GCE A LEVEL MARKING SCHEME

SUMMER 2022

A LEVEL
PHYSICS – UNIT 5
1420U50-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2022 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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WJEC GCE A LEVEL PHYSICS

UNIT 5 – PRACTICAL EXAMINATION

SUMMER 2022 MARK SCHEME

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response question).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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EXPERIMENTAL TASK MARK SCHEME

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1.	(a)	(i)	Correct log conversion must be seen in the plan i.e. $\ln h_2 = n\ln h_1 + \ln k$ (1) Accept $\log_e 10$		1				
			Teacher assessed - graph to be plotted of $\ln h_2$ against $\ln h_1$ (1)		1				
			Trial readings provided (1)		1				
			Sample size to give a minimum of 5 readings over a minimum range of 40 cm (1)			1			
			Repeat readings taken – must be stated (1)	1					
			Method - Constant (fiducial) point chosen on the table tennis ball e.g. bottom / top / middle of the ball **or** reduce parallax / readings taken at eye level (1)			1	6	2	6
		(ii)	**Teacher assessed** – No significant risk Accept risk of clamp stand falling over	1			1		1
	(b)		Clear headings and units for all columns (1)	1					
			Minimum of 5 sets of readings with repeats to resolution of apparatus (1)		1				
			Mean values correct (1)		1				
			$\ln h_2$ *and* $\ln h_1$ calculated correctly (1)						
			Log values consistent to 2 or 3 s.f. / consistent decimal places in the column (1)		1				
			Resolution of ruler stated anywhere ± 1 cm (accept 0.01 m) (1)	1			6	3	6
	(c)	(i)	Titles and no units on the axis all correct allow **ecf** from (b) (1)	1					
			Suitable scales that occupy at least ½ of the graph paper with no awkward multiples e.g. 3, 6 (1)		1				
			All points plotted correctly to within ± ½ small square division **ecf** (1)		1				
			Line of fit drawn correctly (1)		1		4	3	4

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Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Large triangles used (should be close to the extremities of the lines) **or** two suitable points clearly shown on each graph or clearly implied by calculation (1) Gradient = n stated or implied (1) Gradient correct i.e. 1.0 ± 0.3 (ignore units and s.f.) (1)	1		1 1	3	2	3
		(iii)	Point taken from the graph (1) $y = mx + c$ used where $c = \ln k$ **ecf** gradient from (c)(ii) or line extrapolated to provide an intercept (1) k calculated correctly **ecf** (ignore units and s.f.) (1)			3	3	2	3
	(d)		**Any 2 × (1) from:** • Freeze frame photography / video • Use of a release mechanism / consistent dropping method / partner (assistant) • Larger range used / taking more readings in the range chosen (not more repeat readings) • Clean surface Don't accept light gates or use of lasers or use a vacuum			2	2		2
			Question 1 total	**6**	**10**	**9**	**25**	**12**	**25**

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PRACTICAL ANALYSIS TASK MARK SCHEME

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1.			**Method 1:** Using $E = \frac{1}{2}kx^2$ so energy stored = 87 [J] (accept 86.7 [J]) (1) %unc in extension = 1.2 [%] (1) %unc for energy = 5 + 2 × 1.2 = 7.4 [%] (1) Absolute uncertainty in energy = ± 6 [J] **ecf** ignore sf (1) so it might exceed maximum energy (1) **Method 2:** Using $E = \frac{1}{2}kx^2$ so energy stored = 87 [J] (accept 86.7 [J]) (1) Using max extension = 0.86 and max k = 252 (1) Max energy stored = 93 [J] (accept 93.2 J) (1) so it might exceed maximum energy (1) Absolute uncertainty =± 6 [J] (from 93 J – 87 J) ignore sf (1) **Worked examples of both methods:** **Method 1** $W = ½\ kx^2 = ½ \times 240\ \text{N m}^{-1} \times (0.85)^2 = 86.7$ [J] $p_W = p_k + 2p_x$ $= 0.05 + 2 \times \frac{1}{85} = 0.07[4]$ ∴ Absolute uncertainty = 0.074 × 86.7 J = 6 [J] (1 sf) ∴ W = (87 ± 6) J which can exceed 90 J so unsafe. **Method 2** Best value of W = 86.7 [J] [as above] Maximum possible value = ½ × (1.05 × 240) × $(0.86)^2$ = 93.2 [J] This is above 90 J so unsafe. Absolute uncertainty = 93.2 J – 86.7 J = 6.5 [J] So W = (86.7 ± 6.5) J or 87 ± 7 J		1 1 1 1	1	5	5	5

