Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/21**

Paper 2 Theory **May/June 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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Examples of how to apply the list rule

State **three** reasons… [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B

(4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C

(4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D

(4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E

(4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F

(4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G

(5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

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Question	Answer	Marks
1(a)	scale vector diagram showing 12 N, 36 N and correct resultant force in correct direction	**B1**
	38 ± 1 kN	**B1**
	018 ± 3°	**B1**
1(b)(i)	(only in uniform acceleration) same increase / change in speed / velocity **or** has a constant acceleration **or** speed-time graph is a straight line	**B1**
	(only in uniform acceleration) same increase / change in speed / velocity in same time (period) **or** same rate of change of speed / velocity (with time) **or** change in speed / velocity is proportional to time	**B1**
1(b)(ii)	(a =) F / m in any way, algebraic or numerical	**C1**
	0.63–0.66 m / s^2	**A1**

Question	Answer	Marks
2(a)	dull black line 100	**B1**
	dull white 60 **and** shiny white 40	**B1**
2(b)	hot air rises	**B1**
	density of hot air less (than cold air) **or** air expands on heating	**B1**
	hot air rises and cold air falls **or** a complete current described	**B1**

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Question	Answer	Marks
3(a)	(E =) mcT in any form algebraic or numerical	**C1**
	$2 \times 460 \times 450$	**C1**
	$4.1 \times\times 10^5$ J	**A1**
3(b)(i)	any one of: • boiling occurs at one temperature / boiling point **or** evaporation occurs at any temperature / below boiling point • boiling occurs within liquid **or** evaporation occurs on the surface • evaporation increased by draughts, more surface area (and boiling does not)	**B1**
3(b)(ii)	(average) speed / K.E. of molecules decreases (as temperature falls) **or** (molecules) do not have the energy to escape / break bonds	**B1**
	fewer fast / energetic molecules escape **or** (only) fastest / high KE molecules escape	**B1**

Question	Answer	Marks
4(a)(i)	Fig.4.1 transverse **and** Fig.4.2 longitudinal	**B1**
4(a)(ii)	wave drawn with larger wavelength	**B1**
4(a)(iii)	backwards and forwards, left and right, to and fro, vibration parallel to arrow / direction of wave (movement)	**B1**
4(b)	frequency	**B1**
	ultrasound	**B1**
	gamma	**B1**

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Question	Answer	Marks
5(a)	convex **or** converging	**B1**
5(b)	as it enters – refracts (towards normal) **or** changes speed	**B1**
	as it leaves, one of: • bends / refracts away from normal • speed increases • wavelength increases • emerges parallel to the (principal) axis	**B1**
5(c)	either emergent ray R or the ray through F extended to the left of the lens	**B1**
	both ray through F and R shown and image marked at intersection of extended rays	**B1**
5(d)	upright **and** virtual	**B1**

Question	Answer	Marks
6(a)	bar cuts magnetic field (lines / flux) **or** change in magnetic flux (in circuit with ammeter)	**B1**
	emf or current induced	**B1**
6(b)	negative (small)	**B1**
	no reading	**B1**
	no reading	**B1**
6(c)	move bar faster **or** wider magnet	**B1**
6(d)	force downwards (caused by current in magnetic field) **or** force opposes movement / motion	**B1**

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Question	Answer	Marks
7(a)	lower temperature / cooling of thermistor	**B1**
	less light on LDR	**B1**
7(b)(i)	energy / work per unit charge	**B1**
7(b)(ii)	Any 2 from: • voltage across diode • voltage across ammeter • voltage across internal resistance (of battery) • (e.m.f. / voltage of battery =) 5.4 + 0.6 (or larger)	**B2**
7(b)(iii)	(*E* =) *VQ* **or** *VIt* in any form algebraic or numerical	**C1**
	3200 J	**A1**
7(b)(iv)	no current / no ammeter reading **and** diode has been reversed / diode does not conduct / has (very) high resistance / blocks current / reference to current / voltage graph	**B1**

Question	Answer	Marks
8(a)(i)	weight of horse in mid-section of horse **and** labelled	**B1**
	force upwards on at least two legs **and** labelled	**B1**
	force downwards on saddle area labelled *F*	**B1**
8(a)(ii)	forces equal **and** opposite	**B1**
	acts <u>on rider</u> (upwards from horse)	**B1**
8(b)(i)	cross at centre of left-hand fence	**B1**
	cross at centre of right-hand fence **and** lower than for right-hand fence	**B1**

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Question	Answer	Marks
8(b)(ii)	does not topple / falls back as fence tilts / rotates / turns / changes angle **or** turns to larger angle / needs more force before toppling **or** centre of mass is lower	**B1**
	(low angle of tilt) centre of mass still inside / above base **or** weight turns fence back if tilted	**B1**
8(c)(i)	K.E. = $\frac{1}{2}mv^2$ in any form algebraic or numerical	**C1**
	$v^2 = 2 \times 4000 / 520$ **or** $v = \sqrt{\frac{2 \times 4000}{520}}$	**C1**
	3.9 m / s	**A1**
8(c)(ii)	(h =) P.E. / mg in any form algebraic or numerical	**C1**
	3000 / (10 × 520) **or** 0.58 m	**C1**
	2.0 m	**A1**

Question	Answer	Marks
9(a)	correct symbol for lamp	**B1**
	correct symbol for voltmeter placed across lamp	**B1**
	correct symbol for variable resistor in series with lamp and battery **or** used as a potential divider	**B1**
9(b)	start on 10 A scale (and lower if reading small) **or** uses 10 A scale for points from 1 to 1.8 A **or** uses 10 A scale for voltages above 2 V (and for 2 V)	**B1**
	for lower readings switch to (0-) 1 A scale	**B1**

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Question	Answer	Marks
9(c)	graph curved **or** not a straight line (through origin) **or** current not (directly) proportional to voltage	**B1**
9(d)(i)	(*R* =) *V* / *I* in any form algebraic or numerical	**C1**
	at 0.40 V, resistance = 0.80 (± 0.03) Ω	**A1**
9(d)(ii)	at 6.0 V, resistance = 3.3–3.4 Ω	**B1**
9(e)(i)	temperature not constant / increases	**C1**
	resistance increases as temperature increases	**A1**
9(e)(ii)	(resistance is directly) proportional to length	**B1**
	(resistance is) inversely proportional to area **or** proportional to 1 / area	**B1**
9(e)(iii)	any clear use of proportionality using 0.80 Ω	**B1**
	0.050 m	**B1**

Question	Answer	Marks
10(a)	*alpha* positive (+2)	**B1**
	alpha stopped by paper **or** thin metal **or** 3–10 cm air	**B1**
	beta electron	**C1**
	gamma electromagnetic (wave / particle)	**A1**
	gamma no charge	**C1**
	gamma not stopped (easily) **or** stopped by a few cm of lead **or** stopped a few metres of concrete	**A1**

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Question	Answer	Marks
10(b)(i)	(nuclei / atoms with) same number of protons (in nucleus)	**B1**
	different number of neutrons	**B1**
10(b)(ii)	ionisation **or** can penetrate (through air / boxes) **or** has high energy	**B1**
10(b)(iii)	stopped by box / (air-tight) bag, instruments **or** stopped by air	**B1**
10(b)(iv)	decays too quickly **or** has to be replaced often	**B1**
10(c)(i)	(alpha) repelled by nucleus	**B1**
	alpha **and** nucleus are positive	**B1**
10(c)(ii)	most of an atom is empty space / nucleus is only a small part of atom	**B1**
	alpha particle rarely passes close to nucleus	**B1**

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