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Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/41**

Paper 4 Extended Theory **October/November 2022**

MARK SCHEME

Maximum Mark: 80

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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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.

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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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Acronyms and shorthand in the mark scheme

acronym / shorthand	**explanation**
A marks	Final answer marks which are awarded for fully correct final answers.
C marks	Compensatory marks which may be scored to give partial credit when final answer (A) marks for a question have not been awarded.
B marks	Independent marks which do not depend on other marks.
M marks	Method marks which must be scored before any subsequent final answer (A) marks can be scored.
Brackets ( )	Words not explicitly needed in an answer, however if a contradictory word/phrase/unit to that in the brackets is seen the mark is not awarded.
Underlining	The underlined word (or a synonym) must be present for the mark to be scored. If the word is a technical scientific term, the word must be there.
/ or **OR**	Alternative answers any one of which gains the credit for that mark.
owtte	Or words to that effect.
ignore	Identifies incorrect or irrelevant points which may be disregarded, i.e., not treated as contradictory. Ignore is also used to indicate an insufficient answer not worthy of credit on its own.
CON	An incorrect point which contradicts any correct point and means the mark cannot be scored.
ecf [question part]	Indicates that a candidate using an erroneous value from the stated question part must be given credit here if the erroneous value is used correctly here.
cao	correct answer only

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Question	Answer	Marks
1(a)	2.3 J	**A2**
	∆g.p.e. = $mg\Delta h$ in any form **or** 0.50 × 10 × 0.45	C1
1(b)(i)	1.2 N s	**A3**
	impulse = change in momentum **or** 2.0 × 0.60	C1
	$I = m\Delta v$ in any form **or** 2.0 × 0.60	C1
1(b)(ii)		**B3**
	kinetic energy (of block A) decreases	B1
	thermal / internal energy produced / increases (due to friction)	B1
	friction mentioned **or** block slows down / decelerates	B1

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Question	Answer	Marks
2(a)(i)		**B2**
	magnitude **or** size	B1
	direction	B1
2(a)(ii)		**B2**
	any **two** from: acceleration / deceleration, gravitational field strength, impulse, momentum, velocity, weight	B2
2(b)(i)	0.12 m	**B1**
2(b)(ii)		**B2**
	beyond where the extension is not directly proportional to the load **or** (point) where extension stops being directly proportional to the load **or** point up to which extension is directly proportional to the load	B1
	10.4 N $\leqslant$ weight $\leqslant$ 10.9 N	B1
2(b)(iii)	22 N / m $\leqslant k \leqslant$ 25 N / m	**A3**
	clear subtraction of 0.12 from a length that is in Hooke's law region e.g. 0.54 – 0.12	C1
	$k = F / x$ in any form **or** $k = W / x$ in any form **or** k = 1 / gradient	C1

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Question	Answer	Marks
3(a)	620 N	**B1**
3(b)		**B2**
	no resultant force (on object in equilibrium)	B1
	no resultant moment (on object in equilibrium)	B1
3(c)(i)	560 N m	**A2**
	(Γ =) $Fx_{\perp r}$ **or** 620 × 0.90	C1
3(c)(ii)	540 N	**A3**
	use of any moment	C1
	$T \times 1.2 \sin 60°$ (= 560) **or** (T =) 560 / (1.2 × sin 60°)	C1

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Question	Answer	Marks
4(a)(i)	240 N	**A2**
	$F = pA$ in any form **or** $1.0 \times 10^5 \times 2.4 \times 10^{-3}$	C1
4(a)(ii)	5.0 J	**A2**
	WD = $Fx_{\parallel}$ **or** 240×0.021	C1
4(b)	$(-)3.5 \times 10^3$ J	**A2**
	$E = CDT$ in any form **or** $89 \times (21 - (-18))$ **or** $89 \times (3)$ **or** 89×39	C1
4(c)		**B3**
	(as the volume decreases) the particles collide more often	B1
	(as the temperature decreases) the particles collide less violently	B1
	two effects cancel (to leave the pressure unchanged) **or** particles collide with walls / piston / cylinder	B1
4(d)		**B2**
	(attractive) forces between (any two) particles large(r than in gases)	B1
	particles close(r) together (than gas particles) **or** particles already touching	B1

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Question	Answer	Marks
5(a)	infrared	**B1**
5(b)(i)	(both) transverse / electromagnetic / travel in a vacuum / have the same (high) speed (in a vacuum)	**B1**
5(b)(ii)	(it / visible light) compared with an e.m. radiation stated by candidate in **5(a)** in terms of frequency / wavelength	**B1**
5(c)(i)		**B3**
	equipment e.g. black container, white container, thermometers **or** Leslie's cube and detector	B1
	measurements made warm / hot water in container **and** temperature decreases recorded **or** time to reach a given temperature / to cool **or** warm / hot water in cube **and** meter readings recorded	B1
	how a conclusion is reached better emitter surface cools quicker **or** greater reading from better emitter surface	B1

