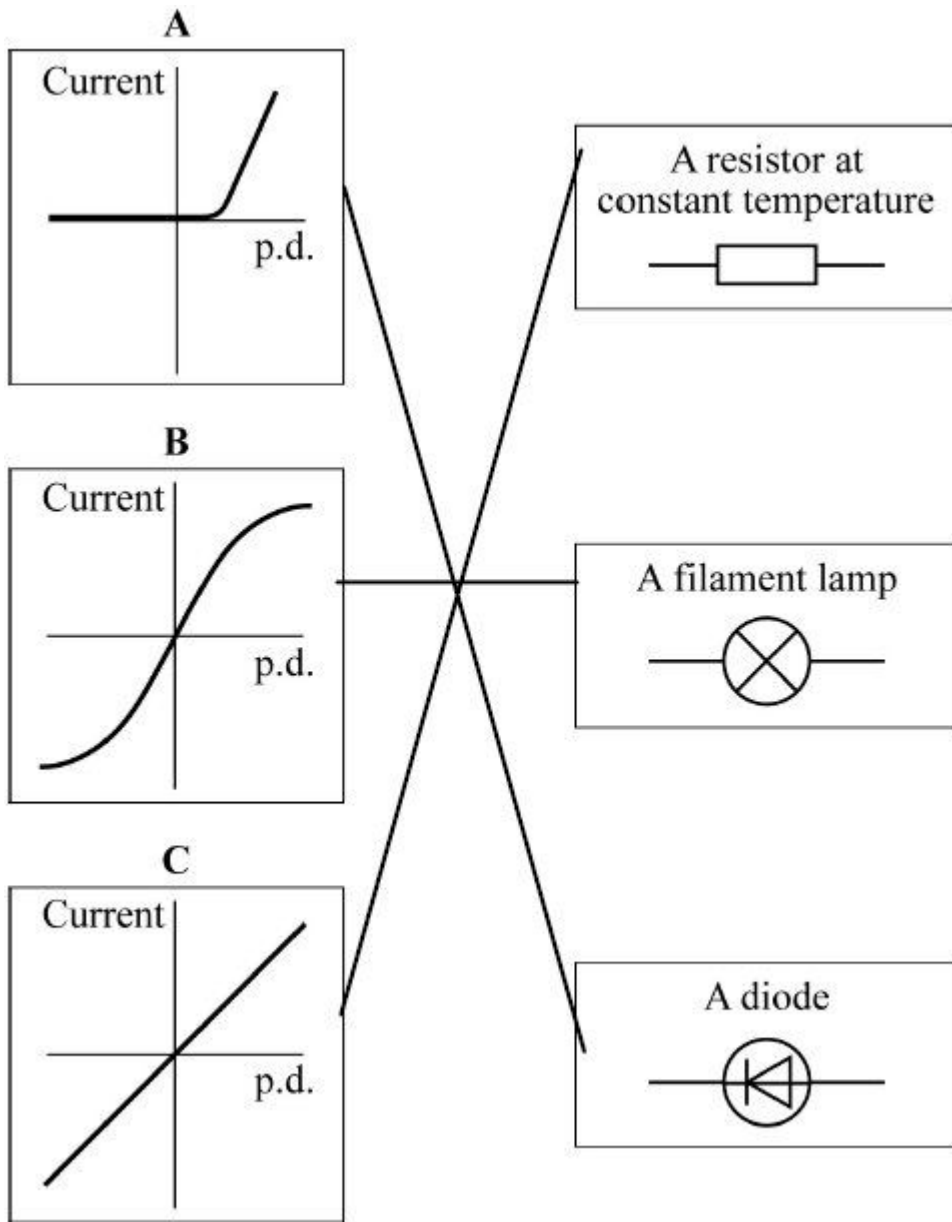
1

   (iii)   0.4

1

   (iv)   equally/ evenly

the same is insufficient
allow credit for candidates that correctly mention pd across the connecting wires
accept (nearly) 2 V (each)

1

[5]

4 (a) **three** lines drawn correctly

A

Current

p.d.

