Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/22**

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.

Cambridge International is publishing the mark schemes for the May/June 2022 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.

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Specific Instructions for Marking 5054/22

Marking

Question	Answer	Marks
1(a)	600 N	**B1**
1(b)	ANY 2 separate bullet points from: • weight is a vector **/** weight has direction / mass has no direction / mass is a scalar • mass is the amount of matter / substance • weight is a force / weight is mass × gravitational field strength • weight varies with position (of object) / gravitational field (strength) / mass does not vary with position • mass resists change of motion / has inertia	**B2**
1(c)(i)	friction (with water) **or** drag **or** air / water resistance mentioned	**B1**
	(forces) balance / cancel **or** no resultant force	**B1**
1(c)(ii)	(resultant force) 20 (N) or 70 – 50 seen	**C1**
	(*a* =) *F* / *m* algebraic or numerical in any form	**C1**
	0.33 m / s^2	**A1**

Question	Answer	Marks
2(a)	ANY 2 from: • kinetic energy • heat / thermal energy / internal energy • sound	**B2**
2(b)(i)	(PE =) *m g h* algebraic or numerical in any form with any mass or distance	**C1**
	1.8 J	**A1**

Question	Answer	Marks
2(b)(ii)	(shc =) $E / m \times T$ algebraic or numerical in any form	**C1**
	$80 \times 1.8 / (0.15 \times 7.0)$ **or** 1.7 **or** 0.0017	**C1**
	140 J / (kg °C)	**A1**
2(b)(iii)	any 1 of • (more time for) heat / energy loss • more time to cool down • masses do not fall full distance / masses slide along tube • thermal energy / temperature (rise) shared with tube • tube heats up • friction with tube (increases) • less kinetic energy	**B1**

Question	Answer	Marks
3(a)	force divided by area	**B1**
3(b)	(molecules) move (around at random) / have K.E.	**B1**
	(molecules) hit sides / piston	**B1**
	(molecules) cause force on piston / sides	**B1**
3(c)(i)	$10 / 1.2 \times 10^{-4}$ **or** 8.3×10^{4} (Pa) seen	**C1**
	1.8×10^{5} Pa	**A1**
3(c)(ii)	$P_1V_1 = P_2V_2$ algebraic or numerical in any form **or** $P \propto 1 / V$	**B1**
	27 **or** 28 cm^3	**B1**

Question	Answer	Marks
4(a)	clear angle is to / from the normal **or** 90°– angle between ray and surface	**C1**
	angle between/with the refracted ray / beam and the normal or vv **or** angle from the normal to the refracted ray / beam or vv	**A1**
4(b)	(refractive index =) sin*i* / sin*r* algebraic or numerical in any form	**M1**
	1.5	**A1**
4(c)	refractive index smaller (for red)	**B1**
	larger angle of refraction (for red) **or** (red) bends / refracts less (towards normal) assume comparison is for light **entering** glass at equal incident angles unless clear otherwise	**B1**
4(d)	P infrared **and Q** ultraviolet	**B1**

Question	Answer	Marks
5(a)	**middle** box of 1st three boxes and **top** box of 2nd three boxes	**B1**
5(b)(i)	(*P* =) VI **or** I^2R algebraic or numerical seen in any form	**C1**
	0.0024 W	**A1**
5(b)(ii)	$V = IR$ algebraic or numerical in any form **or** potential divider formula seen	**C1**
	4.8 (V) seen **or** 6.0 – 1.2 / 0.002 **or** 3000 − 600 **or** $6 = 0.002 \times (600+R_Y)$ **or** $1.2 = 6 \times 600 / (R_Y + 600)$	**C1**
	2400 Ω	**A1**

Question	Answer	Marks
5(b)(iii)	resistance of thermistor / X increases (on cooling)	**B1**
	current (in thermistor) decreases **or** potential divider argument used to explain decrease in pd across Y **or** pd across X increases	**B1**
6(a)(i)	top magnet N pole at bottom **and** S pole at top	**B1**
	like poles repel **or** N and N repel	**B1**
6(a)(ii)	iron magnetised (by induction) / iron a temporary magnet / poles produced on iron (by magnet)	**B1**
	unlike poles attract **or** N -pole attracts S-pole **or** bottom pole of iron is a S pole **or** S pole (on iron) faces N-pole (on magnet)	**B1**
6(b)	at least three circles centered on wire	**B1**
	clockwise direction marked on at least one closed shape around wire and no arrows wrong	**B1**

Question	Answer	Marks
7(a)(i)	acceleration constant / for 10 s **or** acceleration 1.6 m / s^2 **or** speeds up for 10 s / until it reaches 16 m / s	**B1**
	constant / uniform speed for 10 s / from 10 to 20 s / of 16 m / s **or** zero acceleration for 10 s / from 10 to 20 s	**B1**
	decelerates constantly / for 4 s / from 20 s to 24 s / until 24 s **or** deceleration 4 m / s^2 **or** acceleration −4 m / s^2	**B1**

