



Cambridge O Level

PHYSICS

5054/21

Paper 2 Theory

October/November 2020

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 **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 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 '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)	accelerating or increasing speed	B1
	decreasing acceleration or speed increasing at a decreasing rate or reaches a constant speed	B1
1(a)(ii)	<u>initially</u> acceleration is due to force of gravity / weight (only) or force of gravity / weight larger than air resistance from ($t = 0$ to ≈ 7 s)	B1
	air resistance increases (with speed)	B1
	resultant force decreases / becomes zero or forces balance or air resistance equals weight	B1
1(b)	two different pairs of co-ordinates from <u>straight-line</u> section of graph seen	C1
	correct use of co-ordinates in a division	C1
	48 – 52 m / s	A1

Question	Answer	Marks
2(a)	it / a scalar does not have a <u>direction</u>	B1
2(b)	<i>displacement</i> and <i>force</i> underlined	B1
2(c)(i)	direction (of motion) is changing	B1
	velocity is changing (with time) or it is accelerating (which requires a resultant force)	B1
2(c)(ii)	gravitational attraction / field of the earth	B1

Question	Answer	Marks
3(a)(i)	($\Gamma = $) $Fx_{\perp r}$ or 25×0.72	C1
	18 N m	A1
3(a)(ii)	(WD =) Fx_{\parallel} or $F\pi r / 2$ or $25 \times 4.5 / 4$ or 25×1.13	B1
	28 J	B1
3(b)	moment due to force P is greater	B1
	distance of X to hinge is greater than distance from where force F acts	B1

Question	Answer	Marks
4(a)(i)	it decreases	B1
4(a)(ii)	it does not change	B1
4(b)(i)	(c =) $\sin^{-1}(1 / n)$ or $\sin^{-1}(1 / 1.6)$ or $\sin^{-1}(0.625)$	C1
	39°	A1
4(b)(ii)	reflected ray at Z and $i = r$ and no refracted ray	B1
	ray strikes vertical face perpendicularly and undeviated in air	B1

Question	Answer	Marks
5(a)	X, Y and Z to be two (or three) different metals	B1
5(b)(i)	(output / thermoelectric) electromotive force / e.m.f. / voltage	B1
5(b)(ii)	linearity indicates whether the output (voltage) is directly proportional to something	B1
	directly proportional to the temperature difference (between the junctions)	B1

Question	Answer	Marks
5(c)	any two from: measures rapidly varying temperatures / quick response / small heat capacity electrical output / output can be fed directly into a computer measures high temperatures / large range robust precise location remote reading	B2

Question	Answer	Marks
6(a)	<u>iron</u> core and two coils wrapped around core	B1
	input and output clear and more turns on secondary / output coil	B1
6(b)	magnetic field mentioned	B1
	alternating current (a.c.) produces magnetic field that varies	B1
	core channels magnetic field to secondary coil and electromagnetic <u>induction</u>	B1
6(c)	less energy transferred to thermal energy in wires	B1
	(because) smaller current (for a given power)	B1

Question	Answer	Marks
7(a)	joining together of (smaller) nuclei / hydrogen nuclei	B1
	releasing (large amounts of) energy	B1
7(b)	hydrogen reacts to produce helium	B1

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Question	Answer	Marks
7(c)(i)	gravitational potential energy to internal energy / kinetic energy	C1
	gravitational potential energy to kinetic energy to internal energy / light	A1
7(c)(ii)	energy emitted by (infrared / electromagnetic) radiation	B1
	energy loss is equal to / balances energy from fusion reaction	B1

Question	Answer	Marks
8(a)	(normal) force per unit area or (normal) force \div area	B1
8(b)(i)	$(p =) h\rho g$ or $25 \times 1000 \times 10$	C1
	2.5×10^5 Pa	A1
8(b)(ii)	1.0×10^5 Pa	B1
8(c)(i)	pressure increases with depth	B1
	pressure / force on outer face greater than that on inner face	B1
	resultant force on piston	B1
8(c)(ii)	pressure increases and more collisions (of molecules with walls of cylinder)	B1
	more frequent collisions or more collisions per unit area	B1
	molecules have less distance to travel between collisions (with walls) or molecular density greater	B1
8(c)(iii)	<u>curve</u> with negative gradient and gradient of decreasing magnitude	B1
	<u>negative gradient</u> at V_0 and approaches x-axis asymptotically	B1
8(c)(iv)	atmospheric pressure varies or temperature varies	B1

Question	Answer	Marks
8(c)(v)	molecules touching or (very) close together (and cannot be forced closer)	B1
	(repulsive) forces between molecules (very) large	B1

Question	answer	Marks
9(a)	(oil) hotter initially or cooler finally	B1
	temperature difference (between oil and freezer) decreases	B1
	loses energy faster when hotter or more slowly when cooler	B1
9(b)	molecules move more slowly or less <u>kinetic</u> energy or less internal energy	B1
	level decreases and oil contracts / volume of oil decreases	B1
	oil / liquid contracts more than glass / solid or molecules move closer	B1
9(c)(i)	−10°C	B1
9(c)(ii)	(attractive intermolecular) force between molecules or liquid solidifies	B1
	(intermolecular) potential energy decreases (as molecules move closer)	B1
	thermal energy lost (to freezer) is potential energy lost or latent heat lost	B1
9(d)(i)	($Q =$) ml_f or $0.045 \times 5.7 \times 10^4$	C1
	2.6×10^3 J	A1
9(d)(ii)	0.36 J / s or 0.36 W	B1
9(e)	specific heat capacity of liquid oil is smaller (than of oil in solid state)	B1
	the temperature decreases more quickly (in liquid state)	B1

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Question	Answer	Marks
10(a)(i)	(resistance) is <u>directly</u> proportional to length	B1
10(a)(ii)	(resistance) is <u>inversely</u> proportional to (cross-sectional) area	B1
10(b)	($R =$) $6.4 \times 7.5 \times 10^{-4} / 100$ or 4.8×10^{-n} (n is an integer)	C1
	$4.8 \times 10^{-5} \Omega$	A1
10(c)(i)	energy / work done in driving a charge round a circuit or energy transferred to electrical energy	B1
	energy / work done per unit charge or energy / charge	B1
10(c)(ii)	($R =$) $6.4 + 9.6$ or 16	C1
	($V =$) $1.2 \times 6.4 / 16$ or current = $1.2 / 16$ or current = 0.075	C1
	0.48 V	A1
10(c)(iii)	trace moves vertically away from centre line	B1
	moves distance of 2.4 cm	B1
	remains horizontal or distance moved by trace directly proportional to distance moved by jockey or comment about tape	B1
10(d)(i)	the battery lasts twice as long as the single cell	B1
10(d)(ii)	no effect or trace moves in an identical manner	B1
	e.m.f. of identical cells in parallel equals the e.m.f. of a single cell	B1