A resistor at
constant temperature

B

Current

p.d.

A filament lamp

C

Current

p.d.

A diode

*allow **1** mark for 1 correct line*

if more than one line goes from a graph, both are incorrect

2

(b) **J**

1

[3]

5 (a) (i) 6

1

(ii) 6 (volts)

accept their (a) (i) ignore any units

1

(b)   0.30

>   *accept 0.3*

1

(c)   smaller(than)

>   *accept correct alternatives to smaller than e.g. less than*

1

a bigger current flows through the lamp

>   *only accept if 'smaller than' is given*
>   *accept converse*
>   *accept a correct calculation*
>   *accept resistance is half of 60*
>   *accept resistance = 30 (Ω)*
>   *do **not** accept answers in terms of p.d*

1

[5]

6   (a)   (i)   0.0046

>   *accept 4.6 mA*
>   *allow **1** mark for correct substitution and transformation*

>   *i.e. current =* $\dfrac{230}{50000}$

>   *an answer of 4.6 gains **1** mark*

2

(ii)   •   increases overall resistance

1

•   (in event of a shock) gives a smaller current

>   *accept gives smaller shock*
>   *do **not** accept no shock/current*

1

(b)   (i)   50 (hertz)

>   *ignore units*

1

(ii)   NO has the lowest current at which people cannot let go

>   *answer and reason needed*
>   *accept a sensible reason in terms of their answer to (b) (i)*

or YES changing the frequency changes the current by only a small amount

1

(c)   a current flows through from the live wire/metal case to the earth wire

accept a current flows from live to earth
*do **not** accept on its own if the current is too high*
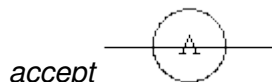
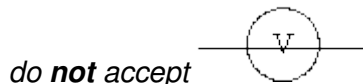this current causes the fuse to melt

accept blow for melt

2

[8]

7   (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 p.d / accept change the voltage
accept increase / decrease for change

1

(b)   (i)   data is <u>continuous</u> (variable)

1

(ii)   36 (Ω)

correct answer only

1

(iii)   5.4 or their (b)(ii) × 0.15

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

2

(c)   (i)   the thick<u>er</u> the putty the low<u>er</u> 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

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

1

(iii)   repeat readings
  accept check results again
  accept do experiment again
  accept do it again
  accept compare own results with other groups
  *do **not** accept take more readings*

1

[10]

8   (a)   (i)   4 (V)
  *allow **1** mark for correct substitution*

2

(ii)   5 (V) or (9 – their (a)(i)) correctly calculated
  e.c.f
  *do **not** allow a negative answer*

1

(b) (i) <u>thermistor</u>

c.a.o

1
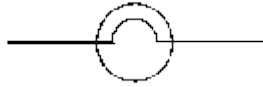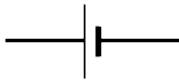
(ii) 0°C to 20°C

1

[5]

9 (a) circuit symbol for a lamp correct

accept

accept any standard of drawing providing circuit would work

1

circuit symbol for a cell correct

1

2 lamps drawn in parallel with <u>3</u> cells

polarity of cells must be correct (+ to –) but cells may be either way around

1
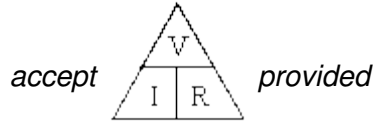
(b) 4.5

1

(c) the same as

accept any clear indication of the correct answer

1

[5]

10 (a) (i) potential difference = current × resistance

        *accept voltage **or** pd for potential difference*

        accept V = I × R

        accept correct transformation

        *do **not** accept V = C × R*

        *do **not** accept V = A × R*

accept *provided*

        subsequent use of Δ correct

        *do **not** accept an equation expressed in units*

        1

(ii) 46

        *credit correct transformation for **1** mark*

        allow 1 mark for use of 11.5 V or division of final resistance by 20

        *a final answer of 920 gains **2** marks only*

        3

ohm(s)

        accept symbol Ω

        *do **not** accept Ω s*

        unit / symbol mark can be awarded in (iii) provided unit / symbol is omitted in (ii)

