

**MARK SCHEME for the October/November 2008 question paper**

**9702 PHYSICS**

**9702/31**

Paper 31 (Advanced Practical Skills 1), maximum raw mark 40

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- 1 (c) Value of  $t$  in range 8 to 18s. [1]

### Table

- (d) Six sets of readings scores 5 marks, five sets scores 4 marks, etc.  
Write number of sets (ringed) next to table.  
Help from Supervisor then –1.  
 $t$  should show general increase with  $l$ . If not then –1. [5]
- Repeated readings for  $t$  (do not credit if values identical for every row). [1]
- $l_{\min} \leq 0.35m$  and  $l_{\max} \geq 0.55m$ . [1]
- Table headings – every column should have a label and an appropriate unit. [1]
- Consistency in raw data – all values of  $t$  should be given to 0.1 or all given to 0.01s. [1]
- Check value of  $1/\sqrt{l}$  (for largest  $l$ ) and tick if correct. [1]
- Each value of  $1/t$  should be to the same s.f. as (or one more than) the raw value of  $t$ . [1]
- Quality of data – judge from scatter of all plotted points (at least five) about line of best fit.  
Allow scatter of  $\pm 0.025 \text{ m}^{-1/2}$  in the  $1/\sqrt{l}$  direction. This mark cannot be scored for wrong graph or wrong trend, or if all points have not been plotted. [1]

### Graph

- (e) Points should occupy at least half the grid in both directions and scales should be sensible (not 3:10, etc.) and labelled with a quantity. Allow reversed axes. [1]
- Check that the ‘worst’ point is correctly plotted.  
This mark cannot be scored unless all data from the table has been plotted – write number of plots (ringed) on the graph.  
Do not allow blobs (diameter  $\geq$  half a small square). [1]
- Line of best fit. Allow five trend plots. [1]
- (f) Triangle chosen has a hypotenuse at least half the length of the drawn line.  
Vertices lie on the line and read-offs are correct (to half a small square in both directions) and method of calculation of gradient is correct. Ignore POTE. [1]
- Intercept calculated using readings from line and a valid method (or read from y-axis provided there is no FO).  
Ignore any POTE. [1]

### Conclusions

- (g) Gradient equated with  $p$ .  
Value of  $p$  in range  $0.400$  to  $0.600 \text{ m}^{1/2} \text{ s}^{-1}$  inclusive. [1]
- (h)  $q$  calculated starting with ‘intercept value =  $-p/q$ ’, and correct substitution.  
 $q$  must be opposite sign to intercept unless gradient is negative. [1]

[Total: 20]

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- 2 (a) (i) Raw value(s) of  $d$  recorded to the nearest mm. [1]  
 Repeated readings for  $d$ . [1]
- (ii) Absolute uncertainty of 1 or 2 mm (or half the range) used in a correct percentage uncertainty calculation. [1]
- (iii) Calculated value of  $x$  correct. [1]
- (c) (i) First value for  $n$ .  
 First value for  $V$  in range  $0.5 \leq V \leq 2.0$ .  
 First value for  $I$  with  $I < 1.0\text{A}$  (unit required).  
 If significant help from Supervisor then  $-1$ . [3]
- (d) Second set of measurements (with different  $n$ ). [1]  
 Correct calculation of second  $R$ . [1]  
 Calculated value of second  $\mu$  correct (allow e.c.f.). [1]  
 Quality – the two values of  $\mu$  are within 20% of each other. [1]  
 (This will require a check calculation of first value of  $\mu$ ).

### Drawing conclusions

- (e) Valid comment on whether  $R$  proportional to  $n$ , based on comparison of two calculated ratios (e.g. two values of  $\mu$  or two values of  $R/n$ ).  
 Validity can be based on the candidate's own stated criterion (e.g. 'values within 10%') or, if not stated, on 20% difference.  
 Accept reversed trend as evidence for  $R$  not proportional to  $n$ . [1]

	(f) (i) Problems [4]	(f) (ii) Improvements [4]
A	Two sets of readings are not enough (to draw a conclusion)/only two readings.	Take more readings and plot graph.
B	Tube not circular/tube not rigid.	<u>Repeated</u> measurements of $d$ in <u>different directions</u> .
C	Coils not circular (helix inferred)/different turns have different lengths/wire kinked or loosely wound/ $x$ different to $\pi d$ /turns unevenly spaced.	Measure the length in one turn by wrapping string, then unwrapping and measuring/workable method of getting even spacing of turns.
D	Difficult to judge whole number of turns when positioning contacts/large contact area.	Mark lateral line on tube to give positions for contacts/use knife edge contact or smaller plug.
E	Contact resistance/lead resistance/circuit resistance/fluctuating or changing readings.	Measure lead resistance and subtract from $R$ /reposition voltmeter connections closer to contacts/clean the contacts/use shorter leads.
F		Use vernier calipers <u>to measure <math>d</math></u> .

[Total: 20]