Cambridge Assessment International Education

Cambridge O Level

PHYSICS **5054/22**

Paper 2 Theory **October/November 2022**

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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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	<u>'List rule' guidance</u> 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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Question	Answer	Marks
1(a)	(distance =) area (under graph) **or** 77 × 56 **or** ½ × 77 × 70 **or** 4300 **or** 2700 **or** ½ × 77 × (56 + 126)	**C1**
	77 × 56 + (½ × 77 × 70) **or** 4300 + 2700 **or** ½ × 77 × (56 + 126)	**C1**
	7000 m **or** 7.0×10^3 m **or** 7.0 km	**A1**
1(b)(i)	(a =) $\Delta v / \Delta t$ **or** 77 / 70 (etc.)	**C1**
	1.1 m / s^2	**A1**
1(b)(ii)	(F =) ma **or** $3.8 \times 10^5 \times 1.1$	**C1**
	4.2×10^5 N	**A1**

Question	Answer	Marks
2(a)	(ρ =) m / V **or** (ρ =) m / hA **or** $2.9 \times 10^4 / 3.6$ **or** $2.9 \times 10^4 / (2.0 \times 1.8)$	**C1**
	8.1×10^3 kg / m^3	**A1**
2(b)(i)	(g.p.e. =) $mg\Delta h$ **or** $2.9 \times 10^4 \times 10 \times 0.80$	**C1**
	2.3×10^5 J	**A1**
2(b)(ii)	k.e. / ½mv^2 = g.p.e. / $mg\Delta h$ / 2.3×10^5 **or** (v =) $\sqrt{2gDh}$ **or** $\sqrt{2 \times 10 \times 0.80}$	**C1**
	(v =) $\sqrt{2gDh}$ **or** $\sqrt{2 \times 10 \times 0.80}$	**C1**
	4.0 m / s	**A1**

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Question	Answer	Marks
3(a)	chemical potential energy **and** no other energy	**B1**
3(b)(i)	radiation **or** infrared mentioned	**B1**
	radiation **and** infrared (travel to the man)	**B1**
	energy / infrared / radiation absorbed by the man / pullover **or** travels in straight line **or** travels at the speed of light **or** increases (man's) internal energy	**B1**
3(b)(ii)	(shiny surface) reflects radiation (to man)	**B1**
	less (thermal) energy escapes **or** more (thermal) energy reaches / absorbed by man	**B1**
3(b)(iii)	**EITHER** black (surface) is good absorber / poor reflector of infrared radiation	**B1**
	more (thermal) energy absorbed **or** more thermal energy transferred to man	**B1**
	OR trapped air **and** reduced convection / air poor conductor / air is a good insulator	**(B1)**
	less (thermal) energy lost	**(B1)**

Question	Answer			Marks
4(a)	equipment	e.g.	(evacuable) container **and** (suspended electric) bell / source of sound **and** (air) pump	**B1**
	action	e.g.	ringing / sound (produced) / sound heard **and** evacuate air / vacuum (produced)	**B1**
	observation	e.g.	transmission / hearing of sound ceases / no sound	**B1**

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Question	Answer	Marks
4(b)	(they) vibrate	**M1**
	(vibration) parallel to / in the direction of propagation / of energy travel	**A1**
4(c)	(point where) molecules are further apart (than average) **or** (point where) pressure / density is lower (than average)	**B1**
4(d)	(λ =) v / f **or** 1500 / 140 000	**C1**
	1.1×10^{-2} m **or** 1.1 cm **or** 11 mm	**A1**

Question	Answer	Marks
5(a)	energy / work done per unit charge **or** $\frac{\text{energy}}{\text{charge}}$ **or** $\frac{\text{work done}}{\text{charge}}$	**B1**
	property of a source / cell / battery / power supply **or** energy used driving charge around a (complete) circuit **or** energy transferred to electrical energy	**B1**
5(b)	it lasts for a longer time **or** more (electrical) energy available **or** power supply still functions if one cell fails / runs flat **or** can replace one cell without stopping circuit / stopping current	**B1**
5(c)(i)	resistance (of thermistor / circuit) decreases **c.a.o.**	**B1**
	current change **or** voltage change across thermistor matching the change in the resistance of the resistor	**B1**
	reading of voltmeter increases **c.a.o.**	**B1**
5(c)(ii)	(V_1 =) $V_0 \times R_1 / R_0$ **or** $1.5 \times 4000 / (4000 + 8000)$ **or** $1.5 \times 4000 / 12\,000$ **or** $I = V / R$ **or** $1.5 \times 8000 / (4000 + 8000)$ **or** I =1.5 / 12 000 **or** 0.125 mA	**C1**
	0.50 V	**A1**

