



Cambridge IGCSE™

CO-ORDINATED SCIENCES

0654/03

Paper 3 Theory (Core)

For examination from 2025

MARK SCHEME

Maximum Mark: 120

Specimen

This document has **12** 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 descriptions for the question
- the specific skills defined in the mark scheme or in the generic level descriptions 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 descriptions.

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 descriptions 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.

mark scheme abbreviations

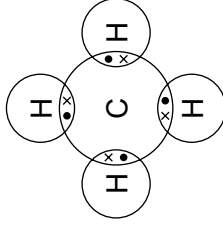
;	separates marking points
/	alternative responses for the same marking point
R	reject the response
A	accept (a less than ideal answer which should be marked correct)
I	ignore (mark as if this material was not present)
ecf	error carried forward
AVP	alternative valid point
ORA	or reverse argument
owtte	or words to that effect
AW	alternative wording (where responses vary more than usual)
AND	both responses required for the mark
OR	alternative responses for the same marking point
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
()	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks

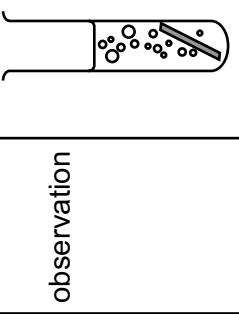
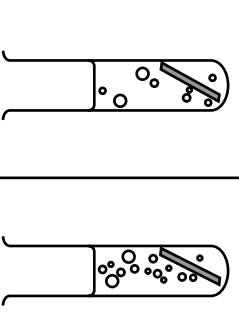
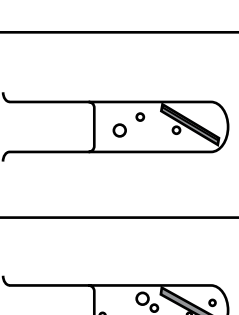
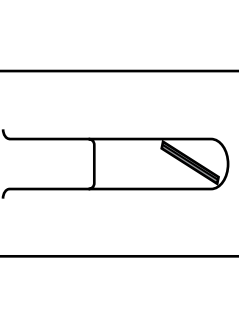
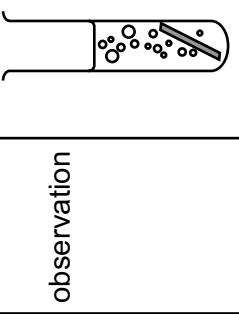
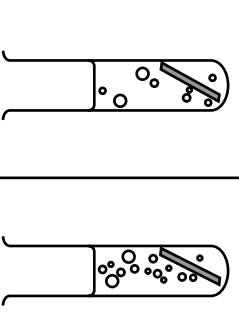
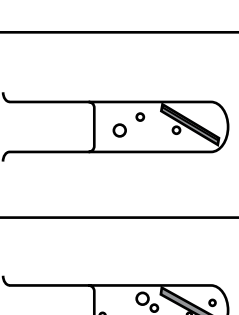
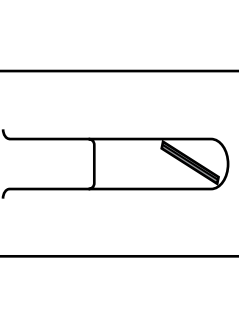
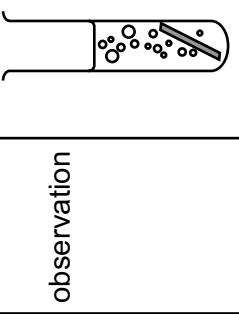
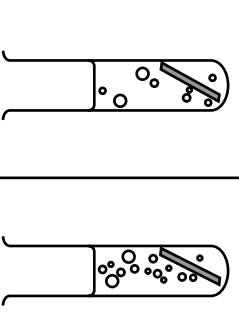
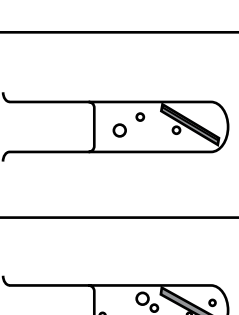
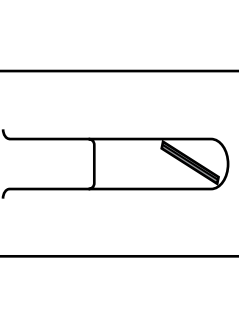
Question	Answer	Marks	Guidance
1(a)	water ; mineral ions / named mineral ion ;	2	A in either order
1(b)	glycogen / starch ; protein ; fat ; starch ;	4	
1(c)	(tissue) muscle ; (organ) heart ; liver ; lung ; (organ system) nervous system ;	3	1 or 2 correct – 1 mark 3 or 4 correct – 2 marks all 5 correct – 3 marks
1(d)(i)	(90 / 0.12) = 750 ;	1	
1(d)(ii)	to transmit electrical <u>impulses</u> over long distances / owtte ;	1	R messages / signals

