CAMBRIDGE
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Cambridge IGCSE™

PHYSICS **0625/43**

Paper 4 Theory (Extended) **May/June 2024**

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 descriptions 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 mark	Final answer mark which is awarded for fully correct final answers including the unit.
C mark	Compensatory mark which may be scored when the final answer (A) mark for a question has not been awarded.
B mark	Independent mark which does not depend on any other mark.
M mark	Method mark which must be scored before any subsequent final answer (A) mark 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	Indicates either an incorrect or irrelevant point which may be disregarded, i.e., not treated as contradictory.
insufficient	An 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.
ORA	Or reverse argument.

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Question	Answer	Marks
1(a)	(deceleration is) decrease in velocity per unit time **OR** rate of decrease in velocity **OR** negative rate of change of velocity **OR** $-\Delta v / \Delta t$	**A2**
	negative acceleration **OR** change in velocity per unit time **OR** rate of change of velocity	C1
1(b)	$a = \Delta v / (\Delta)t$ **AND** (Δt =) 14 / 9.8 **OR** (Δt =) $\Delta v / a$ = 14 / 9.8	**B1**
1(c)	10 m	**A3**
	(initial) E_k of ball = (maximum) E_p gained **OR** $\frac{1}{2} mv^2 = mgh$	C1
	(h =) E_p / mg **OR** (h =) $\frac{1}{2} v^2 / g$ **OR** (h =) 12.74 / (0.13 × 9.8) (= 10 m) **OR** (h =) (½ × 196) / 9.8	C1
1(d)	any **three** from: • (ball) accelerates • (accelerates) at 9.8 m / s^2 initially **OR** (accelerates) due to force of gravity • air resistance / resistive force increases (with speed / velocity) • resultant force (downwards) decreases • acceleration decreases • terminal velocity is reached when acceleration is zero **OR** terminal velocity is reached when resultant force is zero	**B3**

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Question	Answer	Marks
2(a)	chemical (energy store)	**B1**
2(b)	if one lamp breaks, the other one will remain lit	**B1**
2(c)(i)	the useful energy / power output from the solar panel is 22% of the total energy / power input owtte	**B1**
2(c)(ii)	68 W	**A2**
	(%) efficiency = {useful power output} / {total power input} (× 100%) **OR** 15 / 0.22	C1
2(d)	any **two** from: • no need for cables (to connect to mains) / good for locations remote from mains supply • less power loss than mains (electricity) that must be transmitted • not affected by mains power cuts	**B2**

Question	Answer	Marks
3(a)(i)	clockwise moment has increased (and no change to anti-clockwise moment)	**B1**
3(a)(ii)	(mass of backpack =) 45 / (1.6 × 9.8)) 2.9 (kg)	**A3**
	(at balance) sum of clockwise moments = sum of anti-clockwise moments **OR** (900 × 0.85) = 1.6 × (450 + *W*)	C1
	(clockwise moment =) 765 (N m) **OR** (moment due to backpack =) 45 (N m) **OR** (*W* =) [{900 × 0.85} – {450 × 1.6}] / 1.6	C1
3(b)(i)	(impulse is the) force × time (for which the force acts) **OR** $I = F \times t$ **OR** (impulse =) change in momentum **OR** $\Delta\{mv\}$	**B1**
3(b)(ii)	any **three** from: • change in momentum/impulse is the same (on both floors) • (change in momentum/Impulse) is over longer time • force = rate of change of momentum **OR** $F = \Delta\{mv\} / \Delta t$ • less force on child (so less injury)	**B3**

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Question	Answer	Marks
4(a)	(average) KE of particles increases / particles move faster	**B1**
4(b)(i)	$\rho = m / v$ **OR** ($m =$) ρv	**M1**
	$1\ cm^3 = 1 \times 10^{-6}\ m^3$ **OR** $250\ cm^3 = 2.5 \times 10^{-4}\ m^3$ **OR** $1000 \times 2.5 \times 10^{-4}$ (= 0.25 kg)	**A1**
4(b)(ii)	47000 J	**A3**
	($\Delta\theta =$) 65 – 20 °C **OR** ($\Delta\theta =$) 45 °C	C1
	$E = mc\Delta\theta$ **OR** ($E =$) $mc\Delta\theta$ **OR** ($E =$) $0.25 \times 4200 \times 45$	C1
4(b)(iii)	thermal energy also transferred to the pan / surroundings **OR** thermal energy escapes from the water (as it is being heated)	**B1**
4(c)	any **two** from: • (aluminium saucepan) takes longer to heat the water • more (thermal) energy is needed (with aluminium pan for the same increase in temperature) • (because aluminium) has a higher specific heat capacity	**B2**

Question	Answer	Marks
5(a)	any **three** from: • (metals contain) delocalised / free / mobile electrons • (delocalised electrons) gain energy (from lattice vibrations of the atoms nearest to the hot water) • (delocalised) electrons move through the metal (lattice) • collisions between the (delocalised) electrons and (remote) ions / atoms (transfers thermal energy to all parts of the metal container)	**B3**
5(b)	no delocalised / free electrons	**B1**
5(c)	particles are further / far apart	**B1**
	fewer particle collisions (to transfer energy) **OR** no lattice vibrations (to transfer energy)	**B1**

