Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/22**

Paper 2 Theory **October/November 2021**

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.

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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.

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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.

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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)	any **two** from: weight / it is a vector / has a direction weight / it is a force weight / it depends on location / gravitational field strength weight / it is measured with a spring balance (not a beam balance) / electronic balance / top-pan balance / newton meter	**B2**
1(b)	(pour liquid into) measuring cylinder **and** read / find the volume **or** zero the reading on the balance	**B1**
	take reading on balance **or** find the mass (of full measuring cylinder) **or** (pour liquid into) measuring cylinder **and** read / find the volume	**B1**
	subtract original reading / 34.9 g (from reading on balance) **or** take reading on balance **or** find the mass (of full measuring cylinder)	**B1**
	divide difference between readings by volume **or** divide (final) reading on balance by volume	**B1**
1(c)	(ρ =) 0.65 / 780	**C1**
	8.3×10^{-4} m^3 **or** 830 cm^3	**A1**

Question	Answer	Marks
2(a)	(a vector quantity has) magnitude **and** direction	**B1**
2(b)(i)	the wall exerts a force on swimmer	**B1**
	opposite in direction (to force of swimmer on wall) **or** to the right	**B1**
	equal in size (to force of swimmer on wall) **or** (resultant) force causes acceleration **or** force on object Y due to X is equal and opposite to force on object X due to Y	**B1**

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Question	Answer	Marks
2(b)(ii)	(water) resistance / resistive force / friction (on swimmer)	**B1**
	(water) resistance / backward force / resistive force / friction / opposing force increases (with speed / time)	**B1**
	(at constant speed) forward force is equal to resistive / backward force **or** no resultant force **or** forces balance	**B1**

Question	Answer	Marks
3(a)(i)	it / light refracts / bends / moves towards normal **or** angle of incidence greater than angle of refraction	**B1**
	change in direction of the ray / refraction shows a change in speed (at the boundary) **or** sin(*i*) / sin(*r*) is ratio of speeds **or** top of ray slows down first **and** enters the block first	**B1**
3(a)(ii)	(wavelength) decreases	**B1**
	(frequency) does not change.	**B1**
3(b)(i)	(sin(*r*) =) sin(*i*) / *n* **or** sin(45°) / 1.6 **or** 0.71 / 1.6 **or** 0.44 **or** (*r* =) 21(°)	**C1**
	26(°)	**C1**
	64°	**A1**
3(b)(ii)	64° / angle of incidence / *i* is greater than the critical angle / 39° **or** angle of incidence = 64**°**	**B1**
	it undergoes total internal reflection	**B1**

Question	Answer	Marks
4(a)(i)	13 A	**B1**
4(a)(ii)	0 (A)	**B1**

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Question	Answer	Marks
4(b)(i)	resistance of earth wire (and casing) small **or** disconnects circuit **or** no electric shock (possible) **or** stops current	**B1**
	current in (live and) earth wire (briefly)	**B1**
	fuse (in live wire) blows / melts	**B1**
4(b)(ii)	voltage (source) disconnected (by fuse's blowing) **or** live voltage immediately next to (switch and blown) fuse **or** it / live wire at high / maximum voltage / potential	**B1**
	no part of the washing machine / casing is live **or** no current to casing	**B1**

Question	Answer	Marks
5E(a)	(t =) Q / I **or** 7.2 / 0.0016 **or** 7.2 / 1.6 **or** 4.5×10^{N}	**C1**
	4500 s	**A1**
5E(b)(i)	does not change **and** p.d. / voltage across resistor N does not change / ammeter 2 is not in the branch that contains the LDR	**B1**
5E(b)(ii)	resistance of LDR increases **or** current (in M / in ammeter 1) decreases	**B1**
	time taken increases	**B1**
5O(a)	(bipolar npn) transistor	**B1**
5O(b)(i)	its resistance decreases **or** current in the LDR increases	**B1**
5O(b)(ii)	base current **or** base-emitter voltage increases	**B1**
	there is now a current in the relay coil **or** transistor switches (circuit) on **or** coil / core magnetised	**B1**
	relay coil attracts the relay switch / closes switch (in the mains circuit)	**B1**