        1

(iii) 920 (ohms) **or** their (a)(ii) × 20

        1

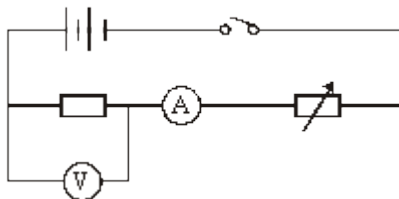(b) as temperature increases, resistance increases

        accept hotter for temperature increase

        *do **not** accept a reference to resistance only i.e. it / resistance goes up*

        1

        [7]

11 (a) all symbols correct

accept push switch symbol switch may be open or closed
*any lines through symbols = **0** marks*

1

correct circuit drawn

polarity of cells not relevant provided they are joined correctly

1

voltmeter must be across resistor only

two cells are required in the diagram
ignore the order of the components
allow small gaps in circuit
*omission of any component = **0** marks*

1

(b) (i) potential difference = current × resistance

accept voltage or p.d. for potential difference
accept V= I × R

accept *provided I R subsequent use correct*

*do **not** accept C for current*

1

(ii) 2

*allow **1** mark for correct substitution*
wrong working loses both marks

2

(iii) straight line drawn <u>through the origin</u>

judge by eye

straight line passes through I = 0.4, V = their (b)(ii) / 2 **and** 0.0

this mark may be awarded if all points shown including these points
are correct even if no line is drawn
*N.B. a curve scores **0** marks*

1

(c) temperature <u>increases</u>

> *accept filament lamp / it gets <u>hotter</u>*
> *allow heat for temperature*

1

[8]

12 (i) power = potential difference × current

> *accept voltage for potential difference*
> *accept P = V × I*
> ***or** correct transposition*
>
> *accept* *provided subsequent method correct*

1

(ii) 8

> *allow **1** mark for correct substitution or transformation **or** an answer 2.67 / 2.7*

2

[3]

13 (a) (i) $A_1 = 0.5$

> *ignore any units*

1

$A_4 = 0.5$
> *allow **1** mark for $A_1 = A_4 \neq 0.5$*

1

(ii) the resistance of **P** is more than 20 Ω

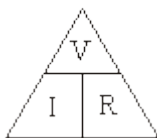**1**

a smaller current goes through P / A_2 (than 20 Ω)
> *dependent on getting 1st mark correct*
> *accept converse*

1

(b) (i) potential difference = current × resistance

accept pd / voltage for potential difference
accept V = I × R, correct symbols and correct case only
accept volts = amps × ohms
accept

provided subsequent method is correct
allow combination of
physical quantities and named units
allow voltage = I × R

1

(ii) 6

*allow **1** mark for correct substitution*
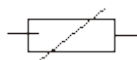
2

(iii) 6

accept their (b)(ii)

1

(c) <u>thermistor</u> or

accept correct circuit symbol
allow phonetic spelling

1

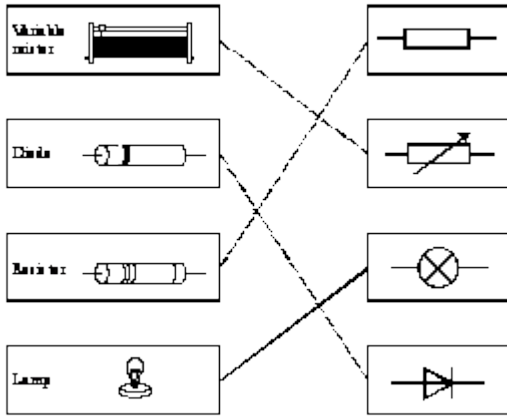<u>resistance</u> goes down (as temperature of thermistor goes up)

