PreDP revision questions answers for Section C of the exam

(a) *R* values 0.553, 1.55, 2.74, 3.74, 4.92
(2,3,4 or more significant figures) [1]
Consistent 3 or consistent 4 significant figures for final four entries [1]

(b) Graph:
Axes labelled and scales suitable (must include origin) [1]
Plots correct to ½ square (–1 each error or omission) [2]
Well judged str. line taking account of all points and reaching an axis [1]
Thin line [1]

(c) Statement proportional (wtte) or as *x* increases, *R* increases [1]
Justification straight line through origin [1]

(d) Clear indication of method on graph [1]
Correct value to ½ square [1]

(e) low current/switch off between readings
or add (variable) resistor/lamp
or reduce voltage/power [1]

(a) **Q** correct position with suitable number(s) [1]
Rule correctly tilted, and on bench (or arrow to indicate) [1]

(b) Any two from:
Readings taken at either side/diameter of cylinder
Position of mid point found
Mark position of centre [2]

(c) 34.5 cm [1]

(a) (i) d 0.5 cm or 5mm [1]

(ii) x 10.0 [1]

(b) (i)–(iii)

table: T 1.0, 0.95, 0.895 (0.90, 0.9), 0.84, 0.775 (0.78) [1]
T^2 1.00, 0.903, 0.801, 0.706, 0.601 (if T correct) [1]

(c) graph:

axes labelled [1]
scales suitable, plots occupying at least half grid [1]
plots all correct to ½ square [1]
well judged line [1]
thin line, 5 neat plots [1]

(d) statement NO and not through origin/
inverse/negative gradient/
x increases, T^2 decreases/ wtte [1]

(a)–(c)

table:
V, A, Ω [1]
V 1.8 [1]
I 0.25 [1]
R values 7.20, 3.46(3.5) [1]
consistent significant figures for R (2 or more) [1]

(d) y 0.48, 0.49, 0.5 (ecf) [1]
2/3 significant figures and no unit [1]

(e) (i) correct symbols and circuit (ignore power source symbol) [1]

(ii) voltmeter position correct [1]

(iii) control current/voltage/resistance/speed of motor [1]

(a) **(i)** l = 29 (mm) and l = 31 (mm) (allow 2.9 cm, 3.1 cm) [1]
e_A = 14 (mm) and e_B = 15 (mm) (ecf) (ignore minus signs) [1]

(b) **(i)** both l correct to (21.5 – 22) and 24 [1]

(ii) (6.5 – 7) and 8 (ecf) (ignore minus signs) [1]

(iii) e_{av} = 7.5 (c.a.o.) [1]

(c) statement matches readings (expect YES) (ecf NO) [1]
justification matches statement and by reference to results
(expect within limits of experimental accuracy, wtte) (too different, wtte) [1]

(d) any one of:
avoidance of parallax error explained
use of horizontal aid
measuring to same point each time
repeats
wait for springs to stop moving [1]

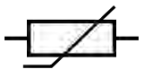
(a) table:
1/*d* values correct
0.0331, 0.0418, 0.0500, 0.0585 (0.058 to 2 sig. fig.), 0.0662 [1]
consistent 2 or 3 significant figures [1]

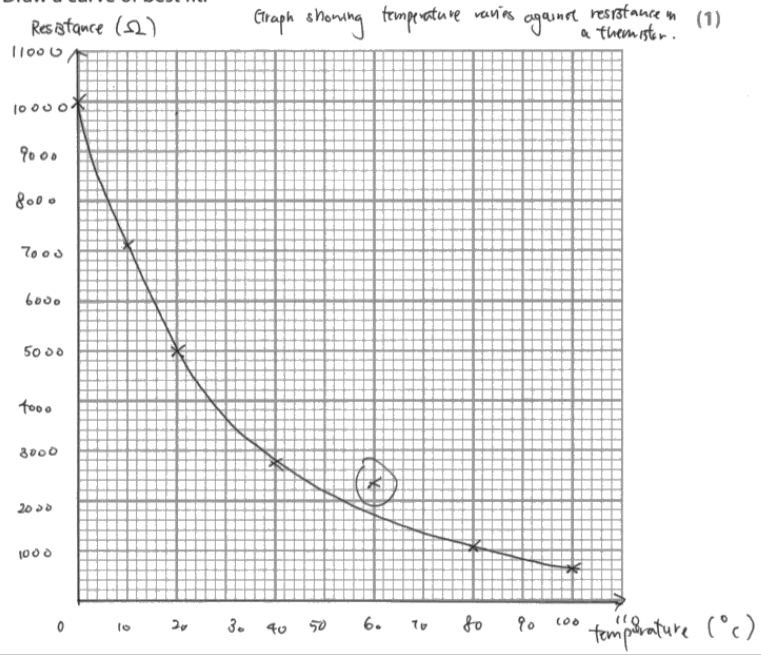
(b) graph:
axes labelled [1]
scales suitable, plots occupying at least half grid [1]
plots all correct to ½ square (ecf) – take centre of plot if large [1]
well judged line thin line (≤½ square) [1]
(no mark if plots > ½ square)

