Mark scheme (Unused)

January 2022

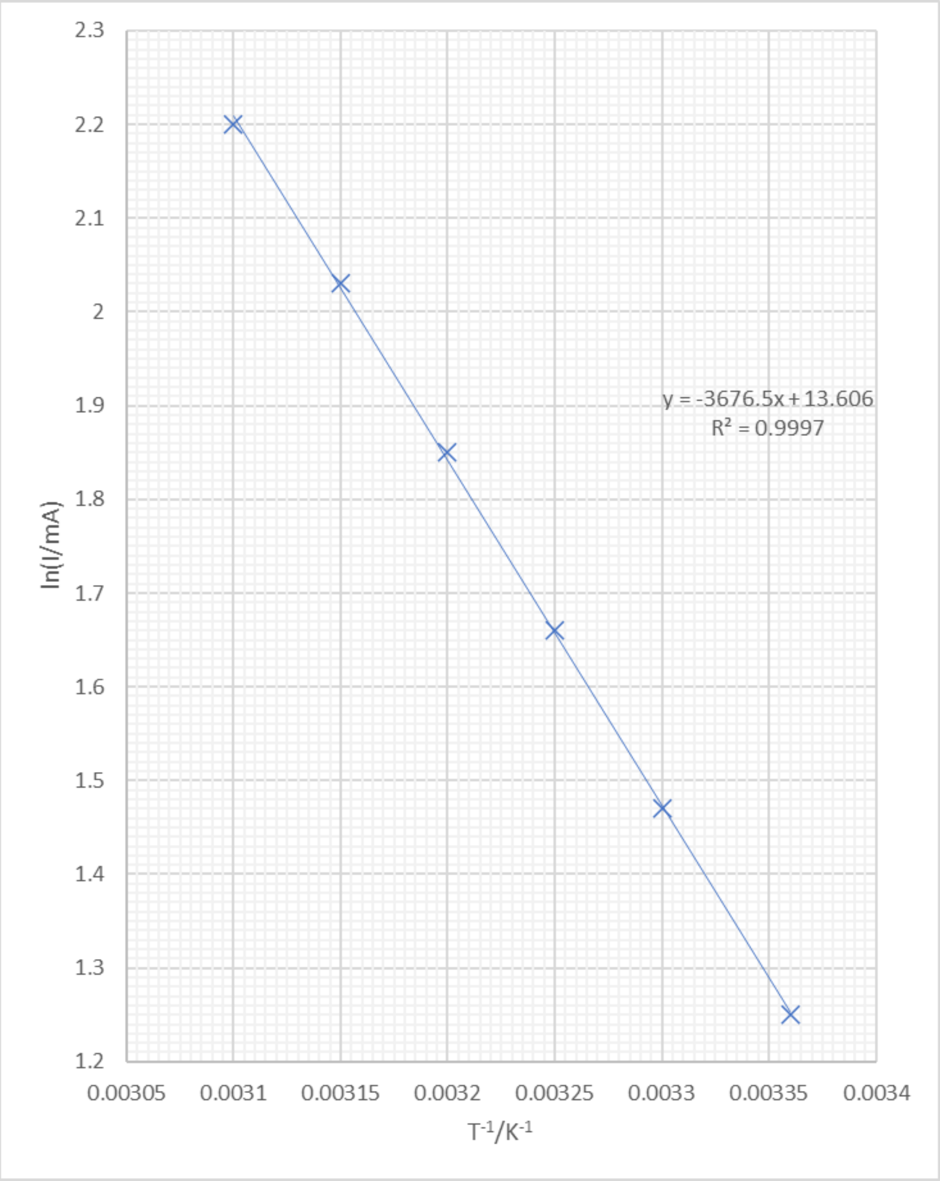
Pearson Edexcel
International Advanced Level
in Physics (WPH16)
Paper 01 Practical Skills in Physics II

