Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/04**

Paper 4 Theory (Extended) **For examination from 2023**

MARK SCHEME

Maximum Mark: 80

Specimen

This document has **12** pages. Any 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 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.

Mark categories

B marks	These are independent marks, which do not depend on other marks. For a **B** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer.
M marks	These are method marks upon which **A** marks later depend. For an **M** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer. If a candidate is not awarded an **M** mark, the later **A** mark cannot be awarded either.
C marks	These are compensatory marks which can be awarded even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known them. For example, if an equation carries a **C** mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C** mark is awarded. If a correct answer is given to a numerical question, all of the preceding **C** marks are awarded automatically. It is only necessary to consider each of the **C** marks in turn when the numerical answer is not correct.
A marks	These are answer marks. They may depend on an **M** mark or allow a **C** mark to be awarded by implication.

Abbreviations and guidance

/	Alternative answers for the same marking point.
underline	Actual word underlined must be used by candidate (grammatical variants accepted).
(brackets)	The word or phrase in brackets is not required but sets the context.
AND / and	Statements on both sides of the **AND** are needed for that mark.
OR / or	Indicates alternative answers, any one of which is satisfactory for scoring the marks.
NOT / not	Indicates that an incorrect answer is not to be disregarded but cancels another otherwise correct alternative offered by the candidate for this mark.
Accept / Acc	A less than ideal answer which should be marked correct.
Ignore / Ig	Indicates that something which is not correct or irrelevant is to be disregarded.
e.c.f.	'error carried forward'
o.w.t.t.e.	'or words to that effect'
s.f.	'significant figures' – answers are normally acceptable to any number of significant figures $\geqslant 2$. Any exceptions to this general rule will be specified in the mark scheme.
Arithmetic errors	If the **only** error in arriving at a final answer is clearly an arithmetic one, all but the final **A** mark can be awarded. Regard a power of ten error as an arithmetic error.
Transcription errors	If the **only** error in arriving at a final answer is because given or previously calculated data has clearly been misread but used correctly, all but the final **A** mark can be awarded.
Fractions	Only accept these where specified in the mark scheme.
Crossed-out work	Work which has been crossed out and not replaced but can easily be read, should be marked as if it had not been crossed out.

Question	Answer	Marks
1(a)	mention of gradient of graph at t = 30 s **OR** tangent drawn at t = 30 s and triangle drawn **OR** values of t and v taken from graph	**C1**
	$\alpha = \frac{\Delta v}{\Delta t}$ **OR** calculation shown	**C1**
	acceleration in range 0.30 to 0.45 m / s^2	**A1**
1(b)	acceleration less / at a slower rate	**B1**
	less driving force **OR** greater resistive force / friction / air resistance / drag **AND** resultant force less	**B1**
1(c)	area under graph / area under line	**C1**
	distance = $(20 \times 40) + (\frac{1}{2} \times 40 \times 10)$ **OR** $\frac{1}{2} \times (30 + 20) \times 40$	**C1**
	1000 m	**A1**

Question	Answer	Marks
2(a)	force	**B1**
	impulse	**B1**
2(b)(i)	(p =) mv **OR** 0.046×65	**C1**
	3.0 kg m / s **OR** 3.0 N s	**A1**
2(b)(ii)	(F =) $\frac{m(v-u)}{t}$ **or** $\frac{3.0}{0.00050}$ **OR** $a = \frac{(v-u)}{t}$ **and** $F = ma$ **or** $\frac{0.046 \times 65}{0.00050}$ **or** $0.046 \times 130\,000$	**C1**
	6000 N **OR** 6000 N	**A1**
2(b)(iii)	elastic (energy) **OR** strain (energy)	**B1**

Question	Answer	Marks
3(a)(i)	nuclear fusion	**B1**
3(a)(ii)	nuclei combine / join together	**B1**
	small nuclei to larger nuclei **OR** hydrogen to helium (in some way) **OR** loss of mass	**B1**
3(b)	any suitable resource, e.g. fossil fuels; hydroelectric; wave; wind **NOT** geothermal, nuclear	**M1**
	renewable **OR** not (according answer) **AND** matching explanation	**A1**
3(c)	any **two** advantages from: no polluting gases / quiet / low maintenance / can be placed on roofs / clean / cheap to run	**B2**
	any **two** disadvantages from: intermittent supply / unattractive / takes up space / uses land / d.c. output	**B2**

Question	Answer	Marks
4(a)	atoms collide with wall (and rebound) **OR** atoms rebound from wall	**B1**
	(atoms) undergo change of momentum	**C1**
	force on wall = (total) rate of change of momentum (of atoms) **OR** = change of momentum (of atoms) per second **OR** = change of momentum (of atoms) / time	**A1**
4(b)(i)	fewer atoms per unit volume **OR** density of gas less	**B1**
	rate of collision (with walls of balloon) decreases **OR** fewer collisions per unit area	**B1**
4(b)(ii)	PV = constant **OR** $P_1V_1 = P_2V_2$ **OR** (P_2 =) $\frac{P_1V_1}{V_2}$ **OR** $\frac{1.0 \times 10^5 \times 9.6}{12}$	**C1**
	8.0×10^4 Pa	**A1**

