Cambridge Assessment International Education

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.

Cambridge International is publishing the mark schemes for the October/November 2020 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 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)	initially 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 straight-line 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 direction	**B1**
2(b)	*displacement* **and** *force* 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)	(Γ =) $Fx_{\perp r}$ **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)	iron 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 induction	**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**

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 ÷ 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)	curve with negative gradient **and** gradient of decreasing magnitude	**B1**
	negative gradient 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 kinetic 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**

Question	Answer	Marks
10(a)(i)	(resistance) is directly proportional to length	**B1**
10(a)(ii)	(resistance) is inversely 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**