(c) triangle method used and shown (any indication on graph) [1]
(triangle) using at least half line (can be seen in calculation) [1]

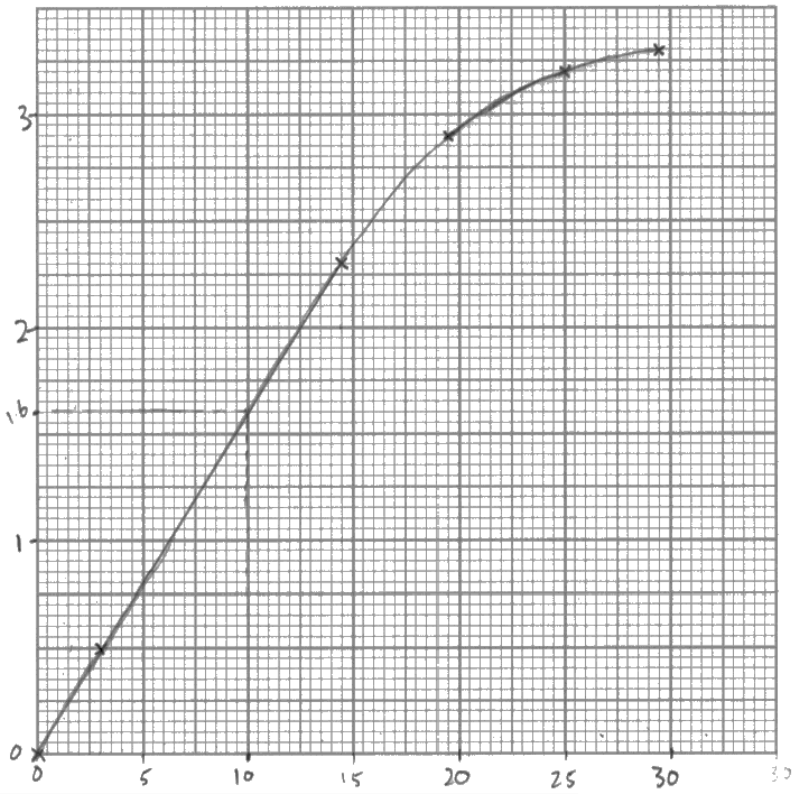
(d) μ 27 – 33 (NO ecf) [1]
2 or 3 significant figures and unit g [1]

a	i	moment = force x (perpendicular) distance (from pivot)	in words or accepted symbols	1
	ii	MP1. calc of 1 correct moment (about the pivot); MP2. stated equivalence of clockwise moment= anticlockwise moment /principle of moments; MP3. final value; e.g. 2 x 60 =120 (one mark) 2 x 60= 10 x F_N (two marks) $F_N = \frac{2 \times 60}{10}$ =12 (N) (three marks)	in words or in numbers allow working in cm or m	3
b		MP1. Increases (force on newtonmeter); MP2. (because) weight of bar has a moment; MP3. in same direction (clockwise) as 2 N weight;	may be shown by a calculation allow F_N = 62(N) for three marks	3
			total = 7 marks	

a		 D		1
b	i	Any two ideas from: MP1. it acts as water bath; MP2. gives more gradual heating or cooling OR gives (easier/better) control of temperature; MP3. protects the thermistor against direct heating/prevents intense heating;	allow water distributes temperature (more) evenly /RA for air very high temperature	2
	ii	B; in parallel across the thermistor in series with the thermistor		1
c	i	ignore orientation of the graph suitable scales marked on both axes (> 50% of grid used); both axes labelled with quantity and unit; points within ± ½ small square;;		4
	ii	anomalous point at 60, 2350;		1
	iii	LOBF; should go through 60, 1750 approx no obvious abrupt changes of gradient		1

		(iii) Draw a curve of best fit. Graph showing temperature varies against resistance in a thermister. (1)  **Temperature in °C** / **Resistance in Ω** 0 / 10 000 10 / 7 060 20 / 5 000 40 / 2 670 60 / 2 350 80 / 1 080 100 / 609		
d	i	water boils at 100°C/OWTTE;		1
	ii	any sensible **method** to get temp between 0 and 20; e.g. add ice to water use cold water from tap/fridge	doing experiment in a fridge is not sensible, but allow if 'walk-in' fridge is mentioned	1
			total = 12 marks	

(a)	A		1
(b) (i)	suitable scales; 6 points plotted;; curve of best fit;	• Must use > half width and half height of grid • to nearest ½ square, up to two marks available for this, -1 each error • reject dot to dot • allow a reasonably smooth curve, points should be evenly distributed about the line	4



