CAMBRIDGE
International Education

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.

Cambridge International is publishing the mark schemes for the May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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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 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.

Question	Answer	Marks
1(a)(i)	P marked in region t = 0–0.8 s **or** in region 1.6–2.0 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**
	1.9–2.4 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**

Question	Answer	Marks
2(b)	(force =) P × 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**
	1.4 s	**A1**

Question	Answer	Marks
3(a)	free / delocalised electrons **or** electrons move	**B1**
	electrons / thermal energy move from hot area to cold area **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 all the energy is used to weaken forces OR kinetic energy of particles stays constant	**B1**
3(b)(iii)	(*Q* =) *mcT* in any form	**C1**
	47 000 (J)	**A1**
3(b)(iv)	(*P* =) *E* / *t* in any form	**C1**
	390 (W)	**A1**

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_{total} = 24 (Ω)	**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**

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**