

**Multiple Choice Answers**

Q36: D

**Multiple Choice Answers**

Q31: D

Q32: C

Q33: A

**Multiple Choice Answers**

Q37: A

|           |                                                                                                       |
|-----------|-------------------------------------------------------------------------------------------------------|
| 6(a)(i)   | $I = 1.3 / 1.1$<br>$= 1.2 \text{ A}$                                                                  |
| 6(a)(ii)  | $v = I / nqA$<br>$= 1.2 / (8.5 \times 10^{28} \times 1.60 \times 10^{-19} \times 4.7 \times 10^{-7})$ |
|           | $= 1.9 \times 10^{-4} \text{ m s}^{-1}$                                                               |
| 6(a)(iii) | $\rho = RA / L$                                                                                       |
|           | $= (1.1 \times 4.7 \times 10^{-7}) / 0.45$                                                            |
|           | $= 1.1 \times 10^{-6} \Omega \text{ m}$                                                               |
| 6(b)(i)   | (Total) resistance decreases (and the potential difference stays the same)                            |
|           | (so the reading on the ammeter) increases                                                             |
| 6(b)(ii)  | (The average drift speed will be) the same because the current is the same (in X).                    |

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|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1(a)      | Value for $x$ in range 8.0–14.0 cm with unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|           | Non-zero value for $I$ less than 2.00 mA with unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 1(b)      | Six sets of readings of $x$ (different values) and $I$ with correct trend (as $x$ increases, $I$ decreases) and without help from Supervisor scores 5 marks, five sets scores 4 marks etc.                                                                                                                                                                                                                                                                                                                                                             |
|           | Range: $x_{\min} \leq 5.0$ cm <b>and</b> $x_{\max} \geq 16.0$ cm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|           | Column headings:<br>Each column heading must contain a quantity and a unit where appropriate.<br>The presentation of quantity and unit must conform to accepted scientific convention e.g. $\sqrt{I}$ (mA <sup>1/2</sup> ), $\sqrt{I}$ / mA <sup>1/2</sup> .                                                                                                                                                                                                                                                                                           |
|           | Consistency: All values of $x$ must be given to the nearest millimetre.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|           | Significant figures:<br>Values of $\sqrt{I}$ must be given to the same number of s.f. as (or one more than) the number of s.f. in $I$ .                                                                                                                                                                                                                                                                                                                                                                                                                |
|           | Calculation: Values of $\sqrt{I}$ calculated correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1(c)(i)   | Axes:<br>Axes must be labelled with the required quantities.<br>Scales must be chosen so that the plotted points occupy at least half the graph grid in both the $x$ and $y$ directions.<br>Scale markings are no more than 2 cm (one large square) apart.<br>Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions).                                                                                                                                                                                                                |
|           | Plotting of points:<br>All observations in the table must be plotted on the grid.<br>Diameter of plotted points must be $\leq$ half a small square.<br>Points must be plotted to an accuracy of half a small square in both $x$ and $y$ directions.                                                                                                                                                                                                                                                                                                    |
|           | Quality:<br>General trend of points must be negative.<br>All points in the table must be plotted (at least 5) for this mark to be awarded.<br>It must be possible to draw a straight line that is within $\pm 2.0$ cm (to scale) on the $x$ -axis of all plotted points.                                                                                                                                                                                                                                                                               |
| 1(c)(ii)  | Line of best fit:<br>'Best fit' is judged by the balance of all points on the grid (at least 5 points) about the candidate's line.<br>There must be an even distribution of points either side of the line along the full length.<br>Lines must not be kinked or thicker than half a square.<br><br>Some candidates may choose to identify an anomalous point. If 6 or more points are plotted and they identify <b>one</b> point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit. |
| 1(c)(iii) | Gradient:<br>The hypotenuse of the triangle used must be greater than half the length of the drawn line.<br>Both read-offs must be accurate to half a small square in both the $x$ and $y$ directions.<br>Method of calculation must be correct, not $\Delta x / \Delta y$ .<br>Gradient sign on answer line must be consistent with graph drawn.                                                                                                                                                                                                      |
|           | $y$ -intercept:<br>Correct read-off from a point on the line is substituted into $y = mx + c$ or an equivalent expression.<br>Read-off accurate to half a small square in both $x$ and $y$ directions.<br><b>Or</b><br>Intercept read directly from the graph, with read-off at $x = 0$ , accurate to half a small square in $y$ direction.                                                                                                                                                                                                            |
| 1(d)      | $a$ = candidate's gradient value <b>and</b> $b$ = candidate's intercept value.<br>Values must not be written as fractions or given to only one significant figure.                                                                                                                                                                                                                                                                                                                                                                                     |
|           | Units for $a$ and $b$ are correct (e.g. mA <sup>1/2</sup> cm <sup>-1</sup> for $a$ and mA <sup>1/2</sup> for $b$ ).                                                                                                                                                                                                                                                                                                                                                                                                                                    |