Question	Answer	Marks
5(a)	*arrangement:* Ice: in lattice / regular / arranged / orderly / fixed in place Water: random / irregular / not arranged / not orderly *motion:* Ice: vibrate Water: move (around) or slide over each other	**B2**

Question	Answer	Marks
5(b)(i)	$d = \frac{m}{V}$ in any form **OR** (m =) Vd **OR** $1800 \times 0.025 \times 920$	**C1**
	41 000 kg	**A1**
5(b)(ii)	(ΔE =) $cm\Delta\theta$ **OR** $2.1 \times 10^3 \times 41\,000 \times 3.5$	**C1**
	3.0×10^8 (J)	**A1**

Question	Answer	Marks
6(a)(i)	any **two** rays that start at the top of the image from: • seems to come from F_1 to lens and emerges paraxially • passes through centre of lens undeviated • paraxial to the lens and passes through F_2	**M2**
	two correct rays traced back and image indicated	**A1**
6(a)(ii)	any **two** of: enlarged / inverted / real underlined	**B1**
	enlarged **AND** inverted **AND** real underlined	**B1**
6(b)	refracted ray in prism below yellow ray **AND** above normal	**B1**
	emergent ray diverging away from the yellow ray **AND** outside of prism	**B1**

Question	Answer	Marks
7(a)	330–350 m / s	**B1**
7(b)	$v = f\lambda$ **OR** (f =) $\frac{v}{\lambda}$ **OR** $\frac{\textbf{(a)}}{0.022}$	**C1**
	Correct answer: e.g. 330 m / s gives 15 000 Hz	**A1**
7(c)	use of transducer to send and receive pulses of ultrasound	**B1**
	(display used to determine) time for echo of pulse to return from front **AND** back of bubble	**B1**
	use of speed of sound in the metal	**B1**
	use of distance = speed × time to calculate position and size	**B1**

Question	Answer	Marks
8(a)	$R_S = R_A + R_B$ in any form **OR** (R_S =) $R_A + R_B$ **OR** (R_S =) 4 + 8	**C1**
	(R_S =) 12 (Ω)	**C1**
	(R_P =) $\frac{1}{\left(\frac{1}{R_S}+\frac{1}{R_C}\right)}$ in any form **OR** (R_P =) $\frac{R_S R_C}{(R_S + R_C)}$ **OR** (R_P =) $\frac{1}{\left(\frac{1}{12}+\frac{1}{6}\right)}$ **OR** (R_P =) $\frac{(6 \times 12)}{18}$	**C1**
	(R_P =) 4.0 Ω	**A1**
8(b)	V_8 = supply $V \times \left(\frac{8}{12}\right)$ **OR** = $24 \times \left(\frac{8}{12}\right)$	**C1**
	(V_8 =) 16 V	**A1**
	OR alternative route $I_8 = \frac{\text{supply } V}{12}$ **OR** = $\frac{24}{12}$ **OR** = 2 (A)	**C1**
	($V_8 = 2 \times 8$ =) 16 V	**A1**

Question	Answer	Marks
9(a)	ball gets –ve charge (from –ve plate)	**B1**
	–ve(ly charged ball) attracted to +ve / repelled from –ve	**B1**
9(b)	*particles:* electrons	**B1**
	direction: from left to right (through ammeter)	**B1**

Question	Answer	Marks
9(c)	$Q = It$ in any form **OR** $\frac{Q}{t}$ words, numbers, symbols	**C1**
	correct use of $f = 4$ Hz **OR** $T = 0.25$ s i.e. $8.5 \times 10^{-10} \times 4$ **OR** $\frac{8.5 \times 10^{-10}}{0.25}$	**C1**
	$(I =) 3.4 \times 10^{-9}$ A	**A1**

Question	Answer	Marks
10(a)(i)	$^{237}_{93}Np$	**B1**
	$^{4}_{2}\alpha$	**B1**
10(a)(ii)	gamma and beta will not produce enough ions / ion pairs per cm	**B1**
10(b)	(No of Am atoms remaining = $8 \times 10^{14} - 6 \times 10^{14}$) = 2×10^{14}	**C1**
	4×10^{14} (Am atoms remain after 470 yrs or 1 half-life)	**C1**
	(2×10^{14} Am atoms remain after) 940 yrs or 2 half-lives	**A1**

Question	Answer	Marks
11(a)	hydrogen gas in stellar cloud / nebula pulled together by gravity	**B1**
	temperature of hydrogen increases **AND** a protostar is formed	**B1**
	nuclear fusion begins and outward force from this reaction balances inward force of gravity	**B1**
11(b)	any **three** from: microwave radiation is observed at all points in space around the Earth **o.w.t.t.e.** radiation was produced when the Universe was formed this radiation has expanded into the microwave region of the electromagnetic spectrum this is evidence that the Universe expanded	**B3**

Question	Answer	Marks
12(a)	$\frac{N_s}{N_p} = \frac{V_s}{V_p}$ in any form **OR** (N_s =) $\frac{N_p \times V_s}{V_p}$ **OR** $\frac{8000 \times 6}{240}$	**C1**
	200	**A1**
12(b)	$I_pV_p = I_sV_s$ in any form **OR** (I_p =) $\frac{I_s \times V_s}{V_p}$ **OR** $\frac{2.0 \times 6}{240}$	**C1**
	0.050 A	**A1**

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