



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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This document consists of **11** printed pages.

PUBLISHED**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 <i>n</i> responses (e.g. State two reasons ...): • 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.

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
	$8.3 \times 10^{-4} \text{ m}^3$ 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

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 $\sin(45^\circ) / 1.6$ or $0.71 / 1.6$ or 0.44 or $(r =) 21^\circ$	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 <u>casing</u>	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 $\times$ 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)	$4.9 \times 10^5 \text{ N}$	B1
7(d)(i)	(hydrostatic) pressure in a liquid increases with depth or weight of oil (above piston 2) increases	B1
7(d)(ii)	$(\Delta P =) h\rho g$ 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)	$F \times \text{distance / displacement}$	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 <u>resultant</u> moment	B1
8(b)(ii)	equipment shown in diagram (e.g. rule, two loads, pivot)	B1
	<u>what is done</u> to achieve <u>balance</u> (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

Question	Answer	Marks
8(c)(iii)	mass not uniformly distributed along length or more mass at the one end	B1
8(c)(iv)	$(\Gamma =) 80 \times 0.90$	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

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