Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **March 2021**

MARK SCHEME

Maximum Mark: 30

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the March 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6	Calculation specific guidance Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	Guidance for chemical equations Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

General Marking Points

When marking at the computer:
- ensure your sitting position is comfortable
- take regular breaks
- don't mark when very tired
- try to mark some scripts every day
- don't leave it all to the last minute
- there may not be sufficient scripts in the pot if you are the last to finish!

Check Blank Pages e.g. pages 2 and 5 and Additional Objects:
Before marking each script check any blank pages at the end for student answers and add some annotation to show the page has been viewed. It is useful to highlight any written notes.

Annotations
etc.

Question	Answer	Marks
1	**Defining the problem**	
	Mass of cylinder *m* is the independent variable and period *T* is the dependent variable, or vary mass of cylinder *m* and measure period *T.*	**1**
	Keep radius of cylinder constant.	**1**
	Methods of data collection	
	Labelled diagram of workable experiment including: • beaker with (cooking) oil on a bench or container supported by stand where stand is on a bench • cylinder partially submerged in (cooking) oil • cylinder and (cooking) oil labelled.	**1**
	Method to determine mass *m* of cylinder, e.g. use a (top pan) balance.	**1**
	Method to determine period or *T*, e.g. use a stopwatch / timer to time oscillations.	**1**
	Method to determine diameter of cylinder, e.g. micrometer or calliper	**1**
	Method of Analysis	
	Plots a graph of T^2 against *m.* (Allow other valid graphs, e.g. lg *T* against lg *m*)	**1**
	Relationship valid if a straight line passing through the origin is produced. (Allow gradient = 0.5 for log *T* against log *m*).	**1**
	$K = \frac{4\pi}{\text{gradient} \times \sigma r^2}$ ($K = \frac{4\pi}{10^{2\times\text{y-intercept}} \times \sigma r^2}$ for lg *T* against lg *m*).	**1**

Question	Answer	Marks
1	**Additional detail including safety considerations** **Max 6**	**6**
	Use gloves to prevent oil contacting skin / slippery hands OR Perform experiment in a tray to prevent oil spillages.	D1
	Keep density / temperature of the (cooking) oil constant or keep σ constant.	D2
	Mass of oil = mass of beaker and oil – mass of beaker and use a measuring cylinder to determine the volume of the oil. Do not accept (calibrated) beaker.	D3
	Methods to measure volume of oil and determine mass of oil and use equation density σ = mass / volume for measurements.	D4
	Time n oscillations and divide nT by n where $n \geqslant 5$.	D5
	Description of method of counting oscillations with position of fiducial mark / mark on cylinder / beaker / fixed point shown in diagram.	D6
	Repeat experiment for each value of m and average T.	D7
	r = diameter / 2 provided diameter measured.	D8
	Repeat measurements of diameter in different directions and average.	D9
	Wait for oscillations to become even / steady.	D10

Question	Answer	Marks
2(a)	Gradient = $\frac{1}{2uA}$ y-intercept = $\frac{1}{2u}$.	**1**
2(b)	0.046 0.052 0.062 0.072 0.080 0.088	
	First mark for values of $\frac{1}{v}$ / s cm^{-1}; allow 3sf.	**1**
	Second mark for absolute uncertainties from $\pm$ 0.003 to $\pm$ 0.004.	**1**
2(c)(i)	Six points plotted correctly. Must be accurate to the nearest half small square. Diameter of points must be less than half a small square.	**1**
	Error bars in $\frac{1}{v}$ plotted correctly. All error bars to be plotted. Total length of bar must be accurate to less than half a small square and symmetrical.	**1**

Question	Answer	Marks
2(c)(ii)	Line of best fit drawn. Points must be balanced. Do not allow line from top plot to bottom plot. Line must pass between (320, 0.050) and (345, 0.050) **and** between (795, 0.085) and (815, 0.085).	**1**
	Worst acceptable line drawn. Steepest or shallowest possible line. Mark scored only if all error bars are plotted.	**1**
2(c)(iii)	Gradient determined with clear substitution of data points into $\Delta y / \Delta x$; distance between data points must be at least half the length of the drawn line.	**1**
	Gradient of WAL determined and uncertainty = (gradient of line of best fit – gradient of worst acceptable line) or uncertainty = ½ (steepest worst line gradient – shallowest worst line gradient)	**1**
2(c)(iv)	*y*-intercept determined by substitution of correct point into $y = mx + c$	**1**
	y-intercept of worst acceptable line determined by substitution into $y = mx + c$. uncertainty = *y*-intercept of line of best fit – *y*-intercept of worst acceptable line, or uncertainty = ½ (steepest worst line *y*-intercept – shallowest worst line *y*-intercept) Do not accept ecf from false origin method.	**1**

Question	Answer	Marks
2(d)(i)	u determined using y-intercept and u and A given to 2 or 3 sf. $u = \dfrac{1}{2 \times y - \text{intercept}}$	**1**
	A determined using gradient with correct substitution and Units with correct power of ten for u and A. $A = \dfrac{y - \text{intercept}}{\text{gradient}}$ or $A = \dfrac{1}{2 \times u \times \text{gradient}}$	**1**
2(d)(ii)	Percentage uncertainty in A. $\%\text{uncert.} = \left(\dfrac{\Delta\text{gradient}}{\text{gradient}} + \dfrac{\Delta y\text{-intercept}}{y\text{-intercept}} \right) \times 100$ OR Δu clearly determined and $\%\text{uncert.} = \left(\dfrac{\Delta\text{gradient}}{\text{gradient}} + \dfrac{\Delta u}{u} \right) \times 100$ OR Correct substitution for max/min methods.	**1**
2(e)	Value of m determined from **(d)(i)** OR **(c)(iii)** and **(c)(iv)** with correct number substitution into relevant equation and correct power of ten. e.g. $m = \dfrac{2uAt}{L} - A = \dfrac{2uA}{10} - A$, or $m = \left(\dfrac{t}{L} - \dfrac{1}{2u} \right) \times 2uA$ or $m = \dfrac{\dfrac{t}{L} - y\text{-intercept}}{\text{gradient}}$.	**1**