Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/03**

Paper 3 Advanced Practical Skills 1 **For examination from 2022**

MARK SCHEME

Maximum Mark: 40

Specimen

This document has **8** pages. Blank pages are indicated.

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	'List rule' guidance (see examples below) 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	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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.

Abbreviations used in the Mark Scheme

/ alternative answers for the same marking point
<u>underline</u> actual word given must be used by candidate (grammatical variants accepted)
(brackets) the word or phrase in brackets is not required, but sets the context

Examples of how to apply the list rule

State **three** reasons ... [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B (4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks
1(a)	Value of L to the nearest mm in the range 2.5 cm–3.5 cm with unit.	**1**
1(b)	Value of T in the range 0.7 s to 1.5 s with unit.	**1**
	Evidence of repeated timings. Must see nT repeated where $n \geqslant 5$.	**1**
1(c)	Six sets of readings of n (different values) and time with correct trend (T increases as n increases) and without help from Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range of $n \geqslant 9$.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. T / s. No unit for n or $\sqrt{n}$.	**1**
	Consistency: Values of raw time must <u>all</u> be given to 0.1 s **or** <u>all</u> to 0.01 s.	**1**
	Significant figures: All values of $\sqrt{n}$ must be given to 3 significant figures.	**1**
1(d)(i)	Axes: Sensible scales must be used. Scale must not be awkward (e.g. 3:10 or fractions). Scales must be chosen so that the plotted points occupy at least half the graph grid in both x and y directions. Scales must be labelled with the quantity that is being plotted. Scale markings should be no more than 3 large squares apart.	**1**
	Plotting of points: All observations must be plotted on the grid. Diameter of plotted points must be $\leqslant$ 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 on the grid. It must be possible to draw a straight line that is within ± 0.10 on the $\sqrt{n}$ axis of all plotted points.	**1**

Question	Answer	Marks
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 (i.e. circled or labelled) 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 should be greater than half the length of the drawn line. The method of calculation must be correct. Do not allow $\Delta x / \Delta y$. Both read-offs must be accurate to half a small square in both x and y directions.	**1**
	y-intercept: Correct read-off from a point on the line and substituted correctly into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both x and y directions. **or** Intercept read directly from the graph, with read-off at $\sqrt{n} = 0$, accurate to half a small square in y direction.	**1**
1(e)	Value of P = candidate's gradient and value of Q = candidate's intercept. The values must not be fractions.	**1**
	Units for P and Q both s.	**1**
1(f)	Calculation of $g = L\pi^2 / P^2$ correctly using candidate's L and P with consistent unit.	**1**

Question	Answer	Marks
2(a)(i)	Value for D with unit in the range 0.14 mm to 0.16 mm.	**1**
2(a)(ii)	Percentage uncertainty in D based on an absolute uncertainty of 0.01 mm. Correct method of calculation to obtain percentage uncertainty, e.g. (absolute uncertainty / value from **(a)(i)**) × 100.	**1**
2(b)	Value of I in the range 10 mA $\leqslant I \leqslant$ 200 mA with unit (collected without help from Supervisor).	**1**
	Value of V in the range 0.4 V $\leqslant V \leqslant$ 1.0 V with unit.	**1**
2(c)(i)	Value of $d > D$ **and** $d <$ 1 mm.	**1**
2(c)(ii)	Correct calculation of G using candidate's values of D and d.	**1**
2(c)(iii)	Justification for significant figures in G linked to significant figures in D and d.	**1**

Question	Answer	Marks
2(d)	Second value of V.	**1**
	Second value of V less than first value of V.	**1**
2(e)	Second value of d.	**1**
2(f)	Two values of k calculated correctly, and to at least 2 significant figures.	**1**
2(g)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 5%, leading to a consistent conclusion.	**1**
2(h)(i)	**1 mark for each point up to a maximum of 4.** A Percentage uncertainty in the diameter is large because wire is very thin. B Uncertainty in I or V caused by: meter readings change over time / fluctuate **or** repeat readings are different **or** contact resistance varies **or** e.m.f. value drops. C Difficulty with rheostat adjustment e.g. not precise enough / overshoots I reading. D Difficulty measuring diameter(s) because e.g. awkward placing micrometer round wire; only one direction to measure diameter. E Two readings are not enough to draw a valid conclusion.	**4**
2(h)(ii)	**1 mark for each point up to a maximum of 4.** A More precise method to measure diameter, e.g. digital micrometer. B Use power supply **or** method of cleaning crocodile clips / wires. C Method to ensure exact current easier to produce e.g. use of screw thread adjustment. D Provide separate lengths of wire. E Take more readings (for different diameters) and plot a graph **or** take more readings and compare k values.	**4**