AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.2.1 CURRENT, POTENTIAL DIFFERENCE AND RESISTANCE (PACK 2)

SCORE	PERCENTAGE
/235	%

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Q1.

(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]

Q2.

(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

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(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.*

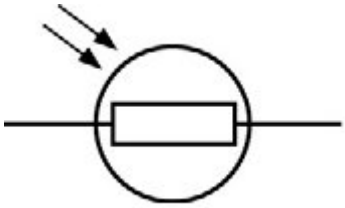
or
a battery/cell gives a constant current/p.d.
accept it's a constant current/p.d.
it is not changing is insufficient

1

[6]

Q3.

(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 k*Ω

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

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1

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

1

[7]

Q4.

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

$I = \frac{Q}{t}$

accept

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)

$V = \frac{W}{Q}$

accept

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]

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Q5.

(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]

Q6.

(a) (i) 6

1

(ii) variable resistor

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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]

Q7.

(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]

Q8.

(a) (i) also double

increases is insufficient

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1

(ii) variable 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 from the origin 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]

Q9.

(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

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(b) (i) 2160

*allow **1** mark for correct substitution, ie ½ × 120 × 6^2*
*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]

Q10.

(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]

Q11.

(a) diode

accept LED

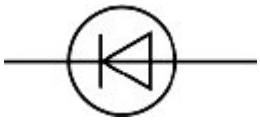
1

(b) all symbols correct

must include at least voltmeter and diode

1

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

allow 17 if using 0.048

2

[6]

Q12.

(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)

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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]

Q13.

(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

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

1

[8]

Q14.

(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

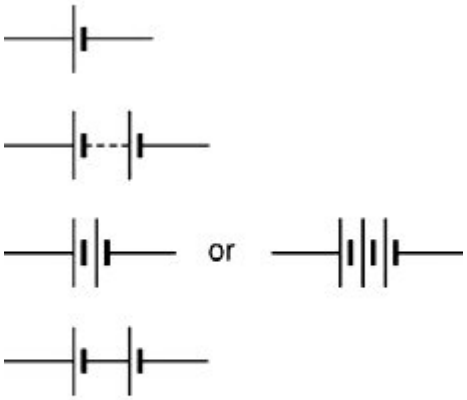
[9]

Q15.

(a) (i) ammeter and battery **in series** with the **gauge**
symbols must be correct
ignore a voltmeter drawn in series

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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 = $\frac{3.0}{0.040}$

2

(ii) increases

1

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

*do **not** accept potential*

1

[7]

Q16.

(a) switch

allow answer circled in box

1

(b) 24

1

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(c) equal to 0.25 A

1

(d) 4

1

[4]

Q17.

(a) a light-dependent resistor

1

(b) any **three** from:

- resistance starts at 500 (kilohms)
- (resistance) falls rapidly as intensity increases from 0
  accept resistance falls
  accept brightness for intensity
- (resistance) halves between 10 and 20 lux
- (resistance) falls slightly between 20 and 50 lux
  or
- (resistance) almost constant / levels out between 20 and 50 lux
- at 50 lux, resistance = 10 (kilohms)
  for full credit the word resistance must be used correctly at least once
  *an answer resistance falls as intensity increases gains **2** marks - this may be combined with one of the bullet point marks for full credit*

3

(c) (i) decrease

1

(ii) resistance increases
this can score without (c)(i)

1

(d) A circuit to switch on security lighting when it gets dark.

1

[7]

Q18.

(a) (i) light dependent resistor / LDR
accept ldr

1

(ii) 25 (kilohms)
accept 24 - 26 inclusive
accept 25 000 Ω

1

(iii) 5 (V) or their (a)(ii) correctly converted to ohms × 0.0002 correctly calculated

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*allow **1** mark for converting 25 kΩ /*
their (a)(ii) to ohms
or
*allow **1** mark for correct substitution*
ie 0.0002 × 25(000)
***or** 0.0002 × their (a)(ii)*
allow an incorrect conversion from kilohms providing this is clearly shown

2

(b) (i) linear scale
using all of the available axis
must cover the range 4 - 6 v
***or** their (a)(iii) - 6 v and lie within the range 0 - 15 inc.*

1

(ii) negative gradient line
*do **not** allow lines with both positive and negative gradients*

1

passing through 20 lux and their (a)(iii)
only scores if the first mark is awarded
only scores if line does not go above 6 volts

1

(c) (i) 37.5 (kΩ) or their (a)(ii) + 50 % (a)(ii) correctly calculated

1

(ii) light intensity value would be unreliable / not accurate

1

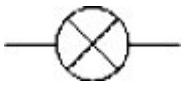
due to variation in <u>resistance</u> value
accept because resistance varies by ± 50 %
accept tolerance of resistor is too great
*do **not** accept results are not accurate*

1

[10]

Q19.

