Cambridge International AS & A Level

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PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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) $0.9V_S$ calculated correctly and to the same number of s.f. as, or one more than, the s.f. of V_S in **(b)(i)**. [1]

(c) (ii) Value for t in range 1.0 s to 9.0 s. [1]

(d) (ii) Six sets of values for V_C and t with correct trend scores 5 marks, five sets scores 4 marks etc. [5]
Minor help from supervisor –1, major help from supervisor –2.

Range: [1]
Range of values to include $V_C \leq 3.0$ V and $V_C \geq 8.0$ V.

Column headings: [1]
Each column heading must contain a quantity and an appropriate unit.
The presentation of quantity and unit must conform to accepted scientific convention e.g. V_C / V or V_C (V).

Consistency: [1]
All values of t must be given to the nearest 0.1 s, or all to the nearest 0.01 s.

(e) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) 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 must 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 ≤ half a small square (no "blobs").
Plotted points must be accurate to half a small square.

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

(f) (ii) Tangent drawn at $V_C = 0.5V_S$.
Tangent must touch curve at the candidate's value of $0.5V_S$ from **(f)(i)**. [1]

(iii) Gradient: [1]
The hypotenuse of the triangle used must be greater than half the length of the drawn line.
The method of calculation must be correct.
Both read-offs must be accurate to half a small square in both x and y directions.

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

(g) Value of a = candidate's gradient and value of b = candidate's intercept. [1]

Correct units for a (e.g. V s^{-1}) and b (s). [1]

(h) Correct calculation of T. [1]

Quality: T in the range 8.0 s to 14.0 s, with consistent unit. [1]

2 (a) d in the range 0.5 mm to 0.9 mm, to nearest 0.1 mm or to 0.01 mm, with unit. [1]

(b) (iii) Value for x in the range 11–19 mm, with unit. [1]

Evidence of repeat readings of x. [1]

(c) Absolute uncertainty in x in range 2 mm to 5 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]

(e) (ii) h_1 recorded to nearest mm, with consistent unit. [1]

(iv) Correct calculation of k to the number of s.f. given by the candidate. [1]

Value of k given to the same number of s.f. as, or one more than, the number of s.f. in $(h_1 - h_2)$ or m, whichever is lower. [1]

(f) Second values of x and n. [1]

Second values of h_1 and h_2. [1]

Quality: Value of $(h_1 - h_2)$ for smaller x less than the value of $(h_1 - h_2)$ for larger x. [1]

(g) (i) Two values of c calculated correctly. [1]

(ii) Valid comment consistent with the calculated values of c, testing against a criterion specified by the candidate. [1]

(h)	**(i)** Limitations [4]	**(ii)** Improvements [4]	Do not credit
A	Two readings are not enough to draw a conclusion	Take more readings and plot graph/ take more readings and compare c values	Repeat readings/ few readings/ only one reading/not enough readings for accurate value
B	d is small/ large (percentage) uncertainty in d	Use a micrometer (to measure diameter)	Digital calipers
C	n not an integer	Estimate n to the nearest ¼ turn	
D	Diameter not constant/ coils vary in diameter/ coils not equally spaced/ coils not circular	Method of making equally-spaced coils e.g. make small marks/grooves on wooden rod Use motor to wind spring by rotating rod	Spring not straight Use 'factory' spring
E	Difficult to measure diameter (x) with reason e.g. calipers distort coils/end of coil gets in the way of ruler	Use thin ruler/graph paper placed between loops of spring	
F	$h_1 - h_2$ small, so <u>uncertainty large</u>	Use larger mass/larger range of masses Travelling microscope with reference to $h_1 - h_2$ Use wires of longer length to increase $h_1 - h_2$	