Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/22**

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.

This document consists of **11** printed pages.

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)	(m =) ρV **or** 1.8×200 **or** 360	**C1**
	$(1.8 \times 200) + 50$ **or** $360 + 50$ **or** 360 **or** candidate's mass + 50	**C1**
	410 g **or** 0.41 kg	**A1**
1(b)(i)	(place / region) where the mass appears to be concentrated **or** where the object balances	**B1**
1(b)(ii)	88 (cm) seen **or** $(84 + 92) / 2$ seen **or** 30 (cm) seen **or** 8(.0 cm) seen **or** 164 (g)	**C1**
	$m_1gx_1 = m_2gx_2$ **or** $F_1x_1 = F_2x_2$ **or** $W_1x_1 = W_2x_2$ **or** (m_1 =) m_2x_2 / x_1 **or** $410 \times (88 - 80) / 30$ **or** 164 (g)	**C1**
	110 g **or** 0.11 kg	**A1**

Question	Answer	Marks
2(a)(i)	(g.p.e. =) mgh **or** $90 \times 10 \times 0.60$	**C1**
	540 J	**A1**
2(a)(ii)	(W.D. =) Fx **or** 290×2.0	**C1**
	580 J	**A1**
2(a)(ii)	friction (between wheel and axle) **or** friction (between tyre / wheel and plank) **or** (work done against) friction	**B1**
2(b)(i)	$\frac{\text{useful energy output}}{\text{(total) energy input}}$ ($\times$ 100%) **or** $\frac{\text{useful power output}}{\text{(total) power input}}$ ($\times$ 100%)	**B1**
2(b)(ii)	wheelbarrow / worker has to be lifted up **ignore** references to friction / air resistance	**B1**

Question	Answer	Marks
3(a)(i)	water expands (as it is heated) **or** molecules move apart	**B1**
	density (of heated water) decreases **or** (heated water) rises	**B1**
	it rises **and** the cold water falls **or** convection current established	**B1**
3(a)(ii)	water (below X) heated by conduction **or** no convection occurs	**C1**
	water is a poor conductor	**A1**
3(b)	air / plastic is a poor / slow (thermal) conductor	**B1**
	trapping the air prevents convection (in air) **or** no free electrons (in plastic)	**B1**

Question	Answer	Marks
4(a)	(molecules in) fixed places / positions / arrangement / pattern	**B1**
	(molecules in) lattice **or** in an orderly / repeating / regular arrangement	**B1**
	(molecules) close together **or** tightly packed	**B1**
4(b)(i)	(Q =) $mc\Delta T$ **or** $8.0 \times 4200 \times (43 - 18)$ **or** $8.0 \times 4200 \times 25$	**C1**
	8.4×10^5 J **or** 840 000 J	**A1**
4(b)(ii)	$\Delta\theta = Q / C$ **or** $8.4 \times 10^5 / 850$ **or** 988 (°C) **or** 990 (°C) **or** 1013 (°C)	**C1**
	988 (°C) **or** 990 (°C) **or** 1013 (°C) **or** $43 + 8.4 \times 10^5 / 850$	**C1**
	1031 °C **or** 1030 °C **or** 1033 °C **or** 1000 °C	**A1**

Question	Answer	Marks
5(a)	if the live / high voltage wire touches the casing / machine **or** if the casing / machine becomes live	**B1**
	large current in earth wire **or** resistance of earth wire small	**B1**
	fuse melts **or** disconnects supply	**B1**
5(b)(i)	live wire	**B1**
5(b)(ii)	when the fuse melts the live wire is not connected to any part of the device / is isolated from the mains / supply	**B1**
5(c)(i)	live **and** neutral	**B1**
5(c)(ii)	double insulation **or** it / casing / hair dryer is plastic	**B1**

Question	Answer	Marks
6(a)(i)	16 protons (in nucleus) **and** 16 electrons in shells **or** 16 protons (in nucleus) 16 electrons around / outside / surrounding / orbiting nucleus	**B1**
	15 neutrons (in nucleus)	**B1**
6(a)(ii)	**one** more neutron (and same number of protons in nucleus) **or** 15 neutrons in P-31 **and** 16 in P-32	**B1**
6(b)(i)	**one** more proton **and one** neutron fewer **c.a.o.**	**B1**
6(b)(ii)	point at / line through (2.0, 1.6×10^{11})	**B1**
	point at (8.0, 3.0×10^{11}) **or** any other obvious correct point	**B1**
	curve of positive and decreasing gradient **and** through their plotted points to at least 6.0 weeks	**B1**
6(c)	any **two** from: lead shielding (e.g. lead apron / gloves / container / (lead) glass screen / (lead glass) goggles / (lead glass) glasses large distance (e.g. tongs / forceps / tweezers / manipulator / carry at centre of large box) minimum time of exposure **or** wear film badge	**B2**