*do **not** accept changes for goes down*
*do **not** accept an answer in terms of current only*
answers in terms of other components are incorrect

1

[10]

14   (a)   all 3 lines drawn correctly

(1only correct, 1 mark)
deduct one mark if more than one line from or to a single box

2

(b)   (i)   series

1

(ii)   any **one** from:

- both lamps **or** lights must be on together

- if one blows, the other goes out

- switch controls both bulbs
  *do **not** accept bulbs dimmer*

1

(iii)   any **two** from

- each lamp **or** light can be switched on independently

- if one lamp blows the other stays on

- switching the second lamp on does not affect brightness of first
  or bulbs brighter (than in first circuit) or energy explanation

2

[6]

15   (a)   C

award mark if A and B identified as not filament lamp

1

resistance increases

negated by wrong statement e.g. current goes down

1

as the lamp gets hot

> *accept as current (through lamp) **or** voltage (across lamp) increases*
>
> *do **not** accept non-ohmic reason independent of choice of component*

1

(b)   ammeter wire and battery only in series

> *non standard symbols acceptable if correctly identified (labelled) for ammeter, voltmeter and battery*

1

 voltmeter only in parallel with wire **or** battery

> *all in series **or** ammeter in parallel neither of these two marks awarded*

1

all symbols correct

> *ignore lines drawn through centres of symbols*

1

(c)   (i)   voltage = current × resistance

> *accept V = I × R*
> *accept volts = amps × ohms*
> *do **not** accept V = C × R*
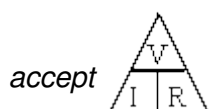
accept

> *if subsequent method correct*

1

(ii)   30

> *accept correct substitution for **1** mark (9/0.3)*

2

ohms

> *accept correct symbol Ω*

1

(iii)   goes up

> *must be a comparison*
> *accept calculation if answer is larger than c (ii)*

1

[11]

16 level drops as petrol used;
causes circuit resistance to increase;
causes current to decrease
> *for 1 mark each*

or if change not specified;
(one correct and two vague statements gains 2 marks,
three vague statements gains 1 mark)
e.g. level changes;   )
so resistance changes;) = 1 mark
so current changes   )

[3]

17 (a)   in range 6 < I ≥ 13 A
> *for 1 mark*
> *(no unit no mark)*

1

(b)   4
> *gains 2 marks*

(else working
> *gains 1 mark*

(resistance of circuit correctly worked (2Ω))

2

(c)   72 (I^2 R) ecf
> *gains 2 marks*

else working
> *gains 1 mark*

an answer of 36W (ie for one lamp) – (1)

2

(d)   1000 or 16.7 min (ecf from (c))
> *gains 2 marks*

else working
> *gains 1 mark*
> *(formula with incorrect substitution – no mark (12V)*

2

[7]

18 (a) Current = 0.4A (1)
R = V/I or 240/0.4 (1)
R = 600 ohm (1)

3

(b) Doubles

gets 2 marks

OR gets bigger

gets 1 mark

2

(c) P = V.I or 240 × 0.4
P = 96W

for 1 mark each

2

(d) 1 = 0.2A
P = 48W

for 1 mark each
BUT may get equation mark here if not in (c)

2

(e) P = V.I.t (1)
P = 240 × 0.2 × 6 × 3600
OR P = 48 × 6 × 3600

gets 1 mark

P = 1036800 W

gets 1 mark

3

[12]

19 (a) to switch on/off
independently OWTTE

for 1 mark each

2

(b) 9

for 1 mark

1

(c) B and E

for 1 mark

1

(d) 1

Two/least number of LED used
for 1 mark each

2

[6]

20 (a) (i) the lamp will be on/will give out light

1

(ii) the lamp will be off/will not give out any light

1

(b) (very) large current flows
or damage the battery/overheat the battery
or short circuit
or wire get hot

1

(c) switch connected in series with lamp and battery

1

[4]

