Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/21**

Paper 2 Theory **October/November 2021**

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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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.

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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.

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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)	(p =) F / A or 2000 / (2 × 0.040) **or** 50 000 (P–a)	**C1**
	25 000 Pa	**A1**
1(b)(i)	symmetrical left-to-right **or** symmetrical front-to-back **or** bench is stable	**B1**
	because centre of mass is in middle (horizontally) **or** centre of mass is within the base	**B1**
1(b)(ii)	(moment =) Fx **or** Wy **or** 2000 × (1.1 – 0.25) **or** 2000 × 0.85 clockwise moment = anticlockwise moment **or** Fx = Wy **or**	**C1**
	Fx = 2000 × (1.1 – 0.25) **or** Fx = 2000 × 0.85 **or** (F =)2000 × 0.85 / 0.25	**C1**
	6800 N	**A1**

Question	Answer	Marks
2(a)	800 N **c.a.o.**	**B1**
2(b)(i)	(F =) ma **or** 80 × 0.50	**C1**
	40 N	**A1**
2(b)(ii)	840 N	**B1**
2(c)	increasing gradient from origin to t = 4.0 s	**B1**
	decreasing gradient from end of first curve	**B1**
	line horizontal at origin **or** at t = 8.0 s (and beyond)	**B1**

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Question	Answer	Marks
3(a)	(nuclear) fusion	**B1**
3(b)(i)	electromagnetic (waves)	**B1**
	produced by hot objects **or** infrared (radiation)	**B1**
3(b)(ii)	3.0×10^8 m / s	**B1**
3(b)(iii)	(t =) x / v **or** $1.5 \times 10^{11} / 3.0 \times 10^8$	**C1**
	500 s	**A1**
3(c)	white surfaces are (good) reflectors / poor absorbers of radiation	**B1**
	less thermal energy absorbed / wearer stays cooler	**B1**

Question	Answer	Marks
4(a)	chemical (energy)	**B1**
4(b)(i)	energy cannot be created **and** energy cannot be destroyed	**B1**
	energy can be transferred from one form into another	**B1**
4(b)(ii)	some chemical energy is transferred to thermal energy (sound and light)	**B1**
	thermal energy lost to air / water / buildings / equipment	**B1**
4(c)	any **one** from: carbon dioxide produced; carbon monoxide produced; global warming; greenhouse gases nitrous oxide produced; sulfur dioxide produced; acid rain; rise in sea-level	**B1**

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Question	Answer	Marks
5(a)(i)	electrons are transferred from rod (on to cloth)	**B1**
5(a)(ii)	it / the cloth becomes negatively charged	**B1**
5(b)(i)	more negative (than positive) signs on left of sphere **and** more positive (than negative) signs on right	**M1**
	equal numbers of positive and negative signs **and** six or fewer	**A1**
5(b)(ii)	negative charges/electrons (on sphere) attracted by positive charges (on rod)	**B1**
	force of attraction greater than repulsion (of positive charges) **or** distance between negative (on sphere) and positive charges (on rod) less than distance between positive and positive	**B1**

Question	Answer	Marks
6(a)	1.5 V	**B1**
6(b)(i)	work done / energy transferred when charge passes through a component	**C1**
	$\frac{\text{work done / energy transferred}}{\text{charge passed}}$	**A1**
6(b)(ii)	4.5 – 2.5 **or** 2.0 (V) seen	**C1**
	(R =) V / I **or** 2.5 / (2.0 / 28) **or** R / 28 = 2.5 / 2.0	**C1**
	35 Ω	**A1**

Question	Answer	Marks
7E(a)	magnetic field lines cut the solenoid / coils **or** changing magnetic field in solenoid	**B1**
	an electromotive force / e.m.f. is induced	**B1**
	electromotive force / e.m.f. produces the current	**B1**
7E(b)	negative / opposite / reversed current / deflection / reading	**B1**
	negative e.m.f. / voltage (induced) **or** magnetic field cut in opposite direction **or** magnetic field changes in opposite sense / decreases (owtte)	**B1**
7O(a)	NOR (gate)	**B1**
7O(b)(i)	lower logic gate has an input of logic level 1 (and so its output / Y is 0) **or** the output X has a logic level 1 and so the inputs must both be 0 (Y is an input to the upper NOR gate)	**B1**
7O(b)(ii)	X changes to 0 **and** Y changes to 1.	**B1**
7O(b)(iii)	both X and Y stay at the new values **or** neither X nor Y changes	**B1**
7O(b)(iv)	the output shows which terminal (P or Q) last had the value 1.	**B1**

