Mark schemes

1.

(a) I = 0.08 (A)

an incorrect value of I from the graph can score all subsequent marks

1

0.230 = 0.08 × V

allow a correct substitution of an incorrectly/not converted value of P

1

$$V = \frac{0.230}{0.08}$$

allow a correct rearrangement using an incorrectly/not converted value of P

1

V = 2.875 (V)

OR

I = 0.08 (A) (1)

V = 0.08 × 36 (2)

V = 2.88 (V) (1)

OR

0.230 = I^2 × 36 (1)

I = 0.08 (A) (1)

V = 0.08 × 36 (1)

V = 2.88 (V) (1)

allow a correct calculation using an incorrectly/not converted value of P

1

(b) the product of current and resistance = a constant

1

calculation of constant (2.88) using three or more pairs of values

if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity

1

(c) current would be (almost) zero (in the variable resistor)

1

(because) the switch has (effectively) zero resistance
or
the potential difference across the variable resistor is (effectively) zero

the switch's resistance is much lower than the variable resistor

allow the switch creates a short circuit

1

[8]

2. (a) (very high p.d. means) very low currents

1

which means less (thermal) energy is transferred to surroundings

allow less power loss in cables

1

which increases the efficiency of power transmission

1

(b) electric field strength is very high

1

causing the air to become ionised

allow the air breaks down

allow the air becomes a conductor

allow the air conducts charge

1

(the kite / string) conducts charge to the person / earth

ignore answers referring to the kite touching the power cables

1

(c) straight line passing through the origin

1

line drawn below existing line for all values

1

(d) the potential difference across the wires/cable is the same

1

(but) the resistance of the steel wire is greater (and so less current in the steel)

1

[10]

3. (a) potential difference

allow p.d.
allow voltage

1

temperature

1

in this order only

(b) the current increases (when the potential difference increases)

1

(which) causes the temperature of the filament to increase

1

(so) the resistance increases

*do **not** accept resistance increases and then levels off*

1

(c) a higher proportion / percentage of the (total) power / energy input is usefully transferred

wastes less energy is insufficient

or
higher (useful) power / energy output for the same (total) power / energy input

1

(d) potential difference increases

1

current decreases

1

(e) 1000 (Ω)

reason only scores if R = 1000 (Ω)

1

potential difference is shared in proportion to the resistance

allow a justification using a correct calculation

1

(f) $12 = I \times 7000$

1

$$I = \frac{12}{7000}$$

1

$I = 1.71 \times 10^{-3}$ (A)

*an answer that rounds to 1.7×10^{-3} (A) scores **3** marks*

1

$I = 1.7 \times 10^{-3}$ (A)

this answer only

or

I = 0.0017 (A)

*an answer of 2.4×10^{-3} (A) scores **2** marks*

*if no other marks scored allow **1** mark for calculation of total resistance (7000 Ω)*

1

*an answer of 1.7×10^{-3} (A) scores **4** marks*

[14]

4. (a) 50

1

Hz / hertz

allow Hertz

1

(b) (both) switches need to be closed / on

1

to complete the <u>series</u> circuit
or
to allow charge to flow
or
so there is a current in the circuit

1

(c)

*an answer of 7.5 (A) scores **3** marks*

*an answer of 0.237(A) scores **2** marks*

$1800 = I^2 \times 32$

this mark may be awarded if P is incorrectly or not converted

1

$I^2 = \frac{1800}{32}$

or

$I^2 = 56.25$

this mark may be awarded if P is incorrectly or not converted

1

$I = 7.5$ (A)

this answer only

1

(d)

*an answer of 300 (s) scores **3** marks*

*an answer of 300 000 (s) scores **2** marks*

$1500 = \frac{450\ 000}{t}$

this mark may be awarded if P is incorrectly or not converted

1

$t = \frac{450\ 000}{1500}$

this mark may be awarded if P is incorrectly or not converted

1

$t = 300$ (s)

this answer only

1

[10]

5. (a) risk of electric shock (if someone touched the case)

allow risk of electrocution (if someone touched the case)

1

(b) 2530 = I × 230

this mark may be awarded if P is incorrectly / not converted

1

$$I = \frac{2530}{230}$$

this mark may be awarded if P is incorrectly / not converted

1

I = 11 (A)

this answer only

*an answer of 0.011 (A) scores **2** marks*

1

*an answer of 11 (A) scores **3** marks*

(c) E = 2530 × 14

this mark may be awarded if P is incorrectly / not converted

1

E = 35 420 (J)

this answer only

1

35 420 = m × 4200 × 70

allow their calculated E = m × 4200 × 70

1

$$m = \frac{35\,420}{4200 \times 70}$$

$$\textit{allow } m = \frac{\textit{their calculated } E}{4200 \times 70}$$

1

m = 0.12 (kg)

allow an answer that is consistent with their calculated value of E

1

[9]