(a)



accept 'the humpback bridge' symbol
accept circle with cross but no lines
if more than one symbol drawn, no mark unless lamp is labelled

1

(b) (i) 24

*allow **1** mark for correct substitution ie* $\frac{2800}{120}$
*allow **1** mark for an answer 1440*

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ignore any unit

2

(ii) watt

1

(c) larger than

accept correct indication inside the box
accept an answer meaning larger than ie greater than

1

[5]

Q20.

L

N

M

K

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

[3]

Q21.

(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

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[7]

Q22.

(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)

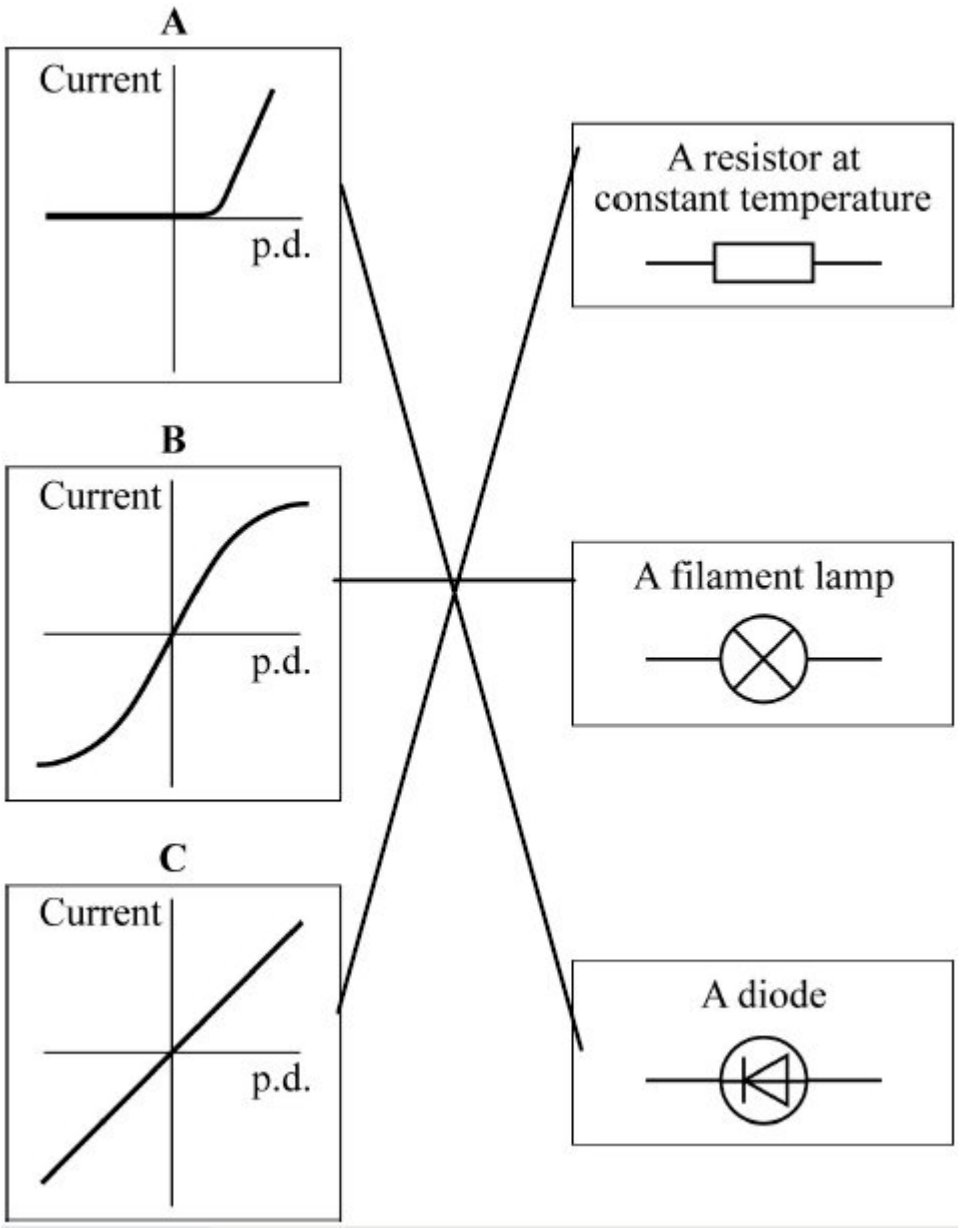
1

[5]

Q23.

(a) **three** lines drawn correctly

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*allow **1** mark for 1 correct line*
if more than one line goes from a graph, both are incorrect

2

(b) **J**

1

[3]

Q24.

(a) (i) 6

1

(ii) 6 (volts)

accept their (a) (i) ignore any units

1

(b) 0.30

accept 0.3

1

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(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]

Q25.

(a) (i) 0.0046

accept 4.6 mA

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

i.e. current = $\frac{230}{50000}$

*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

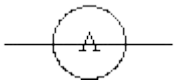
2

[8]

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Q26.

(a) (i) ammeter symbol correct and drawn in series



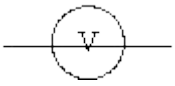
accept

*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

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*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]

Q27.

(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) thermistor

c.a.o

1

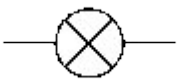
(ii) 0°C to 20°C

1

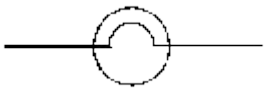
[5]

Q28.

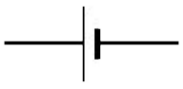
(a) circuit symbol for a lamp correct



accept