Voltage across X in V	Current in X in A
0	0
3.0	0.5
14.5	2.3
19.5	2.9
25.0	3.2
29.5	3.3

(ii)	V= I x R	in words, or accepted symbols or rearranged	1
(iii)	value of I from graph; rearranged equation/sub into equation; evaluation; unit; e.g. I= 1.6 (±1/2 a small square) 10 = 1.6 x R OR R = 10/1.6 R= 6.3 Ω / ohms	allow ECF from graph answers without working can gain full marks R= 6.25 allow answers which round to a number in the range 5.8 to 6.3	4
(iv)	any three **descriptions** from:- MP1. as V increases I increases (at first); MP2. constant gradient/constant R (at first); MP3. I is proportional to V; MP4. gradient changes at high voltage/eq; MP5. ∆I smaller (than previously) for V > 15V;	allow as I increases V increases graph line linear (at first) nonlinear above ~ 15 V graph is less steep at high voltage R increases for V > 15V (to ~8Ω) ignore slows down positive correlation	3

(v)	any two **conclusions** from:- MP1. resistance is constant at first; MP2. **resistance** is not constant / **resistance** increases as V (or I) increases; MP3. because X gets hot(ter); MP4. X is a filament lamp;	allow V and I are proportional at first, it obeys Ohms law at first non-ohmic /does not obey Ohms law / V and I are not proportional increasing temperature total marks = 15	2

(a) (i)	any sensible suggestion; e.g. newtonmeter / balance / scale(s)	 accept (electronic) scale condone newtonmetre ignore weighing machine	1
(ii)	weight = mass x gravitational field strength;	allow in standard symbols or in words e.g. W = m x g allow a 'mixture' e.g. weight = mass x g reject 'gravity' for g	1
(iii)	substitution OR rearrangement; evaluation; e.g. 50 = m x 10 (m =) 5 (kg)	 allow use of g = 9.81 N/kg 5.1(kg) from g= 9.81 accept correct answer with no working for both marks	2
(b)	MP1. use of density = mass/volume; MP2. measure volume (of cannonball); MP3. further volume measurement detail; e.g. volume of cannonball= volume of water displaced OR measure diameter AND calculate volume of sphere	 allow 'find out' for measure allow radius for diameter $v=4/3\ \pi\ r^3$ for volume	3
(c)	any 3 of: MP1. Momentum = mass x velocity; MP2. momentum before (firing) is zero; MP3. momentum is conserved; MP4. idea that after firing cannon must have equal and opposite <u>momentum</u> to cannonball;	ignore references to Newton's laws p = m x v momentum before = momentum after $0 = m_1 \times v_1 - m_2 \times v_2$ (v taken in the direction of the arrows on the diagram)	3

(a)	A1	gradient = q y-intercept = lg p or log p	
(b)	T1 T2	<table><tr><td>1.176 or 1.18</td><td>0.415 or 0.41</td></tr><tr><td>1.279 or 1.28</td><td>0.544 or 0.54</td></tr><tr><td>1.362 or 1.36</td><td>0.643 or 0.64</td></tr><tr><td>1.431 or 1.43</td><td>0.732 or 0.73</td></tr><tr><td>1.491 or 1.49</td><td>0.806 or 0.81</td></tr></table>	T1 is awarded for correct values lg d T2 is awarded for correct values lg I A mixture of 2dp and 3dp is allowed within each column
	E1	$\pm$ 0.016 or $\pm$ 0.017 or $\pm$ 0.02 decreasing to $\pm$ 0.006 or $\pm$ 0.007 or $\pm$ 0.01	Allow more than one significant figures.
(c) (i)	G1	Five points plotted correctly	Must be within half a small square. Use transparency. Ecf allowed from table.
	E2	Error bars in lg I plotted correctly.	Check first and last point. Must be accurate within half a small square. Ecf allowed from table.
(ii)	G2	Line of best fit	If points are plotted correctly then lower end of line should pass between (1.15, 0.370) **and** (1.15, 0.385) and upper end of line should pass between (1.50, 0.815) and (1.50, 0.825). Allow ecf from points plotted incorrectly – examiner judgement.
	G3	Worst acceptable straight line. Steepest or shallowest possible line that passes through <u>all</u> the error bars.	Line should be clearly labelled or dashed. Should pass from top of top error bar to bottom of bottom error bar or bottom of top error bar to top of bottom error bar. Mark scored only if error bars are plotted.
(iii)	C1	Gradient of best fit line	The triangle used should be greater than half the length of the drawn line. Check the "read offs". Work to half a small square. Do not penalise POT.
	E3	Error in gradient	Method of determining absolute error Difference in worst gradient and gradient.
(iv)	C2	y-intercept	Must be negative and the gradient must be used. Check substitution into c = y – mx. Allow ecf from **(c)(iii)**. If gradient within range given, then y-intercept should be about –1.1
	E4	Method of determining error in y-intercept	Determines worst y-intercept using worst gradient and finds difference. Check substitution but do not check calculation. Do not allow ecf from false origin read-off.