6. (a) non-contact (force)

allow electrostatic (force)

1

attraction (between hair and balloon)

allow repulsion between the hairs on the head

1

(b)

*an answer of 2.0 × 10^{-6} (C) scores **3** marks*

*an answer of 2 × 10^{-3} (C) scores **2** marks*

0.0050 = Q × 2500

this mark may be awarded if pd is incorrectly or not converted

1

$Q = \frac{0.0050}{2500}$

this mark may be awarded if pd is incorrectly or not converted

1

Q = 2.0 × 10^{-6} (C)
or
Q = 0.0000020 (C)

these answers only

1

(c)

*an answer of 120 (Ω) scores **5** marks*

0.16 = I × 4.0 × 10^{-3}
or
$I = \frac{0.16}{4.0 \times 10^{-3}}$

this mark may be awarded if time is incorrectly / not converted

1

I = 40 (A)

this value only

1

4800 = 40 × R

allow 4800 = their calculated I × R

1

$R = \frac{4800}{40}$

allow R = 4800 / their calculated I

1

R = 120 (Ω)

allow an answer consistent with their calculated I

1

[10]

7. (a) $15.7 = \frac{15.8 + 15.3 + \mathbf{X}}{3}$

1

X = 16.0 (Ω)

1

(b) precise results show little variation

1

the 4th result was further away from the mean than the other values

allow the range of values has increased

ignore the 4th result was an anomaly

1

(c) two pairs of values of n and R showing that $n \times R$ = constant

e.g. 2 × 24 = 48, 3 × 16 = 48
4 × 12 = 48, 5 × 9.5 = 47.5
6 × 8 =48

1

third pair of values of n and R showing that $n \times R$ = constant

1

(so) $n \times R$ = constant (showing the student was correct)

allow 1 mark each for two statements relating the change in number of resistors to the change in (mean total) resistance

allow 1 mark for use of data from graph to confirm at least one statement

1

(d) multiple paths for charge / electrons to flow

allow current for charge

1

total current is greater (for the same potential difference when more resistors are added)

1

[9]

8. (a) % increase = $\frac{(10\,000 - 3200)}{3200} \times 100$

1

% increase = 212.5 (%)

1

(b) Any **two** from:

- no sulfur dioxide released
- doesn't cause acid rain
- no particulates released
- doesn't cause global dimming
- less carbon dioxide released (per kg of fuel burned)
- less global warming

  allow less climate change

  allow less greenhouse gases
- no solid waste
- gas mining is less destructive than coal mining

  ignore less air pollution

2

(c) mean sea surface temperature shows a (steady) increase

1

over the time period on the graph

conditional on scoring 1st marking point
allow between a correct pair of dates at least 10 years apart

or

from 16.45 (°C) to 16.96 (°C)

allow a correct pair of temperatures at least 10 years apart

1

(d) thermistor C

1

(because) the change in resistance is greatest

conditional on scoring 1st marking point
allow the gradient is highest
allow more sensitive to temperature change

1

between 0 and 25 ºC

conditional on scoring 2nd marking point
allow between 16 and 17 °C
if thermistor C is not chosen, allow for 1 mark each:
not thermistor A because there is no/little change in resistance
not thermistor B as there is only a small change in resistance
not thermistor D as there is no data available between 0 and 40 °C

1

[9]

9. (a) $5.75 = I \times 230$

1

$I = \frac{5.75}{230}$

1

$I = 0.025$ (A)

1

$230 = 0.025 \times R$

or

$R = \frac{230}{0.025}$

allow a correct substitution using an incorrect value of I

or

allow a correct rearrangement using incorrect value of I

1

$R = 9200$ (Ω)

allow a correct calculation of resistance using an incorrect value of I

alternative approach for 4th and 5th marks:

$5.75 = 0.025^2 \times R$ (1)

or

$R = \frac{5.75}{0.025^2}$

R = 9200 (Ω) (1)

alternative approach:

$5.75 = \frac{230^2}{R}$ (3)

R = 9200 (Ω) (1)

1

(b) one wire in the switch is live

allow the switch / circuit is live allow one wire is at a potential of 230 V

1

the electrician is earthed
or
the electrician is at earth potential

1

(so) there will be a (large) potential difference between the live wire and the electrician / earth (if the electrician touched the wire)

1

(c) 50 Hz has the lowest (maximum) let-go current

1

a higher / lower / different frequency would allow people to let go at a greater current

allow a specific numerical example as opposed to a trend

1

[10]