accept any standard of drawing providing circuit would work



1

circuit symbol for a cell correct

1

2 lamps drawn in parallel with 3 cells

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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]

Q29.

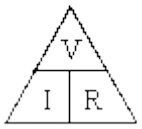
(a) (i) potential difference = current × resistance

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

accept $V = I \times R$

accept correct transformation

*do **not** accept $V = C \times R$*
*do **not** accept $V = A \times R$*

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*

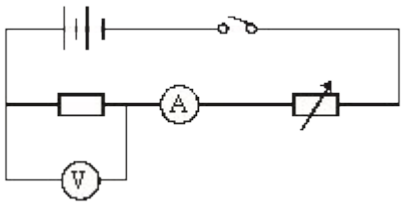
1

[7]

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Q30.

(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]

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Q31.

(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]

Q32.

(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

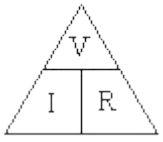
a smaller current goes through P / A_2 (than 20 Ω)

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

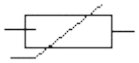
(iii) 6

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accept their (b)(ii)

1

(c) thermistor or



accept correct circuit symbol
allow phonetic spelling

1

resistance goes down (as temperature of thermistor goes up)

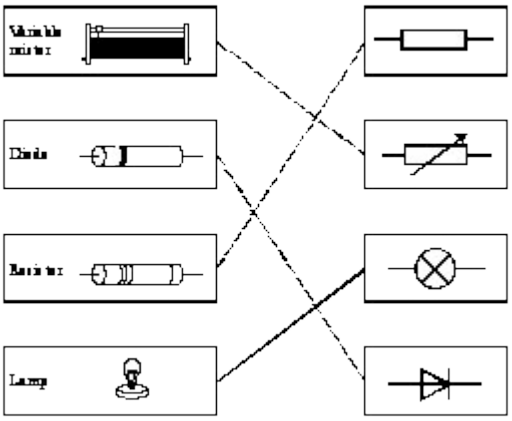
*do **not** accept changes for goes down*
*do **not** accept an answer in terms of current only*
answers in terms of other components are incorrect

1

[10]

Q33.

(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

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

2

[6]

Q34.

(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

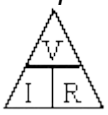
all symbols correct

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

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(iii) goes up

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

1

[11]

Q35.

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]

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