



Cambridge O Level

PHYSICS**5054/21**

Paper 2 Theory

October/November 2022**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 **15** 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.

PUBLISHED**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.

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Question	Answer	Marks
1(a)	measure length / attach marker	B1
	attach load and measure new length and calculate extension or attach load and read extension (using marker) against zeroed rule	B1
	obtain a new result for different load or use of rule(r) or calculation of extension explained	B1
1(b)(i)	straight line of positive gradient from origin and for at least half of the drawn line	B1
	curve of increasing gradient starting at end of straight line and never becomes vertical	B1
1(b)(ii)	P marked where the gradient starts to change	B1
1(c)	($x =$) $0.014 \times 5.5 / 3.5$ or extension is directly proportional to load	C1
	0.022 m	A1

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Question	Answer	Marks
2(a)	(change in g.p.e.=) mgh or $0.12 \times 10 \times 0.45$	C1
	0.54 J	A1
2(b)	k.e. = $\frac{1}{2}mv^2$ or $0.54 = \frac{1}{2} \times 0.12 \times v^2$	C1
	$(v =) \sqrt{2gh}$ or $\sqrt{2 \times 10 \times 0.45}$ or $v^2 = 2 \times 0.54 / 0.12$ or $v^2 = 9$	C1
	3.0 m / s	A1
2(c)(i)	not enough (kinetic) energy (at C) to travel beyond D / to top of circle or more g.p.e. needed originally to travel beyond D / to top of circle or g.p.e. gained cannot be greater than original g.p.e. (transferred to k.e)	B1
2(c)(ii)	it travels back down to C and returns to A	B1

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Question	Answer	Marks
3(a)	($Dp =$) $h\rho g$ or $0.57 \times 1.4 \times 10^4 \times 10$	C1
	8.0×10^4 or 7.98×10^4 or $1.0 \times 10^5 + (0.57 \times 1.4 \times 10^5 \times 10)$	C1
	1.8×10^5 Pa	A1
3(b)(i)	(air molecules) speed up	B1
	(they) hit the liquid surface harder or hit the liquid surface more often	B1
	(increased / extra) force on (surface of liquid) or air pressure increases	B1
3(b)(ii)	(as the liquid moves / as air volume increases) difference between liquid levels / h increases	B1
	(eventually) pressures balance / become equal / stay balanced	B1

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Question	Answer	Marks
4(a)	electromagnetic (waves) or components of electromagnetic spectrum	B1
4(b)(i)	number of oscillations / cycles / wavelengths	B1
	per unit time	B1
4(b)(ii)	gamma rays	B1
4(c)(i)	X-rays directed towards body part with (suspected) broken bone	B1
	X-rays pass through flesh but not (to same extent) through bones	B1
	image produced by digital / electronic / CCD / CMOS detector	B1
4(c)(ii)	X-rays (may) cause cancer / cell mutation / birth defect / miscarriage or X-rays show the bone structure rather than foetal development or image would not be clear	B1

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Question	Answer	Marks
5(a)(i)	$3.2 \times 10^{-19} / (-)1.6 \times 10^{-19}$ or 2 more protons than electrons shown by charges	B1
	(2 + 2 =) 4	B1
5(a)(ii)	${}^9_4\text{Be}$	B1
5(b)	a form of an element	B1
	with a particular number of neutrons / nucleons	B1
5(c)	electrons and nucleus opposite charged or electrons negative and nucleus positive	B1
	(electrostatic / electric) force of attraction or unlike charges attract	B1

Question	Answer	Marks
6(a)	soft iron	B1
6(b)(i)	$(P =) VI$ or 220×39	C1
	$8.6 \times 10^3 \text{ W}$	A1
6(b)(ii)	$(Q =) It$ or 39×4.5 or $39 \times 4.5 \times 60$ or $39 \times 4.5 \times 60 \times 60$ or $39 \times 4.5 \times 3600$	C1
	180 or 11 000 or $39 \times 4.5 \times 60 \times 60$ or $39 \times 4.5 \times 3600$	C1
	$6.3 \times 10^5 \text{ C}$	A1
6(c)	resistance increases with temperature or resistance lower (because of (low / ambient) temperature)	B1