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Question	Answer	Marks
6(a)	magnetic field / flux mentioned	**B1**
	changing / alternating (magnetic) field	**B1**
	voltage induced (in secondary coil)	**B1**
6(b)(i)	(V_S =) $V_P \times N_S / N_P$ **or** 240 × 350 / 5600	**C1**
	15 V	**A1**
6(b)(ii)	(I =) P / V **or** 90 / 15	**C1**
	6.0 A	**A1**

Question	Answer	Marks
7(a)	(surface) water contracts (as it cools) **or** molecules (at surface) become closer	**B1**
	(surface / cold) water / its density increases **or** density greater than rest of water	**B1**
	surface / cold / dense water sinks **or** deeper / warm / less dense water rises / moves upwards	**B1**
7(b)(i)	conduction **and** no other mechanism of thermal transfer	**B1**
7(b)(ii)	it is a good conductor (of thermal energy)	**B1**
7(c)(i)	0.75 **or** 83 seen **or** 100 – 17 seen	**C1**
	(E =) $mc\Delta T$ **or** 0.75 × 4200 × 83 **or** 750 × 4200 × 83 **or** 2.6×10^8	**C1**
	2.6×10^5 J	**A1**

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Question	Answer	Marks
7(c)(ii)	occurs (only) at a specific temperature / boiling point	**B1**
	occurs throughout the liquid **or** produces bubbles **or** does not produce cooling **or** does not depend on draught / surface area	**B1**
7(c)(iii)	does work against the forces / breaks the bonds (between the molecules) **or** increases the potential energy (of the molecules)	**B1**
	so that / as the molecules move apart / separate (and become gas molecules)	**B1**
7(c)(iv)	(m =) E / l_v **or** Pt / l_v **or** 10×60 **or** 600 **or** 7.8×10^5	**C1**
	$1300 \times 60 \times 10 / 2.3 \times 10^6$ **or** $1300 \times 10 / 2.3 \times 10^6$	**C1**
	0.34 kg	**A1**

Question	Answer	Marks
8(a)	electrons move from the cloth / to the rod	**B1**
	cloth becomes positively charged	**B1**
8(b)	mention of free / mobile / delocalised / sea of electrons	**B1**
	(free) electrons present in metal **and** not present in plastic	**B1**
8(c)(i)	positive signs at top (half) of sphere **and** negative signs at the bottom	**B1**
	equal number of each **and** number $\leqslant 7$	**B1**
8(c)(ii)	negative charges / electrons flow to earth (and positive charges do not move	**B1**
8(c)(iii)	(only) top of sphere is / stays positive	**B1**
	bottom of sphere is uncharged / neutral	**B1**

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Question	Answer	Marks
8(c)(iv)	charges repel each other **or** as earth wire is disconnected, charge distribution does not change	**B1**
	(positive) charge is spread (uniformly) over (the surface of) the sphere	**B1**
8(d)(i)	(region of space) where an (electrically) charged particle / charge experiences an (extra) force	**B1**
8(d)(ii)	at least **five** straight lines outside Y **and** none curved **and** perpendicular to the surface	**B1**
	at least one arrowhead pointing inwards **and** none wrong	**B1**
	field lines uniformly spaced at surface of sphere **and** no crossing / touching anywhere	**B1**

Question	Answer	Marks
9(a)		**B1**

	yes	no	it is not possible to tell
it emits an α-particle		✓	
it emits a β-particle	✓		

}

	yes	no	it is not possible to tell
it emits a γ-ray			✓

		B1
9(b)(i)	(both have) 91 protons / equal numbers of protons (in nucleus)	**B1**
9(b)(ii)	(they have) different numbers of neutrons (in nucleus) / nucleons	**B1**

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Question	Answer	Marks
9(c)(i)	(count that is) always present **or** due to the environment / surroundings **or** not deliberately introduced **or** not being tested	**B1**
	any **two** from: rock sources (e.g. benches, building materials, human body, Earth crust) air sources (e.g. radon) cosmic sources (e.g. Sun, space)	**B2**
9(c)(ii)	use tongs / tweezers / forceps **or** wear lead(-lined) clothing / lead(-lined) gloves **or** wear goggles **or** reduce time of exposure **or** keep distance of separation large	**B1**
9(c)(iii)	(radioactive) emission is a random process / occurs at random intervals	**B1**
	measurements fluctuate (about an average value)	**B1**
9(c)(iv)	(coordinates of) **two** points from curve, e.g. (0, 58) and (70, 29)	**C1**
	(coordinates of) **two** points from curve **and** at least two half-lives apart, e.g. (0, 58) and (138, 14.5) **or** $64.0 \leqslant \tau \leqslant 74.0$	**C1**
	$66.0\ \text{s} \leqslant \tau \leqslant 73.5\ \text{s}$	**A1**
9(c)(v)	(large half-life because of) slow rate of decay	**B1**
	radiation / count rate due to $^{234}_{92}\text{U}$ imperceptible / very much less than that of $^{234}_{91}\text{Pa}$ **or** (nearly) all of measured radiation / count rate due to $^{234}_{91}\text{Pa}$	**B1**

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