Mark Scheme (Results)

January 2022

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

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General Marking Guidance

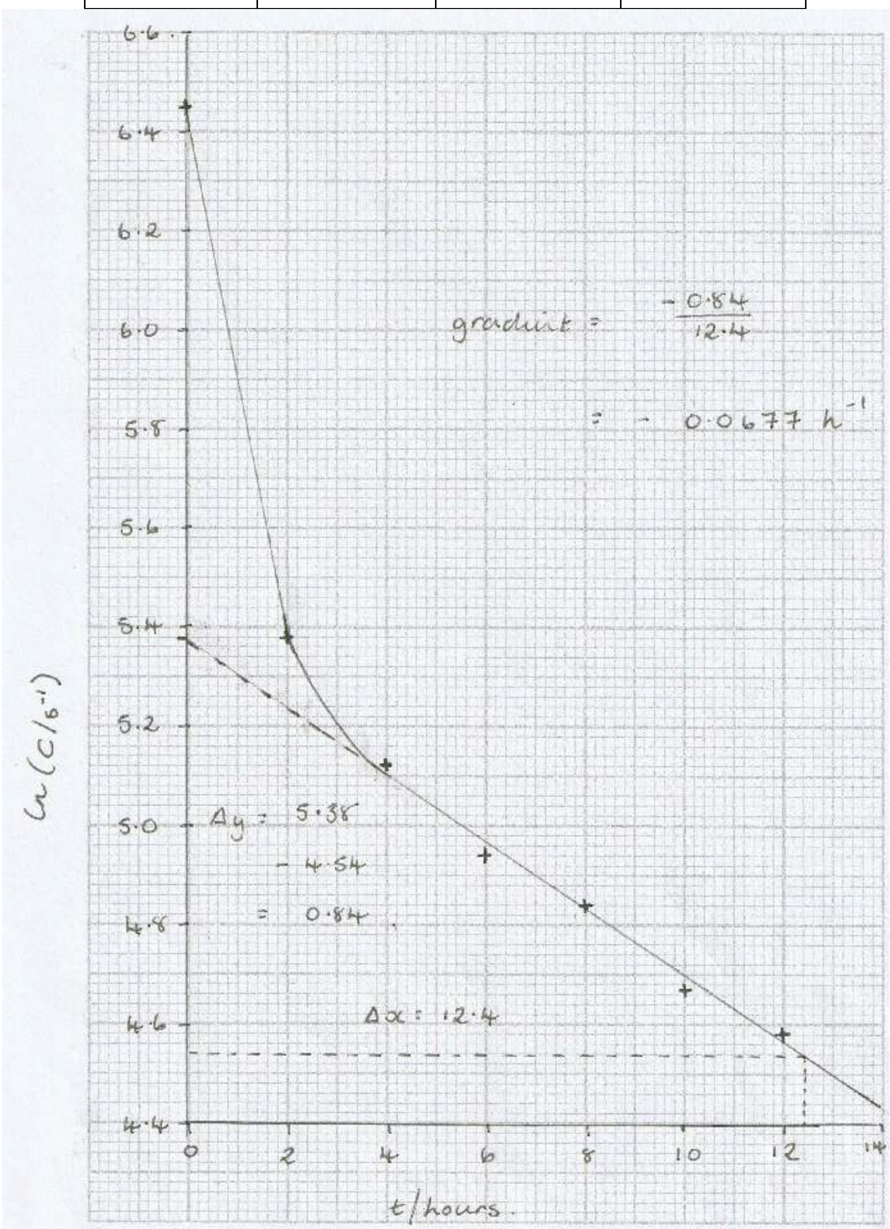
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer		Mark
1 (a)	To ensure the pressure remains constant **Or** To keep the pressure at atmospheric pressure [Accept to allow room for the air to expand]	(1) (1)	**1**
1 (b)	(The boiling water may make) the air expand too quickly **Or** (The boiling water may make) the air expand too much (So) the sulfuric acid could escape	 (1) (1)	**2**
1 (c)(i)	Stir the water Place the thermometer close to the capillary tube	(1) (1)	**2**
1 (c)(ii)	There are too few readings **Or** The range of temperatures is too small To draw an accurate best fit line **Or** To be certain of a linear relationship Which may lead to inaccuracy in the value of θ MP3 dependent on MP1 **OR** MP2	(1) (1) (1)	**3**
	Total for question		**8**

Question Number	Answer		Mark
2 (a)	Measure the length of tube x using a (metre) rule	(1)	
	Ensure the tube is vertical with a set square **Or** Release the magnet from the top of the tube	(1)	
	Measure t using a stopwatch [Accept alternative valid timing methods]	(1)	
	Repeat measurement of time and calculate a mean	(1)	
	Repeat for at least 5 values of x	(1)	
	Plot a graph of t^2 against x to check the gradient (which is ½a) is constant **Or** Plot a graph of t^2 against x to check it is a straight line	(1)	**6**
	Accept alternative graphs. Do not accept gradient = g		
2 (b)	Any **PAIR** from:		
	If the magnet is not aligned with the top of the tube when released	(1)	
	So the magnet would have a velocity when entering the tube	(1)	
	Or		
	It would be difficult to judge when the magnet is about to leave the tube	(1)	
	So this would add to the time	(1)	
	Or		
	The magnet could touch the sides of the tube and experience friction	(1)	
	So the time would increase	(1)	
	Or		
	The length of the tube may vary around the circumference	(1)	
	So this may introduce random error	(1)	**2**
	Total for question		**8**

