Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/41**

Paper 4 Extended Theory **May/June 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.

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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.

Acronyms and shorthand in the mark scheme

Acronym/shorthand	Explanation
A marks	Final answer marks which are awarded for correct final answers to numerical questions.
C marks	Compensatory marks which may be scored to give partial credit when final answer (A) marks for a question have not been scored.
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 cannot be scored.
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.
owtte	Or words to that effect
ignore	If seen, this incorrect or irrelevant point may be disregarded, i.e. it is not to be treated as contradictory.
not/NOT	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. i.e. their error is carried forward to this question and they are not penalised a second time for one error.
cao	correct answer only

Question	Answer	Marks
1(a)	negative acceleration **or** decrease in velocity	**B1**
	change in velocity per unit time **or** rate of change of velocity	**B1**
1(b)	delay in applying brakes **or** (human) reaction time **or** foot not removed from accelerator	**B1**
1(c)(i)	gradient **or** slope	**B1**
1(c)(ii)	20.5 m / s ⩽ answer ⩽ 23.5 m / s	**A2**
	the coordinates at one point on curve (e.g. (0.50, 11)) **and** (upper) time coordinate ⩽ 1.0 s	C1
1(d)(i)	air resistance / air friction acts on the car	**B1**
1(d)(ii)	air resistance / resultant / resistive force decreases **and** as speed decreases / car decelerates	**A2**
	air resistance / resultant / resistive force decreases / changes	C1

Question	Answer	Marks
2(a)	gravitational potential energy	**B1**
2(b)(i)	1.6×10^6 Pa	**A3**
	(p =) $h\rho g$ (in any form) **or** $150 \times 1000 \times 10$ **or** 1.5×10^6	C1
	1.5×10^6 **or** $1.0 \times 10^5 + \{150 \times 1000 \times 10\}$ **or** $1.0 \times 10^5 + 1.5 \times 10^6$ **or** 1.6×10^N	C1
2(b)(ii)	5.6×10^6 N	**A2**
	(F =) pA (in any form) **or** $1.6 \times 10^6 \times 3.5$	C1

Question	Answer	Marks
2(c)	speed (of water) remains constant	**B1**
	otherwise density would decrease **or** gaps would appear in the water **or** volume / density does not change **or** liquids incompressible **or** water enters / leaves at constant rate **or** quantity of water remains constant	**B1**

Question	Answer	Marks
3(a)	fast(er) / high(er) speed / (more) energetic molecules escape (into air)	**B1**
	average speed / average kinetic energy of molecules decreases	**B1**
	temperature related to speed / energy of molecules **or** slow(er) / low(er) speed / less energetic molecules remain (in water)	**B1**
3(b)	any **three** from: atoms / ions vibrate (vibrating) atoms / ions hit electrons electrons propelled / travelling through metal / moving through metal electrons hit (distant) atoms free electrons / delocalised electrons mentioned	**B3**

Question	Answer	Marks
4(a)(i)	two / three wires of at least two different metals	**B1**
	one junction in sulfur	**B1**
	the other junction in ice-water mixture / at room temperature **and** one of the wires must be from the first junction	**B1**
	labelled voltmeter / voltmeter symbol correctly connected	**B1**

Question	Answer	Marks
4(a)(ii)	measure e.m.f.	**B1**
	how to find temperature from e.m.f. (e.g. use calibration graph **or** calculation **or** table)	**B1**
4(b)	measures high temperatures / wires do not melt / rapid response / robust / small heat capacity / electrical output / (can be) remote from observer / direct input to computer	**B1**

Question	Answer		Marks
5(a)	<u>temperature</u>		**B1**
	at which liquid becomes a gas **or** liquid and gas exist together		**B1**
5(b)(i)	1.8×10^5 J		**A2**
	(E =) VIt (in any form) **or** $230 \times 13 \times 60$ **or** 230×13 **or** 3000		C1
5(b)(ii)	9.1×10^{-3} kg / s	9.1×10^{-3} kg / s	**A4**
	(ΔT =) 100 – 22 **or** 78	**or** (ΔT =) 100 – 22 **or** 78	C1
	$m = E / c\Delta T$ (in any form) **or** $1.8 \times 10^5 / (4200 \times 78)$	**or** (rate =) $P / c\Delta T$ (in any form) **or** $m = E / c\Delta T$ **and** $E = Pt$	C1
	$1.8 \times 10^5 / (4200 \times 78 \times 60)$ **or** 5.5×10^N **or** $9.1/9.2 \times 10^N$	**or** $3000 / (4200 \times 78)$ **or** $230 \times 13 / (4200 \times 78)$ **or** $9.1 / 9.2 \times 10^N$	C1
5(c)	1 if the tap becomes live **or** if the (live) cable touches the (metal) tap		**B1**
	there is a current to earth / in the earth wire (which blows the fuse)		**B1**
	2 the current (in earth wire) is large **and** fuse melts / blows / stops current / breaks circuit		**B1**

