Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/02**

Paper 2 Theory **For examination from 2023**

MARK SCHEME

Maximum Mark: 80

Specimen

This document has **10** pages.

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.

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 / A	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)(i)	X marked anywhere on horizontal section	**B1**
	Y marked on vertical section at 11 s	**B1**
1(a)(ii)	weight / gravity	**B1**
1(b)(i)	0 **or** zero	**B1**
1(b)(ii)	4(.0) (N)	**B1**
1(b)(iii)	due to increase in speed **or** more air particles / molecules hitting rock	**B1**
1(c)(i)	tangent drawn at 4.0 s	**M1**
	5.0–5.8	**A1**
	m / s^2	**B1**
1(c)(ii)	(F =) ma in any form algebraic or numerical **or** candidate's **1(c)(i)** × 0.408 seen	**B1**
	allow 2.0–2.4 (N) **e.c.f.**	**B1**

Question	Answer	Marks
2(a)(i)	heat gained from burning fuel / combustion **or** friction between moving parts / with air / road **or** from (radiation of) Sun	**B1**
2(a)(ii)	heat lost to air / surroundings **or** by convection (currents) **or** exhaust / hot gases / fumes **or** from exhaust **or** heat emitted (by hot car) **or** by radiation	**B1**
2(b)	(at start store of) chemical energy decreases	**B1**
	gravitational / potential energy (of car) increases	**B1**
	kinetic energy (of car or air) increases	**B1**
2(c)	KE = $\frac{1}{2}mv^2$ in any form algebraic or numerical	**C1**
	$90\,000 = 0.5 \times 800 \times v^2$ **or** (v =) $\sqrt{\frac{90\,000}{400}}$	**C1**
	15 (m / s)	**A1**

Question	Answer	Marks
3(a)	they / particles hit (inside) wall	**B1**
	they / particles create a force **and** a reference to area	**B1**
3(b)(i)	$p_1V_1 = p_2V_2$ in any form algebraic or numerical	**C1**
	400 (cm^3)	**A1**
3(b)(ii)	no gas / air / particles escape(s) **or** temperature constant **or** no forces between particles	**B1**
3(c)	graph showing decrease in volume with increase in pressure	**C1**
	curved line passing through (80, 500) and (100, 400)	**A1**

Question	Answer	Marks
4(a)	geothermal	**B1**
4(b)(i)	(E =) $mc\theta$ **or** $1000 \times 4200 \times 80$	**C1**
	3.4×10^8 (J)	**A1**
4(b)(ii)	steam condenses **or** steam changes from gas to liquid	**B1**
	latent heat given out	**B1**
	particles come closer together **or** potential energy of particles decreases **or** bonds being made	**B1**

Question	Answer	Marks
5(a)	**only** electromagnetic **and** transverse underlined or circled	**B1**
5(b)	$n = \frac{\sin i}{\sin r}$ **or** $(r =) \sin^{-1}\left(\frac{\sin i}{n}\right)$ **or** $(r =) \sin^{-1}\left(\frac{\sin(60°)}{1.6}\right)$	**C1**
	33(°)	**A1**
5(c)(i)	$n = \frac{1}{\sin c}$ **or** $(c =) \sin^{-1}\left(\frac{1}{n}\right)$ **or** $\sin^{-1}\left(\frac{1}{1.6}\right)$	**C1**
	39(°)	**A1**
5(c)(ii)	angle of incidence given as 57(°) (90° – *their* **5(b)**)	**B1**
	θ greater than the critical angle so total internal reflection	**B1**

Question	Answer	Marks
6(a)(i)	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ **or** $\frac{R_1 R_2}{R_1 + R_2}$ **or** $\frac{1}{R} = \frac{1}{1800} + \frac{1}{9000}$ **or** $\frac{9000 \times 1800}{10\,800}$ **or** 0.00066667	**C1**
	1500 (Ω)	**A1**
6(a)(ii)	$(I =) \frac{V}{R}$ **or** $V = IR$ **or** $\frac{4.5}{\textit{their}\ 1500}$	**C1**
	0.0030 (A) **or** 3.0×10^{-3} (A) **or** 3.0 m(A)	**A1**
6(b)(i)	increases **and** resistance of LDR decreases	**B1**
6(b)(ii)	does not change **and** resistance / e.m.f. does not change / not affected by LDR	**B1**

Question	Answer	Marks
7(a)(i)	force on PQ / wire **or** PQ / wire moves	**M1**
	force / movement out of page / outwards / towards observer (**Ignore** upwards)	**A1**
7(a)(ii)	force / speed / acceleration greater	**B1**
7(b)(i)	magnetic field / flux mentioned	**B1**
	change in field / flux (in coil) **or** field (lines) cut coil / wire	**B1**
7(b)(ii)	more turns **or** stronger magnet **or** move magnet faster	**B1**
7(b)(iii)	(current in coil) produces magnetic field / poles	**B1**
	N pole created at right-hand of coil **or** repels magnet / field in opposite direction	**B1**

Question	Answer	Marks
8(a)(i)	0.2(0) (kW h)	**B1**
8(a)(ii)	$(I =) \frac{P}{V}$ algebraic or numerical	**C1**
	0.17 (A)	**A1**
8(b)	to stop the rest of the circuit / lamps / television being live / having high voltage / 230 V **or** to stop shock	**M1**
	when switched off	**A1**
8(c)	if one lamp fails the other still works	**B1**

Question	Answer	Marks
9(a)	neutron absorbed by a nucleus of uranium	**B1**
	nucleus splits into two smaller / daughter nuclei (releasing energy)	**B1**
	emits more neutrons	**B1**
9(b)	less / fewer neutrons absorbed **or** more neutrons to cause fission	**B1**
	more energy produced **or** higher temperature **or** more fission reactions occur	**B1**
9(c)	on average only one of the neutrons produced by each fission goes on to cause another nucleus to fission / additional neutrons are absorbed by control rods	**B1**
9(d)	slows neutrons down	**B1**
	so that they have a larger chance of being absorbed by another (uranium) nucleus	**B1**

Question	Answer	Marks
10(a)	(collapse due to) gravity	**B1**
	balanced by outward force due to high temperature / pressure of light	**B1**
10(b)	runs out of hydrogen **or** starts to fuse other elements	**B1**
	(expands to) become a red giant	**B1**
	shrinks / cools to become a white dwarf	**B1**
10(c)	$2\pi R$ seen (as the circumference)	**C1**
	$(R =) \frac{vT}{2\pi}$ in any form algebraic or numerical	**M1**
	1.5×10^{11} m **or** 1.5×10^{8} km with correct unit	**A1**
10(d)(i)	Milky Way	**B1**
10(d)(ii)	e.m. radiation / light shifted towards longer wavelength	**B1**
	star / galaxy moving away	**B1**
10(d)(iii)	Q is faster than P **because** it has a larger redshift	**B1**
	Q is further away than P **because** redshift increases with distance	**B1**