Question Number	Answer		Mark
1 (a)(i)	Capacitor Y connected in parallel with X from terminal 2 to below capacitor	(1)	**1**
1 (a)(ii)	Correct symbol for voltmeter connected across X only	(1)	**1**
1 (b)(i)	0.01V	(1)	**1**
1 (b)(ii)	3 significant figures is enough **Or** 2 decimal places is enough [Accept the last digit may fluctuate] [Accept alternative valid answers, e.g. same number of s.f. as p.d. of battery]	(1)	**1**
1 (c)(i)	Three correct values of C_Y All values given to 2 s.f. Example of calculation A: $C_Y = (6.00 – 0.38)/0.38 \times 0.10 = 1.5\ \mu F$ B: $C_Y = (5.97 – 0.72)/0.72 \times 0.22 = 1.6\ \mu F$ C: $C_Y = (5.98 – 1.07)/1.07 \times 0.33 = 1.5\ \mu F$	(1) (1)	**2**
1 (c)(ii)	The range of values is 0.1 μF **Or** Within 10% (allow ecf from ci) Valid conclusion based on results [MP2 dependent]	(1) (1)	**2**
	Total for question		**8**

Question Number	Answer		Mark
2 (a)	Measure the background count (rate)	(1)	
	Measure distance *d* with a metre rule	(1)	
	Record the count (rate) over a long period of time **Or** Record the count (rate) several times and calculate a mean	(1)	
	Subtract the background count (rate) from each recorded count (rate)	(1)	
	Plot a graph of C against $1/d^2$	(1)	
	Any ONE from:		
	Ensure that the radioactive source is perpendicular to the G-M tube	(1)	
	Repeat for at least 5 values of *d*	(1)	
	If the graph is a straight line, then the relationship is valid	(1)	**6**
2 (b)	In Arrangement 1, beta radiation could enter the tube through the window	(1)	
	Hence the count rate in Arrangement 1 would not be just due to gamma radiation.	(1)	
	In Arrangement 2 (most) beta radiation would be absorbed by the metal	(1)	
	Hence the count rate in Arrangement 2 would be due to gamma only so would be more suitable	(1)	**4**
	Total for question		**10**

Question Number	Answer	Mark
3 (a)(i)	Any **TWO** from Place the thermometer close to the diode (1) Stir the water (1) Take current reading and temperature reading simultaneously (1)	**2**
3 (a)(ii)	The initial conditions cannot be easily controlled **Or** The temperature of the surroundings cannot be controlled **Or** The temperature of the surroundings may vary (1)	**1**
3 (b)	$\ln I = \ln I_0 - qV/kT$ (1) is in the form $y = c + mx$ with a gradient of $-qV/k$ (1)	**2**
3 (c)(i)	$\ln I$ values correct to 2 d.p. (1) $1/T$ values correct to 3 s.f. (1) Axes labelled: y as $\ln(I$ / mA) and x as T^{-1} / K^{-1}) (1) Most appropriate scales for both axes (1) Plots accurate to ± 1mm (1) Best fit line with even spread of plots (1)	**6**
3 (c)(ii)	Correct calculation of gradient using large triangle shown (1) Value of q positive and in range (1) Value of q given 2 or 3 s.f., unit C (1) <u>Example of calculation</u> *gradient* = *e* =	**3**
	Total for question	**14**

T / K	I / mA	T^{-1} / K^{-1}	ln(I / mA)
298	3.49	0.00336	1.25
303	4.34	0.00330	1.47
308	5.26	0.00325	1.66
313	6.34	0.00319	1.85
318	7.58	0.00314	2.03
323	9.03	0.00310	2.20



T / K	I / mA	T^{-1} / K^{-1}	ln(I / A)
298	3.49	0.00336	–5.66
303	4.34	0.00330	–5.44
308	5.26	0.00325	–5.25
313	6.34	0.00319	–5.06
318	7.58	0.00314	–4.88
323	9.03	0.00310	–4.71

