



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.

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

PUBLISHED**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)	$(m =) \rho V$ 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
	$m_1 g x_1 = m_2 g x_2$ or $F_1 x_1 = F_2 x_2$ or $W_1 x_1 = W_2 x_2$ or $(m_1 =) m_2 x_2 / x_1$ 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 <u>free</u> electrons (in plastic)	B1

Question	Answer	Marks
4(a)	(molecules in) <u>fixed</u> 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
	$8.4 \times 10^5 \text{ J}$ 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

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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)	15 protons (in nucleus) and 15 electrons in shells or 15 protons (in nucleus) 15 electrons around / outside / surrounding / orbiting nucleus	B1
	16 neutrons (in nucleus)	B1
6(a)(ii)	one more neutron (and same number of protons in nucleus) or 16 neutrons in P-31 and 17 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: <u>lead</u> 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 $t = 35$ ms 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
	$11.7 \leq \text{speed} \leq 12.0$ m/s	A1
7(b)(ii)	<u>total</u> distance / <u>total</u> time or (distance =) 390 (m) and 39 (s) \leq (time =) \leq 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 $10 \text{ s} \leq t \leq 35 \text{ s}$ labelled M	B1

Question	Answer	Marks
8(a)(i)	$n = \sin i / \sin r$ or $1.4 = \sin 55^\circ / \sin r$ or $(r =) \sin^{-1}(\sin i / n)$ or $(r =) \sin^{-1}(\sin 55^\circ / 1.4)$	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)	<u>distance</u> 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 <u>correct</u> far F ray from tip of O through optical centre and undeviated ray from tip of O through <u>correct</u> near F to lens and refracted paraxially	B2
	I marked at intersection of correct rays	B1
8(b)(ii)	$3.4 \text{ cm} \leq \text{distance} \leq 3.5 \text{ cm}$	B1
	(magnification =) candidate's distance / 9.0 or candidate's height / 3.0	C1
	$0.37 \leq \text{magnification} \leq 0.40$ 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 <u>real</u> image (of subject / object) formed on digital light detector / film	B3

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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

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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)