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Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(a)		All values for mean mass correct (1) All values for mean force correct **ecf** (1) All values for uncertainty correct and to 1 s.f. (1) [See end of scheme for table of results]		3		3	3	3
	(b)		Both axes labelled and units included (1) Suitable scales chosen so that data points occupy at least ½ of the vertical axis and not involving awkward factors e.g. 3 for both axes (1) All points plotted correctly to within ± ½ small square division **ecf** (1) All error bars plotted correctly **ecf** (1) Correct lines of maximum and minimum gradient consistent with the error bars **ecf** (1)	1	1 1 1 1		5	4	5
	(c)	(i)	Data is consistent as straight-line graph can be drawn / constant positive gradient / linear relationship (1) Lines appear to straddle the origin or intercept corresponds to origin (1) Don't accept there is no y-intercept Lines pass through all error bars (1) Award 1 mark for directly proportional			3	3		3
		(ii)	Large triangles used (should be close to the extremities of the lines) or two suitable points clearly shown on each graph or clearly implied by calculation [see below] (1) Minimum gradient correctly calculated **ecf** i.e. 5.7 [$\times 10^{-3}$] (1) Maximum gradient correctly calculated **ecf** i.e. 6.9 [$\times 10^{-3}$] (1) Note – ignore units and number of s.f. in this part of the question	1	1 1		3	2	3
		(iii)	Mean gradient correct **ecf** (1) ignore units Percentage uncertainty correct and expressed to 2 s.f. **ecf** = e.g. 10 % (9.5%) [no unit penalty] (1)		2		2	2	2

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Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)	magnetic flux density, $B = \frac{\text{gradient}}{\text{length}}$ (1) % unc(B) = %unc(length) + %unc(gradient) (1) B = 0.12 ± 0.01 T **with unit and correct sf** (1)			3	3	3	3
		(ii)	Check balance readings as reading 2 lower than reading 1 **or** use ammeter / balance **/ calliper** with improved resolution e.g. ± 0.01 A			1	1		1
			Question total	**2**	**15**	**8**	**25**	**19**	**25**

Table of Results:

Current, I / ± 0.1 A	Mass, m / g			Force, F / mN	Uncertainty in force / mN
	Reading 1	Reading 2	Mean		
0.5	0.34	0.29	0.32	3.1	0.2
1.0	0.61	0.57	0.59	5.8	0.2
1.5	0.98	0.92	0.95	9.3	0.3
2.0	1.29	1.23	1.26	12.3 or 12.4	0.3
2.5	1.64	1.58	1.61	15.8	0.3
3.0	1.92	1.88	1.90	18.6 or 18.7	0.2

2.0 A: F_{max} = 12.65 mN, F_{min} = 12.07 mN → 12.4 ± 0.3
2.5 A: F_{max} = 16.09 mN, F_{min} = 15.50 mN → 15.8 ± 0.3
3.0 A: F_{max} = 18.83 mN, F_{min} = 18.44 mN → 18.7 ± 0.2
Accept 12, 16 or 19 for F

