



Cambridge O Level

PHYSICS

5054/21

Paper 2 Theory

May/June 2023

MARK SCHEME

Maximum Mark: 75

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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **13** printed 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	<p><u>'List rule' guidance</u></p> <p>For questions that require <i>n</i> responses (e.g. State two reasons ...):</p> <ul style="list-style-type: none"> • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>. • Incorrect responses should not be awarded credit but will still count towards <i>n</i>. • 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 <i>n</i> 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.

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Question	Answer	Marks
1(a)	<u>uniform / constant</u> acceleration (for 6 s) / acceleration of 3.7 <u>m / s²</u>	B1
	after 6(.0 s) constant speed / zero acceleration	B1
1(b)	$(a =) (v - u) / t$ in any form numerical or algebraic or 3.7 (m / s ²) seen	C1
	$(m =) F / a$ or $(m =) Ft / v$ in any form numerical or algebraic	C1
	490 (kg)	A1
1(c)	area under graph or average speed × time numerical or algebraic	C1
	66 (m)	A1
1(d)(i)	rising of hot air / hot fluid (and falling of cold air) or circulation of air / fluid with temperature differences	B1
1(d)(ii)	high temperature spot on Earth, e.g. from a chimney, dark patch in sunlight, above a town / land / surface; Sun heats surface or (hot) less dense air rises upwards	B1

Question	Answer	Marks
2(a)(i)	the product of mass and velocity	B1
2(a)(ii)	kg m / s or Ns	B1
2(b)	$1100 \times 10 = 4100 \times v$	C1
	2.7 (m / s)	A1
2(c)(i)	($KE = \frac{1}{2}mv^2$ algebraic or numerical for the car	C1
	15 000 (J)	A1
2(c)(ii)	(kinetic energy) becomes heat / thermal energy / internal energy (of vehicles / air) or kinetic energy (of car) goes to kinetic energy of van	B1

Question	Answer	Marks
3(a)	($I = V/R$ in any form or (total resistance =) 700 (Ω)	B1
	0.017 (A)	B1
3(b)	($P = I^2 R$ or VI and either V^2/R or $V=IR$ numerical or algebraic in any form	C1
	or voltage across 400 Ω resistor = (a) \times 400 (6.857 V)	A1
	0.12 (W)	
3(c)	circuit drawn with all 3 resistors in parallel with cell / power supply	B1
	ammeter in series with 100 Ω resistor or in series with resistor with largest current in arrangement drawn	B1

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Question	Answer	Marks
4(a)(i)	($P = $) Force / Area algebraic or numerical	C1
	520 000 (Pa)	A1
4(a)(ii)	They are equal (in size and direction)	B1
4(a)(iii)	small(er) area of contact (with board)	C1
	large(r) pressure (on board)	A1
4(b)(i)	<u>pressure</u> (of water) act / <u>pressure</u> in bag	B1
	<u>force</u> (on water) at right angles to the surface / in a straight line or pressure acts in all directions	B1
4(b)(ii)	larger pressure at A / greater weight of water above A (and greater height / depth / mass / weight (of water above B)	B1

Question	Answer	Marks
5(a)	ANY 2 from <ul style="list-style-type: none"> as temperature rises / heat added particles move faster / vibrate faster / move further apart smaller force between particles (in liquid) 	B1
	<ul style="list-style-type: none"> regular / fixed arrangement of particles in a solid or more space between particles in a liquid / less tightly packed / particles further apart 	B1
5(b)(i)	373 (K)	B1
5(b)(ii)	(energy needed) to <u>separate</u> particles / increase potential energy of particles / overcome (intermolecular) forces (of attraction)	B1
5(c)	$E = Pt$ in any form, algebraic or numerical, seen, e.g. 2400 (J)	B1
	(shc =) E / mT in any form	B1
	0.48 (J / (g °C))	B1

Question	Answer	Marks
6(a)(i)	object within focal length / same distance from lens as the focal length	B1
6(a)(ii)	from divergent / parallel rays or rays followed back (behind lens meet at point on image or rays do not meet on a screen / do not converge or rays appear to come from image	B1
6(b)(i)	ray through optical centre from top of object	B1
	ray parallel to axis from top of object to lens and line from junction with lens to top of image	B1
	both rays extended back to image and ray parallel to axis correctly refracted through lens to appear to come from top of image	B1
6(b)(ii)	4(.0 cm)	B1

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Question	Answer	Marks
7(a)	wavelength has altered / too large or crests in shadow should be bent / quarter circular above or below gap or vertical lines too straight on two crests	B1
7(b)	at least 3 semicircles centered on the gap	B1
	wavelength constant and the same on right and left of gap and some bending	B1
7(c)(i)	distance between two (consecutive) identical points such as two (consecutive) crests	B1
7(c)(ii)	$v = f\lambda$ numerical or algebraic e.g. $f = 6 / 2$ (Hz)	C1
	3(.0) Hz)	A1
7(c)(iii)	1.3 (cm)	B1

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Question	Answer	Marks
8(a)(i)	<u>useful</u> energy output / (total) energy input	B1
8(a)(ii)	heat / thermal energy is produced or energy is wasted	B1
8(b)	(useful output power =) 120×0.062 ; 7.4 (4 W)	C1
	50% or 0.50	A1
8(c)(i)	ANY 2 from <ul style="list-style-type: none"> current flows to earth / ground fuse blows / melts stops current / breaks the circuit/not live 	B2
8(c)(ii)	ANY 2 from <ul style="list-style-type: none"> fuse (still) melts lamp appears off metal case still live / can cause electrocution or shock 	B2

Question	Answer	Marks
9(a)	<u>magnetic</u> field or <u>magnetic</u> flux mentioned (from magnets)	B1
	it/ sides of <u>coil</u> cut (magnetic) field or (magnetic) field (strength) / flux in <u>coil</u> changes	B1
9(b)	AB on right – 6 V	B1
	coil vertical 0 V in both positions	B1
9(c)(i)	one ring (instead of two) with gaps between the two halves	C1
	each side of split ring connected to a different end of the coil and to a brush	A1
9(c)(ii)	(force on) current in a magnetic field or left-hand rule mentioned or magnetic field of coil interacts with field of magnet	B1

Question	Answer	Marks
10(a)	emission from the <u>nucleus</u>	B1
	of an alpha particle or beta particle or gamma (radiation)	B1
10(b)	at least three points plotted at (6000, 800), (12 000, 400), (18 000, 200) and (24 000, 100)	C1
	all points correct and smooth curve drawn	A1
10(c)	GM (tube and) counter (and timer)	B1
	measure number of counts in a specified time (e.g. 1 min) or subtract background count or tube connected to ratemeter	B1
10(d)	measure count rate of similar (mass) sample of living / fresh wood	B1
	use the graph to find time or description of use of half-life to find age	B1

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Question	Answer	Marks
11(a)	Mercury, Jupiter and Uranus	C1
	any two correct names in correct positions all three correct in correct positions	A1
11(b)	(speed =) distance / time numerical or algebraic or $2\pi R$ or πD seen	C1
	24 (km / s)	A1
11(c)	further from the Sun the larger the period	B1
11(d)	further from the Sun the cooler the planet	B1
	except for Venus hotter (than Mercury) / has greenhouse effect OR except for Mercury cooler than expected	B1