Question	Answer	Marks
7(a)(ii)	area under curve **or** formula for area of a triangle / trapezium **seen** **or** working shown used	**B1**
	(accelerating) 80 (m) **or** (at constant speed) 160 (m) **or** (decelerating) 32 (m) seen	**C1**
	(total distance) 270 **or** 272 m	**A1**
7(a)(iii)	(average speed) = total distance / (total) time algebraic or numerical	**C1**
	11 m / s	**A1**
7(a)(iv)	horizontal line drawn from 0 to 24 s at any level **or** horizontal line at the value calculated in **7(a)(iii)** for at least 16 s	**B1**
	horizontal line from 0 to 24 s at the value calculated in **7(a)(iii)**	**B1**
7(b)(i)	27	**B1**
7(b)(ii)	(statement that thinking) distance is proportional to speed **or** thinking distance increases uniformly with speed **or** time = (thinking) distance / speed and stated to be equal / not affected **or** ratio of (thinking) distance to speed is constant **or** (thinking) distance and speed both increase by same ratio **or** same change in (thinking) distance for equal changes in speed	**C1**
	at least two values thinking distance ÷ speed (or inverse) calculated **or** all values of thinking distance/speed stated to be 0.45 (or inverse 2.2) **or** proportionality shown by at least two values **or** double the speed doubles the (thinking) distance **or** each 20 (km / h) / same increase in speed covers an extra 9 (m) distance	**A1**
7(b)(iii)	*thinking distances* increases	**B1**
	braking distances no change	**B1**

Question	Answer	Marks
8(a)(i)	3	**B1**
8(a)(ii)	shape approx. sinusoidal with amplitude 3 mm for the first complete wave (may then change)	**B1**
	1 wave taking 0.5 s for first wave shown within half a square **or** 1.5 s shown for the number of waves in **(a)(i)**	**B1**
8(b)(i)	move bar up and down more often (per second) / faster **or** make rubber band(s) strong(er) / short(er) / tight(er) / more in number **or** use bar of less mass / weight	**B1**
8(b)(ii)	*speed* remains the same	**B1**
	wavelength decreases	**B1**
8(c)(i)	(piece of) plastic / (piece of) glass / block / plate **or** a shallow(er) / deep(er) area / boundary	**B1**
8(c)(ii)	diagram showing within the ripple tank: • crests parallel to bar hitting boundary with a boundary labelled	**B1**
	• correct refraction of plane crests either towards or away from normal on the same side of the normal **or** no direction change if crests are initially parallel to boundary but with a wavelength change	**B1**
	• different wavelength shown before and after refraction and constant before and after (by eye)	**B1**
8(d)(i)	(t =) distance / speed algebraic or numerical seen in any form	**C1**
	$2 \times 560(000)$ seen or used **or** 0.0019 (s)	**C1**
	0.0037 s	**A1**

Question	Answer	Marks
8(d)(ii)	One of (both): • reflect / refract • have same speed (in a vacuum) • travel in a vacuum / don't need a medium • are electromagnetic • are transverse • carry energy / cause heating • have larger wavelength / smaller frequency than visible light	**B1**
8(d)(iii)	less likely to be hacked / intercepted / greater security **or** more channels / better bandwidth possible / more data **or** less likely for transmission to be interrupted **or** cost of satellites saved / satellites expensive	**B1**

Question	Answer	Marks
9(a)(i)	helium atom has (any 1 from) • two electrons (and ion has 1 electron) • one more electron (than the ion) • no charge (and ion positive) • same number of electrons as protons;	**B1**
9(a)(ii)	alpha particle has (any 1 from) : • no electrons • charge +2 (e) • only protons and neutrons **or** He ion has an electron	**B1**

Question	Answer	Marks
9(a)(iii)	*X number of protons* 88	**B1**
	Y number of protons 89 **or** number of protons for X +1	**B1**
	X number of neutrons 137 **or** 225 − number of protons in X	**B1**
	Y number of neutrons 136 **or** number of neutrons for X −1	**B1**
9(b)	GM tube cloud chamber	**B1**
	use paper absorber and / or (thin) metal / >5 cm air **or** deflect with magnetic / electric field / charged plates look at trails in cloud chamber <u>when</u> vapour condenses / cools	**B1**
	with paper, reading / count drops if alpha present **or** alpha particles stopped by paper / >5 cm air **or** correct deflection and sensible detection of alpha particles in field alpha tracks straight / thick / few cm long	**B1**
	with metal, reading / count drops (further) if beta present **or** beta particles stopped by metal **or** correct deflection and sensible deflection of beta particles in field beta tracks spidery / thin / long	**B1**
9(c)(i)	time taken to halve	**C1**
	time for number of (radioactive) atoms / nuclei / count / activity to halve	**A1**
9(c)(ii)	any halving of 4.0×10^{14} seen	**C1**
	only 3 halvings or 3 half lives seen	**C1**
	7300 years	**A1**