Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

(a) An increase in current / voltage leads to an increase in temperature (more heat generated) ✔

Ignore 'of particles' in first mark
Do not condone 'particles' in second mark

This causes an increase in the movement of the lattice/ions/atoms ✔

And therefore an increase in the rate of collisions with electrons ✔

Allow more frequent collisions

So the resistance increases as shown by V / I changing/V not proportional to I (on the graph) ✔

Allow correct reference to gradient of I / V curve unless the answer suggests that this is the resistance or inverse of resistance.

Max 4

(b) 14.3 (Ω)

Allow range 14 to 15
but calculated answer must lie between 14 and 15

1

(c) Determination of pd across either filament or resistor from graph ✔

Pd across resistor can be calculated from resistance value in (b)
Eg V = 0.18 × 14.3 = 2.6

Determination of pd across the other component, and values added ✔

Use of V = IR to give 3.4 (V)

Allow ecf if either value is wrong allow 2 max

Or

Clear attempt to determine total resistance and multiply by 0.18 ✔

Condone small rounding error

(Resistance of lamp at 0.18A = 4.4 Ω)

Total resistance = 18.7 Ω ecf from 2,2 ✔

3.4 V (ecf from 2.2) ✔

Allow for small rounding errors (eg allow range 3.3 to 3.5)

3

(d) Determination of current through either filament or resistor from graph ✔

Allow calculation of resistor current using 4/(answer to 2.2)

Determination of current through the other component, and values added✔

(Current through resistor = 0.28 A

Current through filament = 0.36 A)

R = V/I = 4/ (0.28 + 0.36) = 6.25 (Ω)

If either value wrong allow 2 max

Condone small rounding errors.

Or

Calculation of filament resistance or statement of resistor resistance ✔

Resistance of filament = 11.1 (Ω)

Calculation of other resistance and use of parallel formula (allow ecf from part b) ✔

Either resistance gets the first mark

6.2 -6.3 (Ω) ✔

3

(e) Calculation of area, ignoring power of ten errors.

$A = 8.0 \times 10^{-10}\ m^2$

Correct resistivity 3.1×10^{-8} ✔

Allow ecf for A (for example use of d for r gives 3.2×10^{-11} for A and 1.2×10^{-7} for answer)

Ω m ✔

Some working must be shown for award of unit mark.

3

[14]

Q2.

(a) 15(.0) (Ω) ✔

Only acceptable answer

Must be on answer line or clearly identified as (largest)R

by R = 15 (.0) (Ω) seen.

Allow an answer just above (or below) the answer line in cases where a previous answer has been crossed out.

If not on the answer line, units must be stated.

1

(b) 1.4(1) (Ω) ✔✔

Only selects 2.2 Ω and 3.9 Ω in parallel ✔

Accept evidence from working or a clear labelled sketch of 2.2 Ω and 3.9 Ω in parallel

Possible allowed combinations include:

$(\frac{1}{R} =) \frac{1}{2.2} + \frac{1}{3.9}$

$Condone\ R = \frac{1}{2.2} + \frac{1}{39}$

$(R =) \frac{1}{\frac{1}{2.2} + \frac{1}{3.9}}$

$(R =) (\frac{1}{2.2} + \frac{1}{3.9})^{-1}$

$(\frac{1}{R} =) \frac{5}{11} + \frac{10}{39}$

$(R =) \frac{2.2 \times 3.9}{2.2 + 3.9}$

Accept 1.407 Ω but not >4 sf

Must be on answer line or clearly identified as (smallest) R

by R *= 1.4 (1) (Ω) seen.*

Allow an answer just above (or below) the answer line in cases where a previous answer has been crossed out.

Common wrong answer = 0.71 (Ω) is worth one mark with correct supporting working

2

(c) Any of the following statements:

Power supply is on open circuit (so current is zero)

OR

Voltmeter has a (very) large resistance (so current is zero)

OR

No current (load) (so no lost volts)

OR

(Current is zero) so no lost volts

Accept 'negligible' current for zero current

Accept 'very large' resistance; don't penalise 'voltmeter has very large internal resistance'

Do not allow:

Resistance is zero

Only resistance is the internal resistance

No other component (this implies that the internal resistance is zero)

1

(d) (Current through power supply leads to)

lost volts (across the internal resistance)

OR

(Current through power supply leads to)

voltage drop across the internal resistance

OR

(Current through power supply leads to)

Some of the emf is used in the internal resistance

OR

Voltage is shared between the internal and external resistances

Allow correct 'energy transfer in the internal resistance' arguments

Must refer to a voltage across the internal resistance or r

except when the term "lost volts" is used.

Do not allow:

The current decreases

1

(e) $\varepsilon - V$ = (1.62 – 1.14 =) 0.48(0) (V)

and

$\frac{V}{R} = \left(\frac{1.14}{9.0} = \right) = 0.13(\text{V}\Omega^{-1})$ ✔

Both results required for ✔; accept 0.127 or 0.1267 for $\frac{V}{R}$

Do not allow answers expressed in terms of unknown variables

Answers must be on answer line or clearly identified as answer by using correct subject and equals sign

Allow an answer just above (or below) the answer line in cases where a previous answer has been crossed out.

1

(f) Point correctly plotted to nearest 1 mm (half a grid square)

and

continuous ruled best fit line for the 5 (originally printed) points ✔

Withhold mark if point is hidden or if best fit line is of variable thickness or has discontinuities.

Data point should be marked with a cross. Both × and + marks are acceptable.

***Do not allow** points plotted as dots / dots in circles*

If point is wrongly calculated in Part 1.5 allow CE for an accurate plot of this but this should then be treated as anomalous when judging the best fit line.

The best fit line must intersect each of the 5 originally printed X symbols.

Allow no plot where ECF (even as algebraic equation) point won't fit on the grid and student has stated that it can't be plotted.

If no answer / no plottable answer in 1.5 but student chooses to plot a point then it must be the correct point only (0.13, 0.48)

1

(g) Gradient triangle for **Figure 3**; correct read-offs for points (± 1 mm) from triangle with the $\varepsilon - V$ step at least 0.5 V

Allow $\frac{y2-y1}{x2-x1}$ *seen or gradient triangle drawn with* $\frac{\Delta y}{\Delta x}$ *seen,*

read-offs must be substituted into $\frac{y2-y1}{x2-x1}$ *or* $\frac{\Delta y}{\Delta x}$

Condone one read-off error in four read-offs for gradient method

(common error: candidates miss non-origin on ordinate axis)

(common error: makes a power of 10 error on abscissa)

r in range 3.49 to 3.95 (Ω)

Any correct method other than gradient method (no read-off errors here) allow 1 mark

i.e. allow 1 mark for the accurate use of 1 point from their line

r must be quoted to a minimum of 2 significant figures

***ecf** for r (their gradient from their best fit line)*

r must be supported by correct working

2

(h) The **Figure 1** method is better **because** more R values are available ✔

6 values of R (possible) for method (seen) in Fig 4 ✔

Do not allow:

The 2nd method has a wider range

The 2nd method has a larger maximum resistance

The 2nd method has a smaller minimum resistance

The 2nd method only goes up to 8.2 Ω

(resistances available in Fig 4: 2.0 Ω, 3.2 Ω, 4.3 Ω, 4.6 Ω, 5.0 Ω, 5.3 Ω)

2

[11]