Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/05**

Paper 5 Planning, Analysis and Evaluation **For examination from 2022**

MARK SCHEME

Maximum Mark: 30

Specimen

This document has **10** 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	**Defining the problem** x is the independent variable and E is the dependent variable **or** vary x and measure E.	**1**
	Keep (r.m.s. / peak) current or I (in coil P) constant.	**1**
	Methods of data collection Labelled diagram of workable experiment including: • coil P and coil Q supported • x marked on the diagram • coil P and coil Q labelled.	**1**
	Two circuit diagrams: • a.c. power supply or signal generator connected to coil P with ammeter in series • voltmeter / CRO connected to coil Q.	**1**
	Method to determine x, e.g. use a ruler or ruler shown on diagram adjacent to coils with x indicated.	**1**
	Method to measure x from centre of coil P to centre of coil Q, e.g. measure width of (each) coil and divide by 2 and add to separation of coils	**1**
	Method of Analysis Plots a graph of ln E against x	**1**
	k = –gradient for correct graph	**1**
	$Z = \frac{e^{y\text{-intercept}}}{I}$ for correct graph	**1**

Question	Answer	Marks
1	**Additional detail including safety considerations** Any six from: D1 Do not touch hot coil / use gloves to position hot coil / use heat-proof gloves to position coil. D2 Use large current / large number of turns / an iron core (to produce large magnetic field / induced e.m.f). D3 Use high frequency (to produce large induced e.m.f). D4 Keep the number of turns (on each coil) constant / frequency constant. D5 Method described to check that current is constant, e.g. adjust variable resistor to keep ammeter reading constant. D6 Repeat measurements of x for different parts of the coil and average. D7 Method to position ruler horizontally to measure x described e.g. use a spirit level or same height from bench at both ends. D8 Method to keep coils parallel / co-axial e.g. adjust coil Q until maximum reading or use set square to ensure that coils are at right angles to the axis. D9 $\ln E = -kx + \ln(IZ)$ D10 Relationship valid if a straight line produced for correct graph	**6**

Question	Answer	Marks
2(a)	gradient = Q / E y-intercept = $1 / E$	**1**
2(b)	4.0 or 4.00 or 4.000 3.0 or 3.03 or 3.030 2.1 or 2.13 or 2.128 1.8 or 1.79 or 1.786 1.5 or 1.47 or 1.471 1.2 or 1.19 or 1.190 Values must be all 2 or 3 significant figures **or** all 3 or 4 significant figures.	**1**
	Absolute uncertainties from ± 0.4 to ± 0.1.	**1**

Question	Answer	Marks
2(c)(i)	Six points from **(b)** plotted correctly. Must be within half a small square. Diameter of points must be less than half a small square.	**1**
	Error bars in 1 / P (uncertainties from **(b)**) plotted correctly. All error bars to be plotted. Length of bar must be accurate to less than half a small square and symmetrical.	**1**
2(c)(ii)	Straight line of best fit drawn. Lower end of line must pass between (1.50, 0.70) and (1.65, 0.70) **and** upper end of line must pass between (3.60, 1.40) and (3.80, 1.40).	**1**
	Worst acceptable line drawn. Steepest or shallowest possible line that passes through all the error bars. All error bars must be plotted.	**1**
2(c)(iii)	Gradient determined with clear substitution of data points into $\Delta y / \Delta x$; distance between data points must be greater than half the length of the drawn line.	**1**
	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 into $y = mx + c$.	**1**
	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 allow methods using a false origin.	**1**
2(d)(i)	*E* determined with correct unit using $E = \frac{1}{y\text{-intercept}}$ Correct substitution must be seen.	**1**
	Q determined with correct unit and given to two or three significant figures using $Q = E \times \text{gradient}$ **or** $\frac{\text{gradient}}{y\text{-intercept}}$ Correct substitution must be seen.	**1**

Question	Answer	Marks
2(d)(ii)	Percentage uncertainty in E using $\frac{\Delta(y\text{-intercept})}{(y\text{-intercept})} \times 100$ Correct substitution must be seen.	**1**
2(d)(iii)	Absolute uncertainty in Q. Correct substitution must be seen. Percentage uncertainty in Q: %uncertainty E + %uncertainty in gradient **or** %uncertainty in y-intercept + %uncertainty in gradient absolute uncertainty = $\frac{\text{percentage uncertainty in } Q}{100} \times Q$ **or** Maximum / minimum methods: Max Q = max gradient × max E = $\frac{\text{max gradient}}{\text{min } y\text{-intercept}}$ Min Q = min gradient × min E = $\frac{\text{min gradient}}{\text{max } y\text{-intercept}}$ Absolute uncertainty = Max Q – Q **or** Q – Min Q	**1**

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