CO-ORDINATED SCIENCES (9–1)   **0973/31**

Paper 3 Theory (Core)   **May/June 2024**

MARK SCHEME

Maximum Mark: 120

Published

This document consists of **12** printed pages.

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.

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.

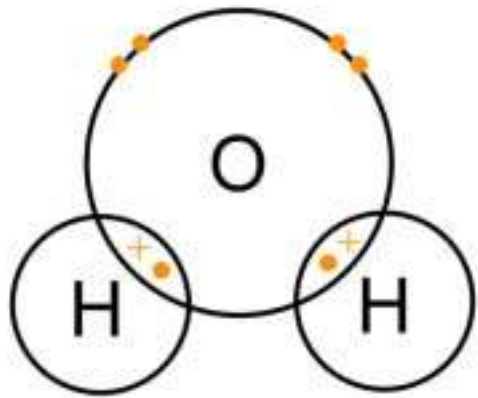| Question	Answer	Marks
1(a)(i)	**A** – enamel ; **B** – pulp (cavity) ;	**2**
1(a)(ii)	mechanical ;	**1**
1(b)(i)	4.6 and 0.8 ; $((3.8 / 4.6) \times 100) = 83$ (%) ;	**2**
1(b)(ii)	*any three from:* improvement in dental care by people ; improvement in dental, care / technology ; reduction in consumption of sugar / more calcium in diet ; ref to education ; addition of fluoride to drinking water / toothpaste ;	**3**
1(c)	*any two from:* red blood cells ; white blood cells ; plasma ; platelets ;	**2**

Question	Answer	Marks
2(a)(i)	sodium ;	**1**
2(a)(ii)	aluminium ;	**1**
2(a)(iii)	iron ;	**1**
2(a)(iv)	platinum ;	**1**

Question	Answer	Marks
2(b)(i)	magnesium zinc iron copper magnesium and copper correct ; zinc and iron correct ;	**2**
2(b)(ii)	lithium, sodium, potassium etc. ;	**1**
2(b)(iii)	<u>increase</u> concentration of acid ; <u>increase</u> temperature of acid ;	**2**
2(b)(iv)	$2\,HCl$;	**1**

Question	Answer	Marks
3(a)(i)	correct symbols for lamp and switch ; all in series **and** all else correct ;	**2**
3(a)(ii)	voltmeter connected across the lamp ; correct symbol ;	**2**
3(a)(iii)	lamp needs 3.0 V so two 1.5 V cells ;	**1**
3(a)(iv)	resistance = pd/current (in any form) or 3.0 / 1.5 ; = 2.0 (Ω) ;	**2**
3(a)(v)	volts ;	**1**
3(b)(i)	angle K equals angle L ;	**1**
3(b)(ii)	normal ;	**1**
3(b)(iii)	reflected / reflection ;	**1**

Question	Answer	Marks
4(a)(i)	banana tree → howler monkey → snake ;;	**2**
4(a)(ii)	*herbivore* howler monkey / three-toed sloth ; *tertiary consumer* jaguar ;	**2**
4(a)(iii)	*any two from:* loss of soil / soil erosion ; flooding ; increase of carbon dioxide in the atmosphere ; habitat destruction / animals displaced ; decreased biodiversity ; AVP ;;	**2**
4(b)	carbon dioxide ; water ;	**2**
4(c)	consumers get their energy from eating animals **or** plants / consumers can be herbivores ; carnivores get their energy from eating (only) animals ;	**2**
4(d)	decomposer ;	**1**

Question	Answer	Marks
5(a)	ice is C – particles are in regular arrangement water is B – particles are (mostly) touching and irregular arrangement steam is A – particles are widely spaced C B A ; one correct explanation ; three correct explanations ;	**3**
5(b)	evaporation ;	**1**
5(c)	7 ;	**1**
5(d)	kills bacteria ;	**1**

Question	Answer	Marks
5(e)	 1 pair of bonding electrons ; all else correct ;	**2**
5(f)	a solute – a substance that is dissolved in a solvent ; a solvent – a substance / liquid that dissolves a solute ;	**2**

Question	Answer	Marks
6(a)(i)	1200 (s) ;	**1**
6(a)(ii)	anywhere between 200 s and 800 s ;	**1**
6(a)(iii)	idea of area under graph ; $25 \times 200 \times 0.5 + 25 \times 600 + 25 \times 400 \times 0.5$ or $2500 + 15\,000 + 5000$; $= 22\,500$ (m) ;	**3**
6(b)(i)	gap allows track to expand / stops rail buckling when track expands ;	**1**
6(b)(ii)	mass of rail = 1027 kg ; volume = mass/density (in any form) or 1027 / 7870 ; $= 0.13$ (m^3) ;	**3**

Question	Answer	Marks
7(a)(i)	**A** ; sweat gland ; produces sweat **B** ; (hair erector) muscle ; contracts to erect hair	4
7(a)(ii)	whales have a thicker fat layer ; fat provides insulation / ref to insulator etc ;	2
7(b)	has receptors that detect changes in blood temperature ✓ ; contracts to trap air to increase body temperature coordinates response to changes in temperature ✓ ; acts as insulation to decrease body temperature shivers to increase body temperature sweats to decrease body temperature	2
7(c)	homeostasis ;	1

Question	Answer	Marks
8(a)(i)	refinery gas ;	1
8(a)(ii)	feedstock for making chemicals ;	1
8(a)(iii)	fractional distillation ;	1
8(a)(iv)	130 (kg) ;	1
8(a)(v)	carbon ; hydrogen ;	2

Question	Answer	Marks
8(b)(i)	coal / natural gas ;	1
8(b)(ii)	methane ;	1
8(b)(iii)	chemical change cannot be reversed by physical means / easily ; chemical change new substances are formed ;	2

Question	Answer	Marks
9(a)(i)	C ;	1
9(a)(ii)	(moving at) constant speed ;	1
9(b)(i)	nucleus ; splits ;	2
9(b)(ii)	Stop the escape of / provide better shielding from ionising radiation OWTTE ;	1
9(c)(i)	distance = speed $\times$ time (in any form) or 1550×0.8 ; = 1240 (m) ;	2
9(c)(ii)	region ; correct use ;	2

Question	Answer	Marks
10(a)	C ; D ; 95 (°C) ; C ;	4
10(b)	pH / avp ;	1
10(c)	carbon, hydrogen, oxygen **and** nitrogen all circled ;	1

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Question	Answer	Marks
10(d)	biuret ;	**1**
10(e)	;;;	**3**

Question	Answer	Marks
11(a)	protons = 20 ; neutrons = 20 ; electrons = 20 ;	**3**
11(b)	loses electrons ; 2 electrons ;	**2**
11(c)(i)	calcium oxide ;	**1**
11(c)(ii)	carbon dioxide ;	**1**
11(c)(iii)	neutralise acidic soil ;	**1**
11(d)(i)	3 ;	**1**
11(d)(ii)	5 ;	**1**

Question	Answer	Marks
12(a)(i)	friction ;	1
12(a)(ii)	electron ; negative ;	2
12(b)	the most energetic molecules escape ; average speed / energy of remaining molecules is lower ;	2
12(c)(i)	5.8×10^7 ; J ;	2
12(c)(ii)	move fast<u>er</u> ;	1
12(d)(i)	increase current / voltage **or** increase number of turns ;	1
12(d)(ii)	force ; pivot ;	2