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| **QUESTION 1** | | |
| **Code** | **Points to score** | **Marks** |
| A1  A2  A3  A4  A5  A6  A7  A8  A9  A10 | **b** measured at at least 3 places  Average value of b: 2.20 ≤ b ≤ 2.50 cm, recorded to 2 pd in cm ½ + ½  **d** measured at at least 3 places  Average value of d: 0.40 ≤ b ≤ 0.60 cm, recorded to 2 pd in cm ½ + ½  C is at 49.5 – 50.5 cm mark, recorded to 1dp in cm ½ + ½  Po recorded to 1 dp in cm  New position of pointer recorded to 1 dp in cm ½ + ½  *x* correctly calculated to 3 decimal places in metres ½ + ½  Correct substitution into the expression – everything in SI units  E correctly calculated (1.00 ≤ E ≤ 2.50) x 1010 N m-2 to 2 or 3 sig. figures 1 + ½ | ½  1  ½  1  1  ½  1  1  ½  1½ |
|  |  | **8½** |
| B1  B2  B3  B4  B5  B6  B7 | Columnar table of: *l*, Po, P, y,log*l* and log y @¼  Correct units: (m), (cm), (cm), (m), -, - @¼  Initial positions of pointer, Po, recorded to 1 dp in cm (or to 3 dp in m) @½  Final positions of pointer, P, recorded to 1 dp in cm (or to 3 dp in m) @½  Values of y correctly calculated to 3 dp in m, decreasing @¼  Values of log*l* read to 3 dp: -0.046, -0.097, -0.155, -0.222, -0.301, -0.398, -0.523 @¼  Values of logy read to 3 dp @¼ | 1½  1½  3½  3½  2  2  2 |
|  |  | **16** |
| C1  C2  C3  C4  C5  C6 | Title of the graph: *A graph of* ***log y*** *against* ***log l***  Axes: Each drawn with an arrow in the increasing direction, each labeled with quantity and unit ……….. ½ + ½  Scales: Uniform, each spanning at least ½ pg, demarcations marked, starting values  indicated ………... ½ + ½  Points correctly plotted: no shading, no use of star ……….@½  Best fit : awarded if at least 4 points were correctly plotted  Intercept, C, correctly read and -1.280 ≤ C ≤ -0.870 to 2 or 3 dp ……… ½ + ½ | ½  1  1  3½  ½  1 |
|  |  | **7½** |
| D1  D2  D3 | Substitution into C = log …. All in SI units  E correctly calculated and (1.00 ≤ E ≤ 2.50) x 1010 N m-2 to 3 sig. figures ... 1 + ½  Calculation of the average value of E from the two methods to 3sig. figures … ½ + ½ | ½  1½  1 |
|  |  | **3** |
| ***Total = 34*** | | |

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| **QUESTION 2** | | |
| **Code** | **Points to score** | **Marks** |
| A1  A2  A3 | u recorded to 1 decimal place in cm and 9.0 ≤ h ≤ 12.0 cm 2 + ½  v recorded to 1 decimal place in cm and 9.0 ≤ a ≤ 12.0 cm 2 + ½  f correctly calculated to 1 decimal place in cm and 9.0 ≤ f1 ≤ 12.0 cm 1 + ½ | 2½  2½  1½ |
|  |  | 6½ |
| B1  B2  B3  B4  B5  B6  B7  B8 | Columnar table of y, X1, X2, d, y2, d2 and (y2 – d2) ………..@¼  Correct units: (cm), (cm), (cm), (cm), (cm2),(cm2), (cm2) ……. @¼  Values of X1 increasing between 10.0 – 14.0 cm, recorded to 1 dp in cm ….@½  Values of X2 decreasing between 10.0 – 14.0 cm, recorded to 1 dp in cm ….@½  d correctly calculated to 1 dp in cm ……………@¼  y2 correctly calculated to 1 dp in cm2 ……………@¼  d2 correctly calculated to 3 or 4 significant figures cm2 (0 dp) ……@¼  (y2 – d2) correctly calculated to 3 or 4 significant figures cm2 (0 dp) ……@¼ | 2  2  3  3  1½  1½  1½  1½ |
