Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/21**

Paper 2 Theory **May/June 2022**

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)(i)	longer	**B1**
	thinner **or** smaller (cross-sectional) area	**B1**
1(a)(ii)	elastic potential **or** strain (energy)	**B1**
1(b)(i)	sum of / total / net / resultant moment is zero	**M1**
	when (the object is) in equilibrium	**A1**
1(b)(ii)	distance of rubber band to pivot is smaller than the distance of the mass (to pivot)	**B1**
1(b)(iii)	$4 \times 18 = F \times 2$	**C1**
	36 N	**A1**
1(b)(iv)	greater **and** the weight (of XY) contributes to the (clockwise) moment/turning effect **or** the moment of the rubber band force is larger	**B1**

Question	Answer	Marks
2(a)	(K.E. =) $\frac{1}{2}mv^2$ numerical or algebraic	**C1**
	$0.5 \times 60\,000 \times 12^2$	**C1**
	4 300 000 J	**A1**
2(b)(i)	reduces global warming	**B1**
2(b)(ii)	wind not always blowing **or** wind not reliable / not available in some places **or** smaller land area (for same power) **or** less harm to birds **or** less visual effect **or** no interference with tv / radar signals	**B1**

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Question	Answer	Marks
2(c)(i)	(amount of energy of a device of power) 1 kW used for 1 hour	**B1**
2(c)(ii)	23 000 kg	**B1**
2(d)	solar, tidal, geothermal, hydro(electric), biomass, wave	**B1**

Question	Answer	Marks
3(a)	amount (of heat / energy) needed to change the state from solid to liquid	**M1**
	without a change in temperature	**A1**
3(b)(i)	rising from 100 °C **and** flat section at 250 °C	**B1**
	rising from flat section to 400 °C / longer at 250 °C	**B1**
3(b)(ii)	longer flat section **or** longer time at 250 °C	**B1**
	needs more energy / heat to melt	**B1**

Question	Answer	Marks
4(a)(i)	correct *i* and *r* marked	**B1**
4(a)(ii)	reflection shown at approximately the correct angle **or** ray along surface	**B1**
4(a)(iii)	correct refraction as red light enters prism showing less refraction than blue light	**B1**
	correct refraction as red light emerges from left side of prism	**B1**

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Question	Answer	Marks
4(b)(i)	angle of incidence	**B1**
	smallest angle when ray totally internally reflects **or** (when ray is) just internally reflected **or** when ray (refracted/emerges) along surface / at 90° to normal / angle of refraction is 90° **OR** angle of refraction when the angle of incidence is 90° B2	**B1**
4(b)(ii)	sin c = 1 / n in any form numerical or algebraic	**B1**
	42°	**B1**

Question	Answer	Marks
5(a)	brush / carbon	**B1**
	split-ring **or** commutator	**B1**
5(b)(i)	faster **or** greater turning effect	**B1**
5(b)(ii)	goes backwards / turns backwards / reverses	**B1**
5(c)(i)	speeds up **and** slows down (when turned on / off)	**B1**
	reaches a steady speed / terminal speed / maximum speed **or** slows down but never to rest **or** cycle continuously repeats	**B1**
5(c)(ii)	same top / constant speed **or** constant speed / maximum speed for a longer time **or** drops to a lower speed / comes to rest	**B1**

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Question	Answer	Marks
6(a)(i)	correct symbol 2 or 3 arrows onto resistor symbol	**B1**
6(a)(ii)	resistance (of LDR) decreases	**B1**
	(voltmeter reading) increases **and** more current in circuit **or** potential divider argument comparing voltage across resistor / LDR / voltage of cell	**B1**
6(b)(i)	$V=IR$ seen in any form **or** (voltage across 4 or 5 Ω) 2.4×4.0 seen	**B1**
	(I =) 9.6 / 5 = 1.9(2 A)	**B1**
6(b)(ii)	(current in 6.0 Ω =) 4.3(2) (A) **or** (voltage across 6 Ω=) 25.8 or 25.9(2) (V) seen **or** resistance of parallel resistors = 20 / 9 (Ω) **or** total resistance = $8\frac{2}{9}$ Ω)	**C1**
	35 V	**A1**