Question Number	Answer	Mark
3 (a)	Any **TWO** from Handle the source using long tongs (1) Keep the source in a lead-lined box when not in use (1) Maintain a distance from the source when in use (1) Use the source for as short a time as possible (1) Do not accept answers relating to PPE	2
3 (b)	Background count rate should be subtracted from measured count rate (1) Background radiation adds a constant amount to the overall count rate **Or** It is a systematic error (1)	2
3 (c)	The gradient of the graph is $-\lambda$ (1) As $\ln C = \ln C_0 - \lambda t$ is in the form $y = c + mx$ **Or** As $\ln C = -\lambda t + \ln C_0$ is in the form $y = mx + c$ (1) [Accept alternative letters for *m* and *c*]	2
3 (d)(i)	ln *C* values correct to 2 d.p. Accept 3 d.p. (1) Axes labelled: *y* as $\ln(C / s^{-1})$ and *x* as *t* / hours (1) Most appropriate scales for both axes (1) Plots accurate to ± 1mm (1) Straight best fit line with even spread of plots in region $t \geq 4$ hours (1)	5
3 (d)(ii)	Correct calculation of gradient using large triangle shown (1) Value of λ in range 0.064 to 0.072 (h^{-1}) (1) Value of λ given as positive, to 2 or 3 s.f. (1) <u>Example of calculation</u> $gradient = ((5.38 - 4.54) / (0 - 12.4) = -0.84 / 12.4 = -0.068$ $\lambda = 0.068$ hr^{-1}	3
3 (d)(iii)	Use of $t_{½} = \ln 2 / \lambda$ (1) Value of $t_{½}$ given 2 or 3 s.f., with correct unit ecf from (d)(ii) (1) <u>Example of calculation</u> $t_{½} = \ln 2 / \lambda = \ln 2 / 0.068 = 10.2$ hours	2
	Total for question	**16**

t / hours	*C* / s^{-1}	ln (*C* / s^{-1})	ln (*C* / s^{-1})
0	633	6.45	6.450
2	217	5.38	5.380
4	167	5.12	5.118
6	140	4.94	4.942
8	126	4.84	4.836
10	107	4.67	4.673
12	98	4.58	4.585



Question Number	Answer		Mark
4 (a)(i)	Any **TWO** from Place the rule as close as possible to the ramp Use a set square to ensure the rule is vertical **Or** Use a spirit level to ensure the rule is vertical Ensure the rule reads zero at the bench Read the scale perpendicularly **Or** Use a set square to read value from the scale	 (1) (1) (1) (1)	2
4 (a)(ii)	The uncertainty of each measurement is half the resolution of the ruler (which is 0.5 mm) **Or** The resolution of the ruler is 1 mm so the uncertainty is 0.5 mm As values of h are subtracted the uncertainty is 0.5 mm + 0.5 mm = 1 mm Accept 2×0.5mm = 1 mm	 (1) (1)	2
4 (b)(i)	Mean value of t = <u>1.95</u> s Correct uncertainty from half range shown **Or** Correct uncertainty from furthest from the mean shown <u>Example of calculation</u> Mean t = (2.10 + 1.86 + 1.94 + 1.89) s / 4 = 7.79 s / 4 = 1.95 s Uncertainty = (2.10 – 1.86) s /2 = 0.12 s	(1) (1)	2
4 (b)(ii)	The values of t will increase **Or** The cylinder will move more slowly So the percentage uncertainty in t will reduce **Or** It will be easier to judge when the cylinder crosses the finish line **Or** The effect of reaction time will be reduced	 (1) (1)	2
4 (c)	Both have the same level of accuracy as the means are the same But cannot tell if they are close to the true value Student B has a smaller range than Student A Therefore Student B is more precise Accept converse, MP4 dependent MP3	(1) (1) (1) (1)	4

4 (d)(i)	Use of $t^2 = 4s^2/gh$ shown (1) g = 10.0 m s^2 — Accept 10 m s^{-2}, dependent MP1 (1) <u>Example of calculation</u> $g = 4s^2 / t^2h$ = (4 × 0.8^{2}m^2)/(2.44^{2}s^2 × 0.043m) = 2.56m^2 / 0.256m s^2 = 10.0 m s^{-2}		**2**
4 (d)(ii)	Use of 2× %U in s **and** 2 × %U in t (1) %U = 5.9 % — Accept 6% or 5.85 % (1) <u>Example of calculation</u> %U = 2 × (0.1 / 80) × 100% + 2 × (0.04 / 2.44) × 100% + (1 / 43) × 100% = 0.25% + 3.28% + 2.33% = 5.9 %		**2**
4 (d)(iii)	Correct value of relevant limit — e.c.f. (d)(i) and (d)(ii) (1) Valid conclusion based on comparison of limit to g = 9.81 m s^{-2} (1) MP2 dependent MP1 <u>Example of calculation</u> %U = 5.9% Lower limit = 10.0 × (100 – 5.9)/100 = 9.4 m s^{-2} As the accepted value of g of 9.81 m s^{-2} lies within the lower limit then the value is accurate. **Or** Correct calculation of %D shown — e.c.f. (d)(i) Valid conclusion based on comparison of %D to %U — e.c.f. (d)(ii) MP2 dependent MP1 <u>Example of calculation</u> %U = 5.9% %D = (10.0 – 9.81)/9.81 ×100% = 1.9% As the %D is less than %U then the value of g is accurate. Accept comparisons to g = 9.8 m s^{-2}		**2**
	Total for question		**18**

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