|  |  | **16** |
| C1  C2  C3  C4  C5  C6  C7 | Title of the graph: *A graph of (y2 – d2) against y*  Axes: Each drawn with an arrow in the increasing direction, each labeled with quantity and unit ……….. ½ + ½  Scales: Uniform, each spanning at least ½ page, demarcations marked, starting values  indicated ………... ½ + ½  Points correctly plotted: no shading, no use of stars ……….@½  Best fit : awarded if at least 4 points were correctly plotted  s correctly calculated, if the coordinates were correctly read and  36.0 ≤ s ≤ 48.0 recorded to 1 or 2 decimal places …….. 1 + ½ | ½  1  1  3  ½  1½ |
|  |  | **7½** |
| D1  D2  D3 | Substitution into s = 4f  f correctly calculated and 9.0 ≤ f ≤ 12.0 to 1dp …... 1 + ½  Calculation of the average value of f from the two methods to 1dp …… ½ + ½ | ½  1½  1 |
|  |  | **3** |
| ***Total = 33*** | | |

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| **QUESTION 3** | | |
| **Code** | **Points to score** | **Marks** |
| A1  A2  A3  A4  A5  A6 | Values of I1 = 0.26 – 0.32 A, recorded to 2 decimal places 1 + ½  Values of V1 = 1.29 – 1.34 V, recorded to 2 decimal places 1 + ½  Values of I2 = 0.17 – 0.22 A, recorded to 2 decimal places 1 + ½  Values of V2 = 1.35 – 1.41 V, recorded to 2 decimal places 1 + ½  Correct substitution into σ =  σcorrectly calculated and 8.0 ≤ σ ≤ 10.0 Ω m-1 . 1 + ½ | 1½  1½  1½  1½  1  1½ |
|  |  | **8½** |
| B1  B2  B3  B4  B5 | Columnar table of: *x*, y, ,  …………………………… @¼  Correct units: (m), (m), (m-1), (m-1) ……………………… @¼  Values of y increasing between 0.380 and 0.600 m, recorded to 3 dp in m (or 1 dp in cm) @1  Values of calculated to 2 decimal places …………… @¼  Values of correctly calculated to 2 decimal places …………… @¼ | 1  1  6  1½  1½ |
|  |  | **11** |
| C1  C2  C3  C4  C5  C6  C7  C8 | Title of the graph: *A graph of  against*  Axes: Each drawn with an arrow in the increasing direction, each labeled with quantity and unit ……….. ½ + ½  Scales: Uniform, each spanning at least ½ page, demarcations marked, starting values  indicated ………... ½ + ½  Points correctly plotted: no shading ……….@½  Best fit : awarded if at least 4 points were correctly plotted  Indication of triangle or equivalent for calculating s, covering all points  s correctly calculated, if the coordinates were correctly read and 0.180 ≤ s ≤ 0.212 recorded to 2 or 3 decimal places …….. 1 + ½  The intercept, C, correctly read and 1.50 ≤ s ≤ 2.00 m-1 1 + ½ | ½  1  1  3  ½  ½  1½  1½ |
|  |  | **9½** |
| D1  D2  D3  D4 | Substitution into **r** =  r correctly calculated and 0.40 ≤ r ≤ 0.80 to 2dp …... 1 + ½  Mention of any 2 genuine sources of error …… @½  e.g - resistances at connection points  - the cells used may slightly run down during the experiment  Mention of any 2 scientific precautions taken relevant to the experiment …….. @½  e.g - ensuring firm connections  - open the switches until when taking readings  - no parts of W within length x should touch any conductor | ½  1½  1  1 |
|  |  | **4** |
| ***Total = 33*** | | |