Cambridge Assessment International Education

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.

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.

Question	Answer	Marks
1(a)	<u>uniform / constant</u> acceleration (for 6 s) / acceleration of 3.7 <u>m / s^2</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 =) ½ 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)** × 400 (6.857 V) 0.12 (W)	**A1**
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**

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 • as temperature rises / heat added particles move faster / vibrate faster / move further apart • smaller force between particles (in liquid)	B1
	• 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 from	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

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**

Question	Answer	Marks
8(a)(i)	useful 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 • current flows to earth / ground • fuse blows / melts • stops current / breaks the circuit/not live	**B2**
8(c)(ii)	ANY 2 from • fuse (still) melts • lamp appears off • metal case still live / can cause electrocution or shock	**B2**

Question	Answer	Marks
9(a)	magnetic field or magnetic flux mentioned (from magnets)	**B1**
	it / sides of coil cut (magnetic) field **or** (magnetic) field (strength) / flux in coil 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 nucleus	**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**

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 πR **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**