21 (a) ... ammeter
for 1 mark

1

(b) 5 right
gains 4 marks

4 right
gains 3 marks

3 right
gains 2 marks

2 right
gains 1 mark

4

[5]

22   (a)   4 symbols correct accept

*(accept ⬡ for bulb; lose 1 mark if line through symbols, lose 1 mark
if circuit incorrect, switch may be open or closed)*
(allow ——╲——   ——╲—— **or** ——‾——*)*
gains 1 mark

4

   but
all correct
    gains 2 marks

ammeter in series with lamp
    for one mark

voltmeter in parallel with lamp / lamp and switch / lamp, switch and ammeter
    for one mark

  (b)   (i)   5 points correctly plotted
allow (0, 0) correct if graph goes through the origin even if no × or O
    gains 1 mark

   but
6 points correctly plotted
    gains 2 marks

smooth curve through points – not straight line / curve + straight line
    for one mark

3

    (ii)   2 (A)

allow ± 0.05 (½ square) from candidates' graph
    for one mark

1

    (iii)   R = V / I   **or**   R = 10 / 2
    gains 1 mark

   but
R = 5 (Ohms)   ecf
    gains 2 marks

2

(c) (i) resistance increases
>   *for one mark*

(ii) temperature (of filament) has increased / filament gets hot
>   *for one mark*

2

[12]

23 (a) (i) variable resistor
>   *accept rheostat*

1

(ii) potential difference = current × resistance
>   *accept V = IR **or** any correct combinations*

1

(b) (i) as the potential difference increases, the current increases
>   *accept it increases*

1

at low values of the potential difference the current is (directly) proportional
>   *accept at low values of the potential difference (the filament) obeys Ohm's law*

1

or
at higher values of potential difference the current is not (directly) proportional
>   ***or***
>   *accept at higher values of the potential difference (the filament) does not obey Ohm's law*
>   *accept it increases but not proportionally for 2 marks*

the resistance (of the filament) increases

1

the temperature (of the filament) increases

1

[6]

24 (a) (i) resistor

1

(ii) voltage / potential difference / volts / v

1

(iii) current / amps / A

1

(b) potential difference = current × resistance
no mark if more than one box ticked

1

[4]

25 (a) variable resistor
accept rheostat

1

(b) voltmeter

1

(c) straight line correct between 0.2 and 0.8
if line incorrect, or no line, and correct plots 0.2 to 0.8 award 1 mark

2

(d) diode / rectifier

1

[5]

26 (a)
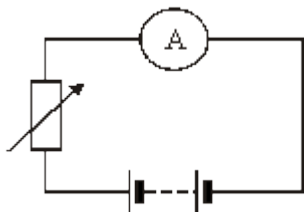
3

one mark for each symbol
allow more than 2 cells joined

max. 2 marks if symbols incorrectly allow rheostat arrow in either direction

(b) current will decrease

1

since resistance greater

1

[5]

27 (a) ammeter anywhere in series in the circuit

accept just letter A or box with A

voltmeter across **or** in parallel with the fixed resistor only

accept just letter V or box with V

2

(b) (i) four correct plots

deduct one for any incorrect plot

a straight line through the points

no requirement to extrapolate through origin

*do not credit bar charts unless correct line drawn **or** correct points*

2

(ii) 0.25

ecf rule applies if graph is wrongly plotted

1

[5]

28 (a) (i) power ÷ voltage = current **or**
2800 ÷ 240 = 11.6 – 11.7 **or** 12

2 marks for correct answer 1 mark for 2.8 ÷ 240

2

(ii) resistance = voltage ÷ current

240 ÷ 11.7

(efc here)

1

20.5 **or** 20.57 **or** 20.6 **or** 21

2 marks for correct answer

1

ohms **or** Ω

do not credit R

1

(b)   850 ÷ 1500 × 100

                marks only available for division of power

                1

   = 56.7

                2 marks for correct answer
                for 1 mark accept 5670

                1

                [7]

