

Cambridge O Level

PHYSICS**5054/21**

Paper 2 Theory

May/June 2024

MARK SCHEME

Maximum Mark: 80

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 **10** 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 descriptions 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 '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.

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)(i)	P marked in region $t = 0\text{--}0.8\text{ s}$ or in region $1.6\text{--}2.0\text{ s}$	B1
	Q marked between 2.0 and 2.5 s	B1
1(a)(ii)	tangent drawn at X	B1
	(speed =) d/t in any form numerical or algebraic	C1
	$1.9\text{--}2.4\text{ m/s}$	A1
1(b)	$v_A < v_C < v_D < v_B$	B1
1(c)	(work done by) gravity / weight / gravitational attraction	B1
	from gravitational potential energy (store)	B1
	to kinetic energy (store)	B1
1(d)	arrow upwards at D	B1

Question	Answer	Marks
2(a)(i)	particles hit piston / sides of container	B1
	each hit creates a small force or force on unit area is pressure or particles momentum changes / direction changes or many hits per second	B1
2(a)(ii)	particles move faster / have higher <u>kinetic</u> energy / more momentum	B1
	more hits / sec. / more frequent hits / larger momentum change per second / larger force on each hit	B1

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Question	Answer	Marks
2(b)	(force =) $P \times A$ in any form numerical or algebraic with any pressure	B1
	6.0×10^5 (N)	B1
2(c)(i)	(momentum =) mv in any form numerical or algebraic	C1
	8.4×10^5 (kg m/s)	A1
2(c)(ii)	(time =) $mv (-mu) / F$ or $(t =) v (-u) / a$ and $F = ma$	C1
	1.4s	A1

Question	Answer	Marks
3(a)	<u>free / delocalised</u> electrons or electrons move	B1
	electrons / thermal energy move <u>from hot area to cold area</u> or electrons hit by or hit particles (of metal) or vibrations / collisions between particles passes on energy	B1
3(b)(i)	273 (K)	B1
3(b)(ii)	latent heat (required) or (particles need) more potential energy / energy supplied is being used to weaken forces between particles	B1
	particles further apart OR <u>all</u> the energy is used to weaken forces OR kinetic energy of particles stays constant	B1
3(b)(iii)	($Q =$) mcT in any form	C1
	47000 (J)	A1
3(b)(iv)	($P =$) E / t in any form	C1
	390 (W)	A1

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Question	Answer	Marks
3(b)(v)	(liquid) water has a higher specific heat capacity; water has stronger bonds	B1

Question	Answer	Marks
4(a)(i)	number of (complete) waves (passing a point) per second	B1
4(a)(ii)	$(V =) f \lambda$ in any form	C1
	330 m / s	A1
4(a)(iii)	ANY one from cleaning, prenatal and other medical scanning, sonar, calculation of depth or distance	B1
4(b)(i)	longitudinal wave - oscillation backwards and forwards / in direction of travel of wave	B1
	transverse wave - oscillation at right angles to (direction of travel of) wave	B1
	diagram of each type	B1
4(b)(ii)	earthquake (waves) or other correct source which is a single source that generates both types of wave, e.g. lightning	B1
4(c)	long wavelengths bend around hill and short wavelengths do not bend	B1
	(due to) diffraction	B1

Question	Answer	Marks
5(a)	correct symbol; 	B1
5(b)(i)	correct curvature	B1
5(b)(ii)	(at higher current / voltage) temperature increases	B1
	(at higher current / voltage) resistance increases	B1

Question	Answer	Marks
5(c)	$(I =) V / R$ in any form	C1
	4 (A) or 6 (A) seen or $R_{\text{total}} = 24 (\Omega)$	C1
	10 (A)	A1
5(d)(i)	any integer between and including 12 and 19 (A)	B1
5(d)(ii)	fuse does not melt / blow or circuit does not shut down aaw	B1
	quickly enough or when there is a fault or when the current is large / dangerous	B1
5(d)(iii)	<u>when fuse melts</u> nothing is live / electrocution not possible OR supply of voltage is cut OR voltage is supplied by live wire.	B1

Question	Answer	Marks
6(a)(i)	turns faster / stronger force / more powerful (motor) / larger moment / larger turning effect	B1
6(a)(ii)	correct current direction shown in coil and magnetic field left to right / N to S	B1
6(a)(iii)	(field and current cause) <u>force</u> on left side or <u>force</u> on right side OR coil becomes a magnet	C1
	force upwards on left side and force downwards on right side OR top face of coil is a N pole / bottom face is a S pole	A1
6(b)(i)	circles close to and around each wire	B1
	correct overall shape with stronger field between wires and splaying outwards	B1
	correct direction of field on at least one line and none wrong	B1

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Question	Answer	Marks
6(b)(ii)	current in one wire causes magnetic field at the other or field between wires stronger	B1
	a current experiences a force in a magnetic field or wire(s) move away from region of strongest magnetic field	B1

Question	Answer	Marks
7(a)(i)	uranium-235 and uranium-238	B1
7(a)(ii)	thorium(-236) and uranium-238	B1
7(a)(iii)	thorium(-236) and protactinium(-236)	B1
7(b)(i)	(radiation) that is natural / present without a source	B1
7(b)(ii)	400	B1
7(b)(iii)	any halving seen, e.g. 400→200 or 200→100 or 420→210	C1
	120	A1
7(b)(iv)	(emission / radioactivity is) random / fluctuates / varies	B1
7(c)	irradiation and sterilisation both γ -radiation	B1
	paper thickness beta radiation	B1

Question	Answer	Marks
8(a)	Venus on left of Sun on dashed line	B1
	Earth approximately 30% round orbit (106°)	B1
	Mercury (1=) 1/4 round orbit i.e. approx. vertically below Sun	B1
8(b)(i)	smaller mass (of mercury)	B1
8(b)(ii)	(mass =) 10 (kg) clearly seen	C1
	98 (N)	A1
8(c)	a (large, natural) object that orbits a planet	B1
8(d)	becomes a red giant / increase in size	B1
	forms a planetary nebula	B1
	becomes a white dwarf	B1