Question	Answer	Marks
8(a)(i)	magnetic field **or** magnet	**B1**
8(b)(i)	the current (in coil continually) reverses (direction) **or** the force (on the coil continually) reverses	**B1**
	the current (in the coil continually) reverses (direction) **and** the force (on the coil continually) reverses	**B1**

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Question	Answer	Marks
8(b)(ii)	cone moves forwards **and** air is compressed / hits (air) molecules	**B1**
	cone moves backwards **and** rarefaction produced / molecules sucked back	**B1**
	(air) molecules vibrate **or** production of compressions and rarefactions continues	**B1**
8(b)(iii)	vibration direction is parallel to energy travel / propagation direction	**B1**
	in transverse wave, vibration direction is perpendicular to propagation / energy travel direction	**B1**
8(b)(iv)	(time period =) 0.0050 (s) **or** 1 / 0.0050 **or** 200 (times per second)	**C1**
	400 (times per second)	**A1**
8(b)(v)	(λ =) c / v **or** 340 / 200	**C1**
	1.7 m	**A1**
8(c)(i)	decreases / less loud / quieter	**B1**
	amplitude of sound / vibration decreases **or** (maximum) force on coil decreases	**B1**
8(c)(ii)	(pitch) stays the same / unchanged **and** no change to frequency / time period	**B1**

Question	Answer	Marks
9(a)(i)	molecules with similar / slightly smaller packing density **and** most molecules touching	**B1**
	random arrangement	**B1**
9(a)(ii)	molecules (of gas) further apart	**B1**
	(repulsive) forces between molecules (much) smaller	**B1**

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Question	Answer	Marks
9(a)(iii)	any **two** of: move faster / greater kinetic energy move further apart forces (slightly) smaller	**B2**
9(b)(i)	(ice point) where ice and water are in equilibrium **or** melting point / temperature of ice	**B1**
	(steam point) where water and steam (water vapour) are in equilibrium **or** boiling point / temperature of water	**B1**
9(b)(ii)	0 (°C) marked at level of thread in ice-water mixture **or** at ice point **or** 100 (°C) marked at level of thread in water-steam mixture **or** above boiling water **or** at steam point	**B1**
	interval between marks divided into 100 divisions	**B1**
9(c)(i)	it / range decreases	**B1**
	(a greater mass) expands more / further along the (capillary) tube (for same temperature increase) **or** range / it is inversely proportional to mass	**B1**
9(c)(ii)	it / range increases	**B1**
	range / it is proportional to square of diameter **or** more expansion / greater volume increase needed (for thread to reach end of the tube)	**B1**
	greater temperature increase needed (for greater volume increase)	**B1**

Question	Answer	Marks
10(a)	same number of protons (in nucleus) **or** same proton number **or** same number of electrons in a neutral atom **or** same atomic number	**B1**

Question	Answer	Marks
10(b)	one more proton	**B1**
	one fewer neutron	**B1**
	one more electron	**B1**
10(c)(i)	18 counts / minute	**B1**
10(c)(ii)	any **two** of: rocks / building (materials) / coal / radon space / Sun / cosmic rays weapons testing / nuclear waste	**B2**
10(c)(iii)	one count rate – 18 **or** one count rate – 18 calculated e.g. 74 – 18 **or** 56	**B1**
	one count rate – 18 halved **or** one count rate – 18 reduced by factor 2^N e.g. 56 / 2 **or** 28 **or** 56 / 4 **or** 14	**B1**
	one count rate – 18 reduced by factor 2^N + 18 e.g. 28 + 18 **or** 46 **or** 14 + 18 **or** 32	**B1**
	65 hours	**B1**
10(c)(iv)	(radioactive decay is) random	**B1**
	in time **or** impossible to predict when a beta-particle is emitted	**B1**
10(d)	correct upward curved path between plates	**M1**
	no more than 1 cm straight at beginning	**A1**

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