**Mark schemes**

Q1.

(a) switch

allow answer circled in box

1

(b) 24

1

(c) equal to 0.25 A

1

(d) 4

1

[4]

Q2.

(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]

Q3.

(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

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 resistance value

accept because resistance varies by ± 50 %

accept tolerance of resistor is too great

do not accept results are not accurate

1

[10]

Q4.

(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

allow 1 mark for an answer 1440

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]

Q5.

L

N

M

K

all four in the correct order

2 marks for 2 correct

1 mark for 1 correct

[3]

Q6.

(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]

Q7.

(i) 30

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

2

(ii) connected in series

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]

Q8.

(a) three lines drawn correctly

allow 1 mark for 1 correct line

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

2

(b) J

1

[3]

Q9.

(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]

Q10.

(a) (i) 0.0046

accept 4.6 mA

allow 1 mark for correct substitution and transformation

i.e. current =

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]

Q11.

(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 continuous (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 thicker the putty the lower 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]

Q12.

(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]

Q13.

(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

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]

Q14.

(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]

Q15.

(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 through the origin

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 increases

accept filament lamp / it gets hotter

allow heat for temperature

1

[8]

Q16.

(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]

Q17.

(a) (i) A1 = 0.5

ignore any units

1

A = 0.5

allow 1 mark for A1 = A4 ≠ 0.5

1

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

1

 a smaller current goes through P / A2 (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) 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]

Q18.

(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]

Q19.

(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]

Q20.

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]

Q21.

(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 (I2 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]

Q22.

(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]

Q23.

(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]

Q24.

(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]

Q25.

(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]

Q26.

(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]

Q27.

(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

(ii) the resistance (of the filament) increases

1

 the temperature (of the filament) increases

1

[6]

Q28.

(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]

Q29.

(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]

Q30.

(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]

Q31.

(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]

Q32.

(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]

Q33.

(a) 0.9

1

1.1

accept the value of A4 + 0.2

1

(b) V = I R or 12 = 0.6 R or

accept V = A R

V = I × ohm’s sign

do not credit Ohm’s law triangle

2

R = 20

correct numerical answer earns both marks

ohms

1

(c) A3 = 0.3

A4 = 0.3

accept the same numeric value as A3

A5 = 0.5

accept the value of A4 + 0.2

3

[8]

Q34.

(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]

Q35.

(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]

Q36.

(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]

Q37.

(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]

Q38.

(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]

Q39.

(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]

Q40.

(a) motor

1

(b) fuse or circuit breaker

1

(c) voltmeter

each for 1 mark

1

[3]

Q41.

(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]

Q42.

(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 round

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]

Q43.

(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]

Q44.

(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]

Q45.

(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]