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Question	Answer	Marks
6(a)	where rays of light parallel (to the principal axis) converge after passing through lens	**B1**
	(focal length is) the distance between (centre of) the lens and principal focus	**B1**
6(b)	any **two** from: • ray from top of object to lens, parallel to principal axis, refracted to F_2 • ray from top of object through centre of lens, undeviated • ray from F_1, through top of object and on to lens, then parallel to principal axis	**M2**
	rays extrapolated back to converge to the left of F_1	**A1**
	image drawn from principal axis to intersection with arrow (to show orientation)	**A1**

Question	Answer	Marks
7(a)(i)	evenly spaced straight vertical lines from one plate to the other	**B1**
	arrows on lines pointing towards negatively charged plate	**B1**
7(a)(ii)	(negatively charged particle has) force / attraction towards positively charged / positive (plate)	**B1**
7(b)(i)	34 C	**A2**
	$I = Q / t$ **OR** (Q =) It **OR** $28\,000 \times 0.0012$	C1
7(b)(ii)	(p.d. =) 3.6 MV **OR** 3.6×10^6 V	**A2**
	$E = ItV$ **OR** (V =) E / It **OR** (V =) E / Q **OR** (V =) $1.2 \times 10^8 / 34$	C1

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Question	Answer	Marks
8(a)(i)	(ultrasound is) sound with a frequency higher than 20 kHz	**B1**
8(a)(ii)	(sound travels) faster (in a liquid than in air) / ORA	**B1**
8(a)(iii)	3.0×10^8 m / s	**B1**
8(b)	any **three** from: • X-rays and ultrasound show internal body parts (without the need to cut open the body) • X-rays and ultrasound both travel through (some parts of) the body • images are formed by ultrasound (partially) reflecting (from boundaries between body matter) • images are formed by X-rays which (travel in straight lines and) pass through soft tissue and are absorbed by bone • X-rays show parts of the skeleton / X-rays show bones **OR** ultrasound shows image of soft tissues • an X-ray detector forms image from X-rays that travel through patient **OR** ultrasound detector forms image from sound waves reflected back (from body parts) • X-rays expose you to radiation (which can be harmful to humans)	**B3**

Question	Answer	Marks
9(a)	(alternating current / a.c. in primary coil / plate produces) changing magnetic field (in primary coil)	**B1**
	secondary / phone coil cuts (this) magnetic field **OR** secondary / phone coil is in this / changing magnetic field	**B1**
	(changing magnetic field) causes <u>induced</u> current (in secondary coil)	**B1**
9(b)(i)	1 kW h = $1000 \times 60 \times 60$ J **AND** $0.012 \times 3.6 \times 10^6$ ($= 4.3 \times 10^4$ J)	**B1**
9(b)(ii)	50% charged = ($4.3 \times 10^4 / 2 =$) 2.15×10^4 (J) **OR** 63% charged in 30 min **OR** (50% charged in $t =$) 24 min	**B1**
	$P = E / t$ **OR** ($t =$) E / P **OR** $2.15 \times 10^4 / 15$ (s) **OR** energy provided in 30 min = (15×30 x $60 =$) 2.7×10^4 (J)	**B1**
	$2.7 \times 10^4 > 2.15 \times 10^4$ **OR** 63% > 50% **OR** 30 min > 24 min	**B1**

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Question	Answer	Marks
10(a)(i)	radiation (always) present in the environment **OR** radiation from natural sources	**B1**
10(a)(ii)	radon gas **OR** rocks / buildings **OR** cosmic rays **OR** food / drink	**B1**
10(a)(iii)	356 counts / min	**A2**
	(corrected count rate =) count rate – background count **OR** 382–26	C1
10(b)	beta OR gamma	**B1**
	alpha would be stopped by soil and not reach detector **OR** beta has sufficient range to be detected above ground OR <u>alpha</u> and <u>beta</u> stopped by soil before reaching detector	**B1**
	gamma would pass through intact pipe as well cracked pipe so no difference detected **OR** beta stopped by intact pipe so variation between piped water and escaped water can be detected OR gamma is only radiation that will reach detector through soil **OR** less gamma reaches detector through solid pipe	**B1**
10(c)(i)	(very short half-life) doesn't allow time for detection before activity has dropped to too low a level **OR** doesn't allow for sufficient build up at the leak to detect difference in rate	
10(c)(ii)	(very long half-life) contaminates water supply	

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Question	Answer	Marks
11(a)	redshift	**B1**
11(b)(i)	(H_0 =) 2.2×10^{-18} per second	**B1**
11(b)(ii)	2.6×10^{8} m / s	**A2**
	$H_0 = v / d$ **OR** (v =) $H_0 d$ **OR** (v =) $1.2 \times 10^{26} \times 2.2 \times 10^{-18}$	C1
11(b)(iii)	any **two** from: • more distant galaxies are moving away faster • universe is expanding • (if galaxies are moving away from each other now, then) in the past galaxies were closer together	**B2**

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