Question	Answer	Marks
7(a)(i)	85 m	**B1**
7(a)(ii)	(speed =) d / t in any form algebraic or numerical	**C1**
	2.1 m / s	**A1**
7(b)(i)	displacement involves direction **or** is a vector	**B1**
7(b)(ii)	5 m shown on dotted line	**B1**

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Question	Answer	Marks
7(b)(iii)	length of diagonal 9.2 (cm) $\sqrt{30 \times 30 + 35 \times 35}$	**B1**
	46 m 46 m	**B1**
7(b)(iv)	39–42° **or** 318–320°	**B1**
7(b)(v)	(average) velocity = (change in) displacement / time **or** (average) velocity is displacement per unit time **or** rate of change of displacement	**B1**
7(b)(vi)	(size of) displacement < distance in **(a)(ii)** or distance covered is less (than 85 m / in **(a)(ii)**)	**B1**
7(c)	air resistance **and** weight / gravitational force mentioned	**B1**
	as speed increases air resistance increases	**B1**
	resultant / net force decreases **or** acceleration decreases	**B1**
	(eventually) air resistance = weight (at terminal velocity) / resultant force is zero	**B1**
	(at terminal velocity / eventually) zero acceleration / constant speed	**B1**

Question	Answer	Marks
8(a)	force per unit (cross-sectional) area **or** force / area	**B1**
8(b)(i)	pressures the same (at either end of water) **or** left side is at atmospheric pressure	**B1**
8(b)(ii)	pressure is large(r) in gas than atmospheric pressure	**B1**

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Question	Answer	Marks
8(b)(iii)	pressure caused by (40 cm) water equals (excess) pressure caused by gas **or** gas pressure = atmospheric pressure + pressure due to water	**B1**
8(c)	40 (cm) **or** 0.40 (m) water seen	**C1**
	$P = \rho g h$ numerical or algebraic	**C1**
	$0.4 \times 10 \times 1000$ **or** 4000 (Pa) **or** 400 000	**C1**
	104 000 Pa	**A1**
8(d)	molecules move faster / have more K.E.	**B1**
	molecules hit (surface of) the water	**B1**
	more hits per second **or** more frequent hits	**B1**
	larger force / larger pressure	**B1**
8(e)(i)	pressure (much) bigger than atmospheric / extra pressure (above atmospheric) of 1.5×10^5 Pa	**B1**
	(difference in) height of manometer levels needed is too large **or** manometer (tubes) too short / water comes out of manometer	**B1**
8(e)(ii)	(use liquid with) larger density	**B1**

Question	Answer	Marks
9(a)(i)	(nucleus has a) different number of neutrons / mass number / nucleon number	**B1**
	same number of protons / same atomic number	**B1**
9(a)(ii)	not an isotope **and** Q has a different proton number / atomic number	**B1**

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Question	Answer	Marks
9(b)(i)	technetium(–99)	**B1**
9(b)(ii)	only gamma detected outside body	**B1**
	EITHER half-life / 6 hours is short **and** less damage (to others / long term) / loses radioactivity quickly **OR** half-life / 6 hours is long enough for isotope to reach site and be detected / long enough to examine patient / does not need to be replaced	**B1**
9(c)(i)	cosmic rays; rocks; buildings; food and drink etc.	**B1**
9(c)(ii)	weapons tests; nuclear weapons; nuclear power stations; nuclear accidents, e.g. Chernobyl;	**B1**
9(c)(iii)	cancer / kill cells / harm DNA / RNA / cause mutations	**B1**
9(d)(i)	superscript 1 **and** subscript 0	**B1**
9(d)(ii)	neutron	**B1**
9(d)(iii)	in the Sun / star **or** at high temperature	**B1**
9(e)	alpha-particles more easily stopped (than beta)	**B1**
	alpha-particles cause more ionisation (than beta)	**B1**
	deflected in opposite directions (by magnetic field) **or** alpha-particles deflected less (for same speed)	**B1**

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