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Question	Answer	Marks
7(a)	acceleration / increase in speed and gravity / weight mentioned	B1
	air resistance / friction increases (with speed)	B1
	terminal / constant velocity reached or air resistance (becomes) equal to accelerating force	B1
7(b)	(distance travelled =) area under the graph or $(x =) \frac{1}{2}(u + v)t$ or $\frac{1}{2} \times 15.2 \times 4.0$	C1
	$35 - (\frac{1}{2} \times 15.2 \times 4.0)$ or 30.4 or 30	C1
	4.6 m	A1
7(c)(i)	(magnitude of deceleration =) gradient or Dv / Dt or $15.2 / 4.0$ or equivalent numbers (from graph) in same ratio	C1
	$15.2 / 4.0$ or equivalent numbers in same ratio	C1
	$3.8 \text{ m} / \text{s}^2$	A1
7(c)(ii)	$(F =) ma$ or $(46 + 9.0) \times 3.8$ or 55×3.8	C1
	210 N	A1
7(c)(iii)	<u>from</u> kinetic energy (and from gravitational potential energy)	B1
	<u>to</u> thermal energy and no intermediate energy	B1
7(d)	due to his mass or mass mentioned	B1
	(his) mass resists a change to its state of motion	B1

Question	Answer	Marks
8(a)(i)	vertical biconcave lens shape along P	B1
8(a)(ii)	on right of P, middle ray continues in straight line	B1
	other two rays diverge from middle ray	B1
8(b)(i)	continuations of the three rays meet at a point and on continuation of middle ray	B1
	meeting point within eye and rays strike back of eye at different places	B1
8(b)(ii)	image is sharp / focused / not blurred	B1
8(b)(iii)	light diverges before entering eye or meeting point now on the back of the eye	B1
8(c)(i)	one point on principal axis 4.0 cm from the centre of the lens indicated	B1
	any two rays from: paraxial ray from tip of object to lens and seems to come from left-hand principal focus after refraction ray from tip of object towards right-hand principal focus (until lens) and paraxial after refraction ray from tip of object <u>reaching</u> the centre of the lens	B2
	image marked at correct intersection	B1
8(c)(ii)	virtual and light only seems to come from the image or light does not pass through image	B1
8(c)(iii)	E marked on the right of the dashed line	B1
8(c)(iv)	height of candidate's I / 3.5	C1
	$0.30 \leq \text{magnification} \leq 0.50$	A1

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Question	Answer	Marks
9(a)	always positive or never negative or direction does not change	B1
	constant value or size does not change	B1
9(b)(i)	$(I =) V / R$ or $12 / (20 + 28)$ or $12 / 48$	C1
	0.25 A	A1
9(b)(ii)	YZ in magnetic <u>field</u> or magnetic <u>field</u> between poles (of magnet)	M1
	(electric) current in YZ or interacts with field of current / YZ	A1
9(b)(iii)	downwards; middle, right-hand box ticked i.e. towards N ☐ towards S ☐ towards Y ☐ towards Z ☐ downwards ☒ upwards ☐	B1
9(b)(iv)	current from Z to Y page / into page and magnetic field left to right	B1
	(Fleming's) left-hand rule / other appropriate rule mentioned / described	B1

Question	Answer	Marks
9(c)(i)	$1 / R_T = 1 / R_1 + 1 / R_2$ or $(R_T =) R_1 R_2 / (R_1 + R_2)$ or $1 / R_T = 1 / 20 + 1 / 30$ or $1 / R_T = 5 / 60$ or $1 / R_T = 1 / 12$ or $(R_T =) 20 \times 30 / (20 + 30)$	C1
	12	C1
	40 W	A1
9(c)(ii)	resistance decreases or resistance is less (with S_2 closed)	B1
	current increases and force increases	B1
9(c)(iii)	1.5	B1