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Question	Answer	Marks
5(c)(ii)	any **two** appropriate quantities e.g. initial temperature of water mass / volume of water dimensions / surface area of container time of cooling mass of container shape of container smoothness of surface **or** surface area of face (of cube) distance of detector temperature of water at time of measurement smoothness of surface	**B2**

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Question	Answer	Marks
6(a)	(light of a) single frequency	**B1**
6(b)(i)		**B2**
	angle of incidence is 0° (hence) angle of refraction is 0°	B1
	or all the wavefront hits the plastic at the same time all slows down at the same time	B1
6(b)(ii)	1.8×10^8 m / s	**A4**
	$n = 1 / \sin c$ in any form **or** $n = 1 / \sin 37°$	C1
	(n =) 1.7	C1
	$v_{pl} = v_0 / n$ in any form **or** $3.0 \times 10^8 / 1.7$ **or** $3.0 \times 10^8 \times \sin 37°$	C1
6(b)(iii)		**B3**
	critical angle (for blue light) < 37° **or** critical angle for red (light) is 37°	B1
	angle of incidence (of blue light) greater than its critical angle (in plastic)	B1
	total internal reflection **or** all the (blue) light reflects **or** no (blue) light leaves the glass / refracts / travels in air along the straight edge	B1

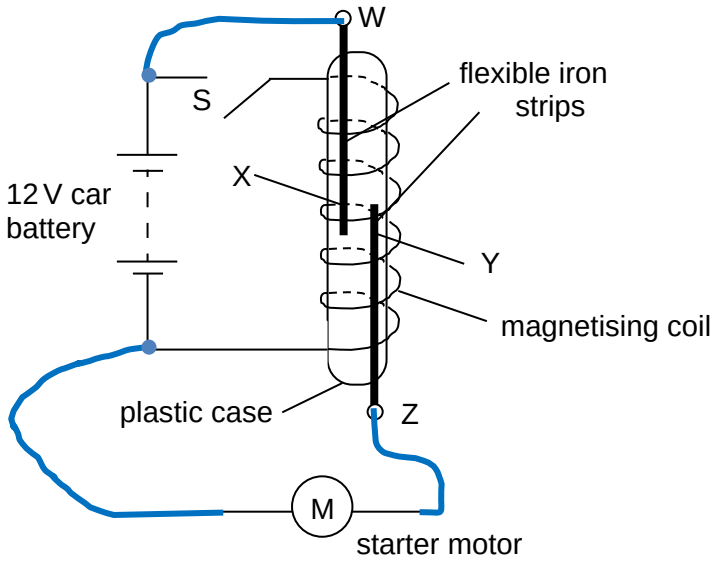
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Question	Answer	Marks
7(a)		**B3**
	X and Y / they become magnetised **or** they / strips have poles	B1
	strips in the centre have opposite (magnetic) poles **or** X and Y attract	B1
	X and Y touch / close switch / activate relay / complete circuit	B1
7(b)(i)	150 A	**A2**
	$I = P / V$ in any form **or** 1.8 / 12 **or** 1800 / 12 **or** 1800 / 12 **or** 0.15	C1
7(b)(ii)		**B2**
	small(er) resistance mentioned	B1
	less thermal energy produced **or** wires do not melt **or** large current mentioned	B1

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Question	Answer	Marks
7(c)		**B2**
	flexible strips in series with motor	B1
	power supply in series with motor	B1
	expected answer:  	

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Question	Answer	Marks
8(a)	both relate to energy per unit charge	**B1**
8(b)	e.m.f. applies to the whole circuit / source **or** p.d. to one (or more) component **or** energy conversion to electrical for e.m.f. **or** from electrical for p.d.	**B1**
8(c)(i)	4.8 V	**B1**
8(c)(ii)	20 Ω	**A3**
	$1 / R_T = 1 / R_1 + 1 / R_2$ **or** (R_T =) $R_1 R_2 / (R_1 + R_2)$ **or** $1 / R_T = 1 / 24 + 1 / 12$ **or** $1 / R_T = 3 / 24$ **or** (R_T =) $24 \times 12 / (24 + 12)$	C1
	8.0 (Ω)	C1
8(c)(iii)	2.9 V	**A2**
	$V = ER / R_T$ in any form **or** $4.8 \times 12 / 20$ **or** $I = E / R$ in any form **or** 0.24 seen	C1

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Question	Answer	Marks
9(a)	they all have the same number of neutrons / nucleons **or** they are all identical	**B1**
9(b)(i)		**B2**
	(number of protons =) 80	B1
	(number of neutrons =) 118	B1
9(b)(ii)	19 counts / minute $\leqslant$ count rate $\leqslant$ 21counts / minute	**B1**
9(b)(iii)	2.4 days $\leqslant \tau \leqslant$ 2.9 days	**A4**
	count rate from line – background count e.g. 390 – 20	C1
	answer from first C1 mark divided by 2 e.g. 370 / 2 **or** 185	C1
	background count + answer from second C1 mark e.g. 20 + 370 / 2 **or** 20 + 185 **or** 205	C1

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