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Question	Answer	Marks
6(a)	any **two** from: number of protons decreases by two number of neutrons decreases by two **or** number of nucleons decreases by four	**B2**
6(b)(i)	background radiation (detected) **or** source of background radiation mentioned (e.g. cosmic rays; radiation in the air)	**B1**
6(b)(ii)	alpha-particles are absorbed by the <u>air</u> (between the source and detector)	**B1**
	all the alpha-particles / radiation are absorbed (by the air between the source and detector) **or** alpha-particles travel less than 10 cm (in air)	**B1**
6(c)(i)	arrow through J towards centre of circular path	**B1**
6(c)(ii)	into the page (i.e. fifth box ticked)	**B1**
6(c)(iii)	force perpendicular to direction of motion **or** no component of velocity along line of action of force **or** work done = force × distance moved in direction of motion	**M1**
	no work done	**A1**

Question	Answer	Marks
7(a)(i)	liquids (almost completely) incompressible	**B1**
7(a)(ii)	molecules touching / very close	**B1**
	large (repulsive) forces between the molecules	**B1**
7(b)	(oil) reduces friction / has high boiling point / no dissolved gas / air	**B1**
7(c)(i)	(P =) F / A **or** 4500 / 0.018	**C1**
	2.5×10^5 Pa	**A1**
7(c)(ii)	3.5×10^5 Pa	**B1**

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Question	Answer	Marks
7(c)(iii)	4.9×10^5 N	**B1**
7(d)(i)	(hydrostatic) pressure in a liquid increases with depth **or** weight of oil (above piston 2) increases	**B1**
7(d)(ii)	(ΔP =) $h\rho g$ **or** $0.50 \times 900 \times 10$ **or** 4500	**C1**
	4500	**C1**
	6300 N	**A1**
7(e)	volume (of trapped air) decreases **or** molecules closer together	**B1**
	molecules collide with walls / bag / surface	**B1**
	molecules collide more often	**B1**

Question	Answer	Marks
8(a)	$F \times$ distance / displacement	**M1**
	perpendicular distance to line of action of force shown on Fig. 7.1	**A1**
8(b)(i)	for an object in equilibrium	**B1**
	(sum of) clockwise moments is equal to (sum of) anticlockwise moments **or** no resultant moment	**B1**
8(b)(ii)	equipment shown in diagram (e.g. rule, two loads, pivot)	**B1**
	what is done to achieve balance (e.g. balance rule on pivot, one load each side of pivot)	**B1**
	how principle is verified (e.g. calculate two opposite moments and find they are equal)	**B1**
8(c)(i)	80 N	**B1**
8(c)(ii)	(point) where the (whole) weight of an object acts / seems to act **or** point where the object balances	**B1**

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Question	Answer	Marks
8(c)(iii)	mass not uniformly distributed along length **or** more mass at the one end	**B1**
8(c)(iv)	(Γ=) 80×0.90	**C1**
	72 N m	**A1**
8(c)(v)	moment / 0.54 **or** 209 (N) **or** 41.1 / 0.54	**C1**
	76 N	**A1**
	downwards	**B1**

Question	Answer	Marks
9(a)	sinusoidal voltage-time graph labelled a.c. drawn	**B1**
	voltage-time labelled d.c. graph with horizontal, non-zero line	**B1**
	an a.c. varies with time **or** an a.c. changes direction / polarity (at regular time intervals) **or** a d.c. is constant with time **or** d.c. is never negative	**B1**
9(b)(i)	(I =) P / V **or** 60 / 240	**C1**
	0.25 A	**A1**
9(b)(ii)	(R =) V / I **or** 240 / 0.25	**C1**
	960 Ω	**A1**
9(b)(iii)	any **two** from: if one lamp blows the others stay lit can be operated separately each lamp has the correct voltage across it **or** lamps glow brightly / normally	**B2**

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Question	Answer	Marks
9(b)(iv)	(number of units =) $5 \times 60 \times 5.5 \times 365 / 1000$ **or** 600 **or** 602.25 **or** 18(.07)	**C1**
	\$90 **or** \$90.34	**A1**
9(c)(i)	cell, lamp and ammeter in series **and** no other components	**B1**
	voltmeter in parallel with lamp	**B1**
9(c)(ii)	(in this circuit) the resistance is (very much) smaller	**B1**
	(metal) filament is cooler	**B1**

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