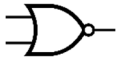
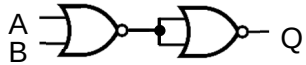
Question	Answer	Marks
6(a)	any **three** from: radiation light / infrared / electromagnetic (radiation) travel through space / vacuum absorbed by road	**B3**
6(b)	road / black surfaces are good absorbers (of radiation) **or** sea is a poor absorber (of radiation)	**B1**
6(c)(i)	they / molecules speed up **or** gain kinetic energy	**B1**
	they / molecules move further apart	**B1**
6(c)(ii)	density (of air above road) decreases **or** density (of hot air) decreases	**B1**
	air (above land / road) rises **or** air (that is hot) rises	**B1**
	air (above road) replaced by cool air / air from above sea	**B1**

Question	Answer	Marks
7(a)	(all the light) meets (at a point) **or** is focused **or** intersects	**A2**
	(all the light) travels towards a point	C1
	it then diverges or spreads out (from that point) **or** point of convergence is on XY / at F / the focal point / principal focus / 3.0 cm from lens	**B1**
7(b)	**two** marked points on XY 3.0 cm from centre of lens **and** one on left and one on right **and** each labelled F	**B1**

Question	Answer	Marks
7(c)(i)	**two** of these rays from tip of N drawn: ray (that seems to come) from left-hand principal focus **and** emerges from lens paraxially paraxial ray to lens **and** then towards right-hand principal focus ray towards / through centre of lens	**M2**
	two rays traced back to intersection **and** line from intersection to axis **and** line labelled I	**A1**
7(c)(ii)	virtual **and** light / rays do not pass through I **or** virtual **and** light / rays only seem to come from I **or** virtual **and** produced by diverging rays virtual **and** (real) rays do not meet	**B1**
7(c)(iii)	magnifying glass	**B1**

Question	Answer	Marks
8(a)	0.27 J	**A4**
	(v =) at (in any form) **or** 10×0.67 **or** 6.7 (m / s)	C1
	6.7 (m / s)	C1
	(KE =) $\frac{1}{2}mv^2$ (in any form) **or** $\frac{1}{2} \times 0.012 \times (10 \times 0.67)^2$ **or** $\frac{1}{2} \times 0.012 \times 6.7^2$	C1
8(b)(i)	magnetic field / magnetic field lines cut the copper / tube / it (**or** vv.)	**B1**
	electromagnetic induction occurs **or** e.m.f. induced	**B1**

Question	Answer	Marks
8(b)(ii)	(upwards / opposing) force on magnet	**B1**
	force / magnetic field / e.m.f. / current opposes the change (producing it) / opposes motion **or** force on magnet due to magnetic field caused by current in tube	**B1**

Question	Answer	Marks
9(a)	digital (signal) consists of 1(s) and 0(s) / high value and low	**B1**
	analogue (signal) is (continuously) variable (in magnitude)	**B1**
9(b)	NOR (gate) **and** 	**B1**
9(c)		**A2**
	 (i.e. NOR gate symbol with two inputs joined seen)	C1

Question	Answer	Marks
10(a)(i)	same number of protons / both have one proton	**B1**
10(a)(ii)	it / hydrogen-3 / $^{3}_{(1)}H$ has one more neutron	**A2**
	different number of neutrons / nucleons	C1

Question	Answer	Marks
10(b)(i)	(high temperature produces) high (kinetic) energy / momentum / speed / ability to do large quantity of work	**B1**
	they repel each other	**B1**
	are positively charged / have like charges **or** need to come close together	**B1**
10(b)(ii)	$^{4}_{2}X$ **or** $^{4}_{2}He$ **or** $^{4}_{2}\alpha$	**B1**
	$^{1}_{0}n$ **and** no other particle	**B1**