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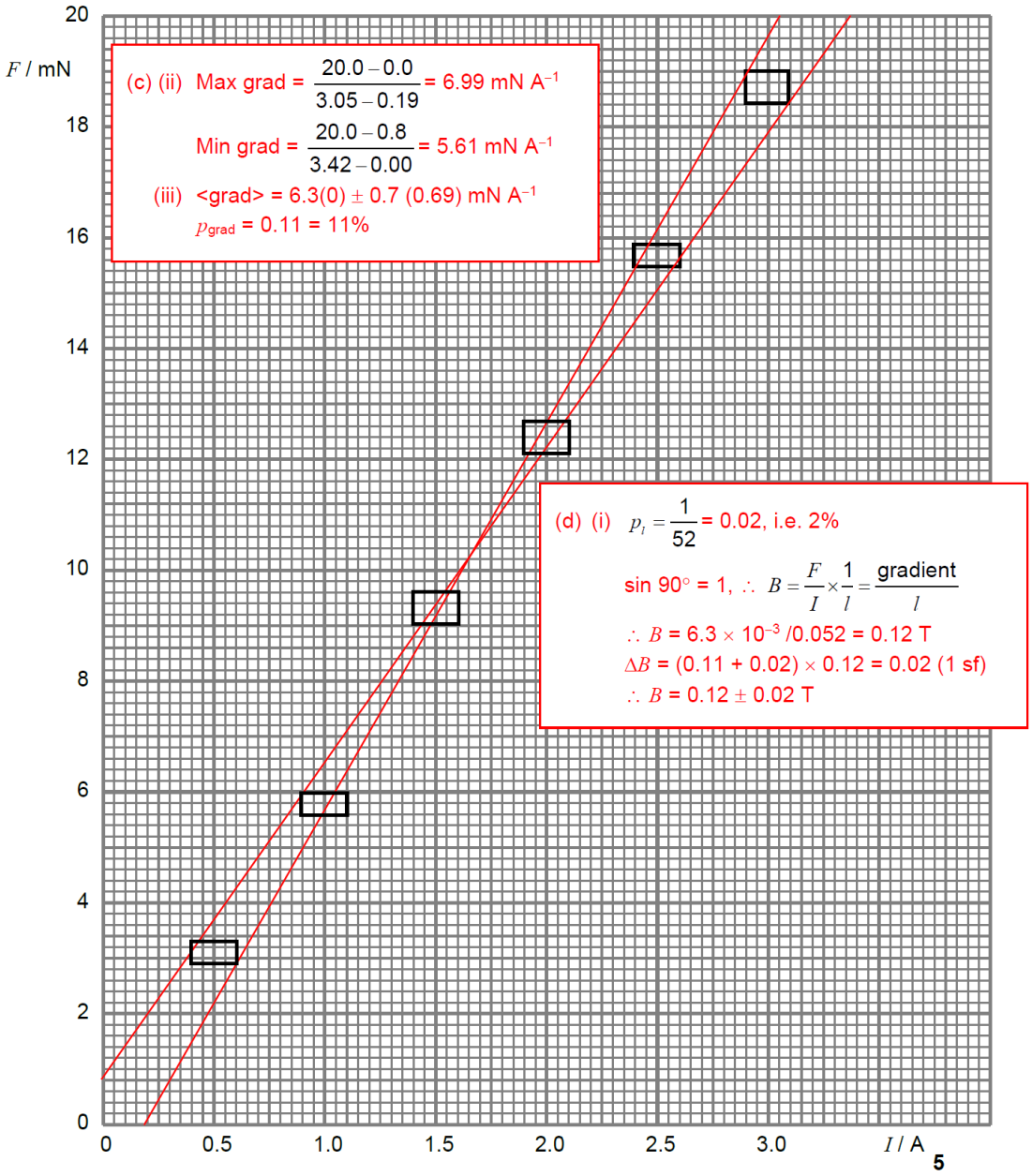

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GCE A LEVEL UNIT 5: PRACTICAL EXAMINATION

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Practical Analysis Task	2	15	8	25	19	25
Experimental Task	6	10	9	25	12	25
TOTAL	**8**	**25**	**17**	**50**	**31**	**50**

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