CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9702 PHYSICS

9702/32 Paper 3 (Advanced Practical Skills 2), maximum raw mark 40

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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1 (b) (ii) Value of t in the range 10.0 s ≤ t ≤ 20.0 s. [1]

Evidence of repeat measurements of t. [1]

(c) Six sets of readings of S and t scores 5 marks, five sets scores 4 marks etc. [5]
If trend wrong or no S or t column –1.
Major help from Supervisor –2 (setting up circuit). Minor help from Supervisor –1.

Range: [1]
Values of S must include 22 (kΩ) or 10 (kΩ) and 1.2 (kΩ) or 1.0 (kΩ).

Column headings: [1]
Each column heading must contain a quantity and a unit.
The presentation of quantity and unit must conform to accepted scientific convention e.g. $1/t$ / s^{-1} $1/S$ / $k\Omega^{-1}$ $1/S$ ($k\Omega^{-1}$) t / s t (s).
($1/t$(s) $1/S$ 1/kΩ $1/S$ $(k\Omega)^{-1}$ are not allowed.)

Consistency: [1]
All values of raw t must be given to the same precision (either 0.1 s or 0.01 s).

Significant figures: [1]
Significant figures for every row of values of $1/S$ must be the same as or one greater than the s.f. in S as recorded in table.

Calculation: [1]
Values of $1/t$ calculated correctly.

(d) (i) Axes: [1]
Sensible scales must be used, no awkward scales (e.g. 3:10).
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.
Points must be plotted to an accuracy of half a small square.
Diameter of points must be ≤ half a small square (no "blobs").

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be awarded.
Judge by the scatter of all the points about the straight line. Points must be less than 0.05 $k\Omega^{-1}$ from a straight line on the $1/S$ axis.

(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.
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 at least half the length of the drawn line.
Both read-offs must be accurate to half a small square in both the *x* and *y* directions. The method of calculation must be correct.

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

(e) Value of *a* = candidate's gradient.
Value of *b* = candidate's intercept / candidate's gradient
= candidate's intercept / *a* [1]

Unit for *a* correct and consistent with value e.g. $k\Omega\,s^{-1}$, $\Omega\,s^{-1}$. [1]

[Total: 20]

2 (a) (i) Measurement of *d* with unit in range 0.5 mm – 2.5 mm. [1]

Evidence of repeated readings of *d*. [1]

(ii) Absolute uncertainty in *d* in the range 0.2 – 0.5 mm. [1]
If repeated readings have been taken, then the absolute uncertainty can be half the range (but not zero if values are equal).
Correct method of calculation to get percentage uncertainty.

(c) (i) Measurement of r_1 recorded to nearest $0.1\,cm^3$, and in range 1 to $5\,cm^3$. [1]

(ii) Value for *n*. [1]

(iii) Correct calculation of *V*. [1]

(d) Justification of s.f. in *V* linked to significant figures in $(r_1 - r_2)$ and in *n*. [1]

(e) (ii) Second value of *d*. [1]

(iii) Second value of *n.* [1]

Quality: *V* larger for larger *d.* [1]

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

(ii) Sensible comment relating to the calculated values of *k*, testing against a criterion specified by the candidate. [1]

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(g)

	(i) Limitations **4 max.**	**(ii)** Improvements **4 max.**	Do not credit
A	two readings not enough (to draw a conclusion)	take many readings and plot a graph/take many readings and calculate more *k* values and compare	repeat readings/few readings/take more readings and (calculate) average *k*/only one reading
B1	large uncertainty in *d* because *d* is small	improved method to measure *d* e.g. measure OD and wall thickness/image of cross-section with scale	flexible tube/rigid tube/wire in tube/micrometer/*d* is small
B2	difficult to measure *d* with reason e.g. tube distorts/difficult to insert both prongs inside tube/difficult to judge when jaws are in line with edges of *d*	use travelling microscope/measure volume and calculate *d*/use a magnifying glass with scale	
C	difficult to count bubbles with reason e.g. plunger moves unsteadily/plunger sticks/bubbles unexpected/bubbles emerge too quickly	method to improve control e.g. use a G-clamp or screw to move plunger/use a narrower diameter syringe with reason (e.g.smaller force needed so better control)	bubbles difficult to count/lubrication
D	difficult to watch the syringe scale and the bubbles at the same time	description of method to allow simultaneous measurement e.g. use video with playback/use video to allow slow motion/use video to see bubbles	parallax/use assistant/change syringe scale/high speed camera/slow motion camera/light gates
E	difficult to keep end of tube at 2 cm depth	method to keep tube at 2 cm depth e.g. use of clamp/Blu-Tack/tape	stick tube/attach tube/water in tube/comments about Blu-Tack seal

[Total: 20]

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