Question Number	Answer	Mark
4 (a)(i)	Place a set square against the vertical edge and aligned with the mark (1) Place the metre rule flat against the tips of the set squares (1) [Accept parallax]	**2**
4 (a)(ii)	The uncertainty of a single measurement is half the <u>resolution</u> of the ruler, which is 0.5 mm (1) As there is uncertainty in the readings at both ends, the uncertainty is doubled (1)	**2**
4 (b)(i)	**Any PAIR from:** Use a (timing) marker (at the centre of the oscillation) (1) to ensure that the start and end of the oscillation are known accurately **Or** to ensure that a whole oscillation is measured accurately (1) Measure multiple oscillations and divide by the number of oscillations (1) to reduce percentage uncertainty (1) Repeat the measurement and calculate a mean (1) to reduce the effect of <u>random error</u> (1)	**2**
4 (b)(ii)	Calculation of mean value shown (1) Mean value of T = <u>1.04 s</u> (1) Use of half range shown (1) Uncertainty = 0.01 s [dependent MP3, accept 3 d.p.] (1) <u>Example of calculation</u> Mean 20T = (20.93 + 20.69 + 20.77 + 20.85) s / 4 = 83.24 s / 4 = 20.81 s Mean T = 20.81 s/20 = 1.04 s Uncertainty 20T = (20.93 – 20.69) s /2 = 0.12 s Uncertainty T = 0.1 s/20 = 0.006 s	**4**
4 (c)(i)	Use of $G = (32\pi M w^2 x) / (3d^4 T^2)$ using S.I. units (1) Value of G given to 3 s.f. [e.c.f. (b)(ii)] (1) <u>Example of calculation</u> $G = 32\pi \times 0.115\text{kg} \times 1.000^2\ \text{m}^2 \times 0.615\ \text{m} / 3 \times (2.35 \times 10^{-3}\ \text{m})^4 \times (1.04\ \text{s})^2$ $= 7.11\ \text{kg m}^3 / 9.91 \times 10^{-11}\ \text{m}^4\ \text{s}^2 = 7.18 \times 10^{10}\ \text{N m}^{-2}$	**2**
4 (c)(ii)	Use of 2× %U in w **Or** 4× %U in d **Or** 2 × %U in T shown (1) Correct value of %U in G [e.c.f. (c)(i) and (b)(ii), accept 1, 2 or 3 s.f.] (1) <u>Example of calculation</u> %U = (0.001/0.115) × 100 + 2 × (0.001/1.000) × 100 + (0.001/0.615) × 100 +	**2**

	$+ 4 \times (0.03 / 2.35) \times 100 + 2 \times (0.01/1.04) \times 100$ $= 0.87\% + 2 \times 0.10\% + 0.16\% + 4 \times 1.28\% + 2 \times 0.96\%$ $= 0.87\% + 0.20\% + 0.16\% + 5.10\% + 1.92\%$ $= 8.26\% \cong 8.3\%$	
4 (d)	Correct calculation of upper limit of G shown (1) Correct calculation of lower limit for G shown (1) Valid conclusion based on comparison of upper limit (1) Valid conclusion based on upper limit (1) <u>Example of calculation</u> Upper limit $G = 42.1 \times 10^9$ N m^2 $\times (1 + 0.06) = 44.6 \times 10^9$ N m^2 Lower limit $G = 42.1 \times 10^9$ N m^2 $\times (1 - 0.06) = 39.6 \times 10^9$ N m^2 Copper falls outside the range so the rod cannot be copper. Both brass and bronze fall inside the range therefore the student cannot determine whether the rod is brass or bronze. **Or** Correct calculation of %D shown for two metals (1) Correct calculation of %D shown for additional metal (1) Valid conclusion based on comparison for two metals (1) Valid conclusion based on comparison for additional metals (1) <u>Example of calculation</u> %D for G of brass = $(42.1 - 40.0)/40.0 \times 100 = 5.3\%$ %D for G of bronze = $(44.5 - 42.1)/44.5 \times 100 = 5.4\%$ %D for G of copper = $(45.0 - 42.1)/45.0 \times 100 = 6.4\%$ The %D of copper is greater than the %U so the rod cannot be copper. The %D for both brass and bronze are less than the %U therefore student cannot determine whether the rod is brass or bronze.	4
	Total for question	**18**