29 (a)   0.9

                1

   1.1

                accept the value of $A_4 + 0.2$

                1

(b) $V = I\,R$ **or** $12 = 0.6\,R$ **or** $\dfrac{12}{0.6} = ?$

                accept $V = A\,R$
                $V = I \times$ ohm's sign
                do not credit Ohm's law triangle

                2

   $R = 20$

                correct numerical answer earns both marks

   ohms

                1

(c) $A_3 = 0.3$

   $A_4 = 0.3$

                accept the same numeric value as A_3

   $A_5 = 0.5$

                accept the value of $A_4 + 0.2$

                3

                [8]

30 (a) (i) the same as

1

(ii) less than

1

(iii) the same as

1

(iv) more than

1

(b) 3

accept D

because there is more **or** twice the current in this part of the circuit
or the resistance is less

*accept only one lamp to go through, (not two) **or** on its own not
sharing the voltage **or** energy with another*

*do not credit one lamp to go through **or** sharing current*

2

[6]

31 (a) series circuit

all four components must be included

if a battery included the neatness mark may still be awarded

1

circuit fully functional **or** properly connected

this is the neatness mark

*do not credit a parallel circuit with one switch controlling both
components*

1

(b) case **or** outer parts are made of plastic **or** insulator **or** non-metallic

1

there is no electrical pathway between inner and outer insulation

accept no connection between inner and outer part

do not credit two layers of insulation

1

(c) (i) [A] power = voltage × current

*accept P = V I **or***
*   W = V × A*
***or** any transformation*

1

[B] 1600 ÷ 230 =current

1

6.96 **or** 7
accept with no working for two marks
accept 6.95
in [A] award a mark for a triangle if calculation correctly performed

1

(ii) [A] voltage = current × resistance
*accept V = I R **or** any transformation*

1

[B] 230 ÷ 7 = overall R = 33
accept 230 ÷ 6.96 = overall R = 33

1

resistance of motor = 33 − 20 = 13
accept with no working for two marks
do not credit negative answer
accept consequential errors from c(i)
in [A] award a mark for a triangle if calculation correctly performed

1

[10]

32 (a) (i) P = V × 1

or equivalent
credit a triangle if part (ii) correctly uses the relationship
*credit power = volts × amps **or** watts V × A*
do not accept C for current

1

(ii) (P = 230 × 10 =) 2300
credit 2.3

1

W **or** J/s
kW

1

(b)   (i)   15 A

*credit 13 A **or** amps*

1

(ii)   any **three** from

earth

any short (to the metal tank) causes fuse to blow

fuse is in the live wire

to prevent damage to the heater
credit to stop the current

3

(c)   (i)   V = I × R

or equivalent
credit a triangle if part (ii) correctly uses the relationship

1

(ii)   (230 = 10 × R =) 23

ohms **or** Ω

2

[10]

33   (a)   (i)   0.2

1

(ii)   0.2

1

(b)   (i)   a series circuit must contain two cells the correct way round and an ammeter
*accept the components in any order in
the series circuit but there must be no
obvious gaps in the wires at corners
or joins*

1

the symbol for a variable resistor a rectangle with a diagonal arrow drawn
through it
accept a diagram for a 'slide resistor'

1

(ii)   decrease

1

[5]

34   (a)   A = battery (of cells)/cells/cell
B = thermistor/temperature dependent resistor
C = transistor
D = LED/light emitting diode
E, F, G = resistors
each for 1 mark

5

(b)   *ideas that* (resistance) falls from 3000 to 200 units – ohms/Ω – referred to
at least once
each for 1 mark

(*credit quickly at first then more slowly with 2 marks*) (*max 4 for part (b)*)

4

(c)   any figure in the range 22 – 26 (inclusive)
gains 1 mark

but 24
gains 2 marks

2

[11]

35   (a)   current rises/starts lower/starts from zero
for 1 mark

ideas that: *
smaller/only 0.45 (A) change in current
quicker/only 2 (ms) for current to settle
slightly lower/0.45 (A) final current
maximum only 0.45 (A) rather than 1.5 (A)
(*must **compare** e.g. "only..." or state figure from first graph*)
any 2 for 1 further mark each