Question	Answer	Marks
7(a)	(between t = 0 and t = 10 s) it is accelerating **or** speed / velocity increasing	**B1**
	between t = 35 s and t = 40 s, it is decelerating **or** speed / velocity decreasing	**B1**
	magnitude of acceleration less than magnitude of deceleration **or** between t = 0 and t = 10 s starts from rest / zero speed **or** between t = 35ms and t = 40 s it finishes at rest / with zero speed	**B1**
7(b)(i)	two pairs of co-ordinates from the straight-line section	**C1**
	appropriate division using candidate's coordinates	**C1**
	11.7 ⩽ speed ⩽ 12.0 m / s	**A1**
7(b)(ii)	<u>total</u> distance / <u>total</u> time **or** (distance =) 390 (m) **and** 39 (s) ⩽ (time =) ⩽ 40 (s)	**C1**
	9.7 to 10.0 m / s	**A1**
7(c)(i)	it / velocity has a direction **or** is a vector **or** depends on displacement (rather than distance)	**B1**
7(c)(ii)	**answers need not be in this order** 1 0 **and** 10 (s) **and** forwards / in the direction of movement	**B1**
	2 21 (s) **and** 24 (s)	**B1**
	perpendicular to the motion / to the direction of movement	**B1**
	3 35 (s) **and** 40 (s) **and** backwards / opposite to the direction of movement	**B1**
7(d)(i)	speed (of bus) varies / changes / decreases / increases	**B1**
7(d)(ii)	any time on Fig. 1.1 from 10 s ⩽ t ⩽ 35 s labelled M	**B1**

Question	Answer	Marks
8(a)(i)	n = sin i / sin r **or** 1.4 = sin 55° / sin r **or** (r =) $\sin^{-1}$(sin i / n) **or** (r =) $\sin^{-1}$(sin 55°/ 1.4)	**C1**
	36°	**A1**
8(a)(ii)	towards (the normal) **and** speed decreases (i.e. fourth box **only**)	**B1**
8(a)(ii)	stays constant	**B1**
8(b)(i)	distance between (one) focal point / principal focus and (the centre of) lens	**B1**
8(b)(ii)	at least one correct focal point labelled / clear / used	**B1**
	any **two** from drawn: paraxial ray from tip of O to lens and refracted through correct far F ray from tip of O through optical centre and undeviated ray from tip of O through correct near F to lens and refracted paraxially	**B2**
	I marked at intersection of correct rays	**B1**
8(b)(ii)	3.4 cm ⩽ distance ⩽ 3.5 cm	**B1**
	(magnification =) candidate's distance / 9.0 **or** candidate's height / 3.0	**C1**
	0.37 ⩽ magnification ⩽ 0.40 **c.a.o.**	**A1**
8(c)	on next page	
8(c)	any **three** from: light (from subject / object) focussed / refracted by lens by moving / sliding / adjusting lens real image (of subject / object) formed on digital light detector / film	**B3**

Question	Answer	Marks
9(a)	**steel** underlined **and** no other material indicated	**B1**
9(b)	use of (plotting) compass	**B1**
	place the (plotting) compass (on the paper next to the magnet) **and** mark a dot where the compass needle points	**B1**
	move compass / other end of needle next to the dot **and** mark a dot where the compass needle points	**B1**
	continue **and** needle points in the direction of the magnetic field	**B1**
9(c)(i)	(free) electrons attracted to K / positive terminal **or** repelled by J / negative terminal	**B1**
	(conventional current) from K to J **or** from positive **or** to negative **or** from right **or** to left	**B1**
9(c)(ii)	(Fleming) left-hand rule mentioned **or** equivalent rule mentioned	**B1**
	magnetic field related to index / pointer finger / equivalent	**B1**
	current related to middle finger / equivalent	**B1**
	thumb points down the page / equivalent **and** force down (the page)	**B1**
	or catapult field explanation: field lines clockwise when viewed from K **or** anticlockwise when viewed from J	**B1**
	extra field lines / stronger field above wire	**B1**
	fewer field lines / weaker field below wire	**B1**
	force towards weaker field	**B1**
9(c)(ii)	there is no force F **or** it disappears / becomes equal to zero	**B1**
	wire is magnetically screened / shielded by the iron tube	**B1**

Question	Answer	Marks
9(d)	moment acts (on coil) **or** forces (on vertical sides) in opposite directions	**B1**
	currents (in vertical sides) **or** in opposite directions	**B1**
	or coil becomes / acts as a magnet **or** coil produces magnetic field	**(B1)**
	N face (of coil) attracted to S pole (of magnet) **or** S face (of coil) attracted to N pole (of magnet) **or** N face (of coil) repelled by N pole (of magnet) **or** S face (of coil) repelled by N pole (of magnet))	**(B1)**