Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/32**

Paper 3 Advanced Practical Skills 2 **May/June 2021**

MARK SCHEME

Maximum Mark: 40

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 May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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.

Question	Answer	Marks
1(a)	Final value of s_A to at least two significant figures <u>and</u> in the range 1.05–1.10 mm.	**1**
	Evidence that s_A has been correctly calculated from a measurement of at least $10s_A$.	**1**
1(b)	Value of G in range 0°–45°.	**1**
1(c)	Six (or more) sets of readings of G and F (different values) with correct trend (F increases as G increases) and without help from the Supervisor scores 3 marks, five sets scores 2 marks, four or fewer sets scores 1 mark.	**3**
	Range: $G_{min} \leqslant 3°$ and $G_{max} \geqslant 17°$.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. Headings for sin F and sin (F–G) must have no unit. The presentation of quantity and unit must conform to accepted scientific convention e.g. F / °.	**1**
	Consistency: All values of raw G <u>and</u> raw F must be given to the nearest degree.	**1**
	Significant figures: Values of sin F should be to the same number of significant figures as, or one greater than, the number of significant figures in the corresponding value(s) of raw F.	**1**
	Calculation: Values of sin (F–G) calculated correctly.	**1**

Question	Answer	Marks
1(d)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). Scales are chosen so that the plotted points occupy at least half the graph grid in both *x* and *y* directions Axes must be labelled with the quantity that is being plotted. Scale markings should be no more than three large squares apart.	**1**
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points are $\leqslant$ half a small square. Points must be plotted to an accuracy of half a small square.	**1**
	Quality: All points in the table must be plotted (at least 5) on the grid. Trend of points on graph must be correct. It must be possible to draw a straight line that is within ± 0.02 on the sin *F* axis of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length. Allow one anomalous point only if clearly indicated by the candidate. There must be at least five points left after the anomalous point is disregarded. Lines must not be kinked or thicker than half a small square.	**1**
1(d)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Method of calculation must be correct, i.e. $\Delta y / \Delta x$. Gradient sign on answer line matches graph drawn. Both read-offs must be accurate to half a small square in both the *x* and *y* directions.	**1**
	y-intercept: Correct read-off from a point on the line and substituted into $y = mx + c$. Read-off must be accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph at $x = 0$, accurate to half a small square.	**1**

Question	Answer	Marks
1(e)	Value of p equal to candidate's gradient **and** value of q equal to candidate's intercept. Values must not be written as fractions.	**1**
	Values for p and q both given without a unit.	**1**
1(f)	Correct calculation of s_B using $s_B = ps_A$.	**1**

Question	Answer	Marks
2(a)(i)	Value of T_V with unit and in range 0.20–0.40 s.	**1**
	At least two measurements of nT_V where $n \geqslant 5$.	**1**
2(a)(ii)	Value for T_S larger than T_V.	**1**
2(b)	Second values of T_V and T_S.	**1**
	Second T_S > first T_S.	**1**
2(c)(i)	Two values of $T_S^2 - T_V^2$ calculated correctly.	**1**
2(c)(ii)	Justification based on significant figures in T_S and T_V.	**1**
2(c)(iii)	Valid comment consistent with the calculated values of $T_S^2 - T_V^2$, testing against a criterion stated by the candidate.	**1**
2(d)(i)	Value for x_1 in range 4.0–6.0 cm.	**1**
2(d)(ii)	Percentage uncertainty based on an absolute uncertainty in the range 2–3 mm. If repeat readings have been taken, then the absolute uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(d)(iii)	Raw value(s) for x_2 to nearest 0.1 cm.	**1**
2(d)(iv)	Correct calculation of g with consistent unit.	**1**

Question	Answer	Marks
2(e)(i)	A Two $T_S^2 - T_V^2$ values are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to maintain single mode of oscillation e.g. spring swings when measuring vertical oscillations/spring bounces when measuring swinging oscillations/spring swings in more than one plane. C Spring slides along rod during the oscillation. D Difficult to judge/determine/decide when an oscillation starts/ends/is complete. E Large % uncertainty in *T*v **or** *T*v is small so large uncertainty. F Difficult to measure x_1 or x_2 with reason e.g. parallax error **or** difficult to measure x_2 due to space at end of ruler. *1 mark for each point up to a maximum of 4.*	**4**
2(e)(ii)	A Take more readings and plot a graph or take more readings and compare (**not** "repeat readings" on its own). B Method to help maintain single mode of oscillation e.g. restrict sideways motion with tube/use parallel guides. C Method to attach spring to rod/stop spring sliding on rod e.g. adhesive putty/glue spring to rod/cut notch in rod/use rod with diameter same as diameter of spring loop/rougher rod. D Video/record/film with timer in view/frame by frame **or** use fiducial marker at centre of oscillation. E Use larger masses/use spring with lower spring constant/stiffness. F Use calipers/travelling microscope/use ruler starting at zero/use blocks with detail. *1 mark for each point up to a maximum of 4.*	**4**