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PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

MARK SCHEME

Maximum Mark: 40

Published

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1 (a) (i) Value of V_F in the range 260.0 cm^3 to 400.0 cm^3. [1]

(c) (v) All values of raw y to the nearest mm and less than 20 cm. [1]

(d) (ii) Six sets of readings of V and y (with correct trend and without help from Supervisor) scores 5 marks, five sets scores 4 marks etc. [5]

Range: [1]
Maximum value of $V \geqslant 200$ cm^3.

Column headings: [1]
Each column heading must contain a quantity and an appropriate unit.
The presentation of the quantity and unit must conform to accepted scientific convention, e.g. y / m or y (cm), V / cm^3 , $2V_F$ / 3 / cm^3.

Consistency: [1]
All values of raw V must be given to the nearest cm^3.

(e) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10, fractions or non-linear) are not allowed.
Scales must be chosen so that the plotted points occupy at least half the graph grid in both x and y directions.
Scales must be labelled with the quantity that is being plotted.
Scale markings should be no more than three large squares apart.

Plotting of points: [1]
All observations in the table must be plotted on the grid.
Diameter of plotted points must be $\leqslant$ half a small square (no "blobs").
Points must be plotted to an accuracy of half a small square.

Quality: [1]
All points in the table must be plotted on the grid (at least 5) for this mark to be awarded.
All points must be within ± 0.25 cm (to scale) in the y direction from a straight line.

(ii) Line of best fit: [1]
Judge by balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length.
Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate.
There must be at least four points left after disregarding the anomalous point.
Line must not be kinked or thicker than half a small square.

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(iii) Gradient: [1]
The hypotenuse of the triangle must be greater than half the length of the drawn line.
The method of calculation must be correct. Do not allow $\Delta x / \Delta y$. Sign of gradient on answer line must match graph drawn.
Both read-offs must be accurate to half a small square in both the x and y directions.

y-intercept: [1]
Either:
Check correct read-off from a point on the line and substituted into $y = mx + c$.
Read-off must be accurate to half a small square in both x and y directions.
Or:
Check read-off of the intercept directly from the graph (accurate to half a small square.

(f) Value of P = candidate's gradient and value of Q = candidate's intercept.
Do not allow fractions. [1]

Units for P (e.g. mm^{-2}, cm^{-2}, m^{-2} but **not** e.g. cm / cm^3) and Q (e.g. m) correct. [1]

(g) (i) V calculated correctly to the number of significant figures given by the candidate.
Sign of answer must be consistent with P and Q values in **(f)**. [1]

(ii) Valid comment with a comparison of volumes e.g. V is greater than V_F. [1]

2 (a) (ii) Value of L with unit in range 0.790 m to 0.810 m. [1]

(iii) Absolute uncertainty in L either 1 mm or 2 mm.
If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.
Correct method of calculation to obtain percentage uncertainty. [1]

(b) (ii) All values of raw d_1 with unit to the nearest mm. [1]

(c) (ii) $d_2 > d_1$ showing scale on rule is used correctly. [1]

(iii) Correct calculation of $|d_2 - d_1|$. [1]

(iv) Correct calculation of M with consistent unit. Do not allow answers to 1 s.f. [1]

(d) Justification for s.f. in M linked to s.f. in m and L. [1]

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(e) Second value of d_1. [1]

Second value of d_2. [1]

Quality: Second value of $|d_2 - d_1|$ < first value of $|d_2 - d_1|$. [1]

(f) **(i)** Two values of k calculated correctly. [1]

(ii) Valid comment consistent with the calculated values of k, testing against a stated numerical criterion. [1]

(g)	**(i)** Limitations [4]	**(ii)** Improvements [4]	Do not credit
A	Two readings not enough to draw a conclusion	Take more readings <u>and</u> plot a graph/ obtain more k values <u>and</u> compare	Two readings not enough for accurate results Repeat readings Few readings Take more readings and calculate average k
B	Difference between d_2 and d_1 is small/ $(d_2 - d_1)$ is small/ large % uncertainty in $(d_2 - d_1)$	Improved method to measure $(d_2 - d_1)$ values e.g. travelling microscope/larger masses/clamp vernier calipers above strip	Laser Ultrasonic position sensor Longer strip Change strip Deflection of strip
C	Difficult to distribute mass evenly/ gaps between masses vary/ masses do not lie in a straight line/ masses have slots	Improved method of distribution e.g. use marker or scale on wooden strip/ use smaller masses to produce the same m/ continuous strip of named material e.g. modelling clay	Masses inaccurate Stick masses to strip Masses falling Replace strip with metre rule Masses with no slots
D	Difficult to measure <u>d</u> values with reason e.g. rule not vertical/ difficult to hold second rule still as a pointer/ parallax error/ rule not held stationary	Improved method to measure d e.g. clamp metre rule/ place a set square on the floor next to ruler (to ensure rule is vertical)/ use of pointer (to metre rule)	Strip oscillates when masses are put on it Use a set square Effects of wind Reference to L
E	Strip becomes permanently bent or deformed	Method to overcome deformation e.g. check d without masses before and between readings/ lay weights on strip to flatten	Elastic properties of wood vary Use a new strip

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