3

(b)   resistance of filament rises as temperature rises/higher at operating temperature
resistance of X falls as temperature rises/low(er) at operating temperature
total resistance stays roughly the same as temperature rises
so current stays roughly the same as temperature rises
(*must be related to previous point*)

resistance of X falls faster at first than resistance of filament rises
so current rises (*must be related to previous point*)
operating resistance slightly increased
so operating current slightly reduced
(*must be related to previous point*)
resistance of X high at start
so current zero/low

> *each gains 1 mark*
> *(must be related to previous point)*
> *(to a maximum of 4)*

4

[7]

36 (a) motor

1

(b) fuse or circuit breaker

1

(c) voltmeter

> *each for 1 mark*

1

[3]

37 (a) • diode

• voltmeter

• ammeter

> *for 1 mark each*

3

(b) *idea that*

• current increases or goes up (with voltage)

> *gains 1 mark*

• 'It' refers to current
  but current increases steadily (with voltage)

> *gains 2 marks*

• (*allow* in proportion) – but not simply a description of the shape
  of the graph

> *gains 1 mark*

- no current at first
  but no current until voltage is more than 0.3 (volts)
  gains 2 marks

4

[7]

38 (a) *idea that*

it/current increases (with voltage)
gains 1 mark

but
current increases steadily (with voltage)
(allow in proportion)
gains 2 marks

4

no current at first
gains 1 mark

but
no current until voltage is more than 0.3 (volts)
gains 2 marks

(b) (i) reverse component X/power supply/change battery <u>round</u>
for 1 mark

(ii) *idea that*
X doesn't conduct in opposite/let current through/no current
(in opposite direction)
(credit X is a diode*)*
for 1 mark

2

[6]

39 (a) (i) diode

[Do not accept 'rectifier' or LED]

(ii) lamp / bulb / light

each for 1 mark

2

(b) • P = voltage / potential difference / p.d. / volts / V

[Allow 'Voltmeter]

• Q = current / amperes / amps / A

[Allow 'ammeter]

each for 1 mark

2

[4]

40 (a) cell and bulb / light correctly labelled

for 1 mark each

2

(b) ordinary cell has higher voltage (normally / at start)

for 1 mark

or

ordinary cell 1.3V nicad 1.2V (normally / at start)

voltage of ordinary cell falls more slowly (*accept* lasts longer)

gains 1 mark

but

as above with relevant quantification e.g. falls to zero in 60 seconds
compared to 6 seconds e.g. falls to zero in 70 seconds compared to
16 seconds – from time zero
or
nicad falls to zero 10 times as fast

gains 2 marks

3

(c) (i) answer in range 32-34 (seconds) (inclusive)

gains 1 mark

but
answer in range 22-24 (seconds) (inclusive)

gains 2 marks

(ii) 12 (seconds)

gains 1 mark

but
2 (seconds)
units not required in (c)

gains 2 marks

4

[9]

41 (a) ordinary cell has higher voltage (normally / at start)
or
ordinary cell 1.3V nicad 1.2V (normally / at start)

for 1 mark

voltage of ordinary cell falls more slowly

gains 1 mark

(*accept* ordinary cell lasts longer)
but
as above with relevant quantification e.g. falls to zero in 60 seconds
compared to 6 seconds
or
nicad falls to zero 10 times as fast

gains 2 marks

3

(b) (i) answer in range 32-34 (seconds) (inclusive)

gains 1 mark

but
answer in range 22-24 (seconds) (inclusive)

gains 2 marks

(ii) 12 (seconds)

gains 1 mark

but
2 (seconds)

gains 2 marks

4

(c)   resistance of the lamp / filament changes / increases

gains 1 mark

but
resistance of the lamp / filament decreases

gains 2 marks

because the temperature of the filament falls / filament cools

for 1 mark

3

[10]