(d)	C3	$p = 10^{\text{candidate's } y\text{-intercept}}$	p should be about 0.08. Allow ecf from **(c)(iv)**. If FO used then p should be about 2.34 to 2.43.
	C4	q = in the range 1.20–1.30 **and** given to 2 or 3 sf.	Candidate's gradient must be used.
	E5	Method for determining errors in values of p and q.	Determines worst p using worst y-intercept and finds difference. Allow ecf from **(c)(iv)**. q error must be same as error in gradient.

Planning (15 marks)

Defining the problem (3 marks)

P1 Vary *d* and measure *y* or *d* is the independent variable and *y* is the dependent variable [1]

P2 Keep current constant [1]

P3 Keep length of wire constant [1]

Methods of data collection (5 marks)

M1 Diagram showing ruler positioned and power supply connected to wire or diagram showing initial and final marks on screen and power supply connected to wire [1]

M2 Use of ammeter to check current – penalise incorrect circuit diagrams [1]

M3 Measurement of *d* using micrometer [1]

M4 Allow time for displacement of wire to stabilise [1]

M5 Detail on measuring *y*; final reading - initial reading [1]

Method of analysis (2 marks)

A1 Plot a graph of log *y* against log *d* [1]

A2 *q* = gradient [1]

Safety considerations (1 mark)

S Safety related to hot wire – use of gloves, wait to cool down/switch off before changing wire, do not touch hot wire [1]

Additional detail (4 marks)

D Relevant points might include [4]

1. Use of vernier scale to measure *y* /well described optical method/use of set square
2. Method for keeping current constant e.g. use of rheostat
3. Check starting position for *y* for same wire
4. lg *y* = *q* lg *d* + lg *p*
5. Repeat measurements of *d* at different points along the wire and determine average
6. Control of additional variables e.g. separation between supports, room temperature
7. Use of protective resistor (either labelled or explained).

(a)	A1	Gradient = h y-intercept = $\lg \frac{1}{g}$ or $-\lg g$	Allow log and/or ln
(b)	T1 T2	2.467 or 2.4669 3.00 or 2.996 2.481 or 2.4814 2.93 or 2.934 2.496 or 2.4955 2.88 or 2.881 2.509 or 2.5092 2.83 or 2.833 2.522 or 2.5224 2.79 or 2.785	T1 for lg T T2 for lg R Allow mixture of dp.
	U1	$\pm$ 0.004 to $\pm$ 0.007	Allow more than one significant figure.
(c) (i)	G1	Five points plotted correctly	Must be within half a small square. Use transparency. Ecf allowed from table.
	U2	Error bars in lg R plotted correctly	Check first and last point. Must be accurate within half a small square. Allow ecf from **(b)**
(c) (ii)	G2	Line of best fit	There must at least four trend plots with a reasonable balance of points about the line. Allow ecf from points plotted incorrectly. Examiner judgement.
	G3	Worst acceptable straight line. Steepest or shallowest possible line.	Line should be clearly labelled or dashed. Should pass from top of top error bar to bottom of bottom error bar **or** bottom of top error bar to top of bottom error bar. Mark scored only if error bars are plotted. Allow ecf from **(b)** and **(c) (i)**
(c) (iii)	C1	Gradient of best fit line	The triangle used should be greater than half the length of the drawn line. Check the read offs. Work to half a small square. Do not penalise POT or sign of gradient.
	U3	Uncertainty in gradient	Method of determining absolute uncertainty Difference in worst gradient and gradient.
(c) (iv)	C2	y-intercept	Gradient must be used. Check substitution into $c = y - mx$. Allow ecf from **(c) (iii)**. If gradient negative then y-intercept should be about 11-13. If gradient positive then y-intercept should be about -4 or -5.
	U4	Uncertainty in y-intercept	Method of determining absolute uncertainty Difference in worst y-intercept and y-intercept. Do not allow ecf from false origin read-off. Allow ecf from **(c) (iv)**

(d)	C3	$g = 1/10^{y\text{-intercept}} = 10^{-y\text{-intercept}}$	*y*-intercept must be used. *g* should be about 10^{-13} Allow ecf from **(c) (iv)**. If FO or positive gradient used then *g* should be about 10^{-4}.
	C4	*h* = candidate's gradient value	Answer must be <u>negative</u> <u>and</u> given to 2 or 3 sf.
	U5	Method for uncertainty in *g* <u>and</u> uncertainty in *h*.	Expect to see difference in values for *g*. Uncertainty in *h* must be the same as the gradient.