Question	Answer	Marks	Guidance
2(a)(i)	deforestation ;	1	
2(a)(ii)	any three from: extinction / species become endangered ; reducing biodiversity ; loss of soil ; flooding ; increased carbon dioxide concentration (in the atmosphere) ; food chain disruption ; AVP ;	3	A enhanced greenhouse effect / global warming / climate change A loss of food source loss of, breeding sites / shelter, or animals migrate /
2(b)	any three from: increase area for housing / building / urbanisation / crop plant production / growing (named) crops ; livestock production ; extraction of natural resources / mining / dredging ; freshwater or marine pollution / (named) pollution ; AVP ;	3	
2(c)	any three from: monitoring / protecting, species ; protecting habitats ; education ; captive breeding programmes ; seed banks ;	3	A ban hunting / remove non-native species / legislation / control of trade (of organisms) A nature reserves A botanic gardens / tissue banks

Question	Answer	Marks	Guidance															
3(a)	C ; B ; E ;	3																
3(b)(i)	ovary ;	1																
3(b)(ii)	in blood / plasma ;	1																
3(c)	<table border="1"> <thead> <tr> <th>secondary sexual characteristic</th> <th>boy</th> <th>girl</th> </tr> </thead> <tbody> <tr> <td>breasts grow</td> <td></td> <td>✓</td> </tr> <tr> <td>sexual organs enlarge</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>growth of pubic hair</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>menstrual cycle starts</td> <td></td> <td>✓</td> </tr> </tbody> </table> ; ; ;	secondary sexual characteristic	boy	girl	breasts grow		✓	sexual organs enlarge	✓	✓	growth of pubic hair	✓	✓	menstrual cycle starts		✓	3	1 mark for each correct row
secondary sexual characteristic	boy	girl																
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Question	Answer	Marks	Guidance
4(a)	64 ; running ; 14 ; <u>aerobic</u> respiration ;	4	
4(b)	ECG / electrocardiogram / listening to valves (closing) ;	1	
4(c)	consuming, too many calories / too much (saturated) fat / too much salt / too much energy intake ;	1	I references to exercise
4(d)(i)	bacteria / virus ;	1	A fungi
4(d)(ii)	any two from: skin ; hairs in the nose ; mucus ; stomach acid ; white blood cells ; AVP ;	2	A cilia A antibodies

Question	Answer	Marks	Guidance
4(e)	to prevent the spread of disease ; by (indirect) transmission of (named) pathogens / contamination by (named) pathogens ;	2	R germs
Question	Answer	Marks	Guidance
5(a)(i)	helium ;	1	
5(a)(ii)	hydrogen ; oxygen ;	2	A in either order
5(a)(iii)	chlorine ;	1	
5(a)(iv)	nitrogen ;	1	
5(b)(i)	cathode correctly labelled ;	1	
5(b)(ii)	electrolyte correctly labelled ;	1	
5(b)(iii)	carbon graphite / platinum ;	1	
5(b)(iv)	oxygen ;	1	
Question	Answer	Marks	Guidance
6(a)	sulfur dioxide ; oxides of nitrogen ;	2	A nitrogen dioxide / nitrogen monoxide
6(b)	incomplete combustion of carbon-containing fuels ;	1	
6(c)	1 pair of bonding electrons between each H and the C atom ; no additional outer shell electrons on the H or C atoms ;	2	centre of electron (x) must be within overlap for mark 
6(d)	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$;	1	

Question	Answer	Marks	Guidance												
6(e)	name ends in –ane ;	1													
6(f)	aqueous bromine ;	1													
Question	Answer	Marks	Guidance												
7(a)(i)	5 (g) ;	1													
7(a)(ii)	does not contain iron / steel contains iron ; does not contain chromium and / or nickel and / or carbon ;	2													
7(a)(iii)	hardness ; resistance to rusting (corrosion) ;	2	A in either order												
7(b)(i)	hydrogen ;	1													
7(b)(ii)	<table border="1"> <tr> <td rowspan="4">observation</td> <td></td> <td>calcium</td> </tr> <tr> <td></td> <td>magnesium</td> </tr> <tr> <td></td> <td>zinc</td> </tr> <tr> <td></td> <td>copper</td> </tr> <tr> <td></td> <td>metal</td> <td>;;</td> </tr> </table>	observation		calcium		magnesium		zinc		copper		metal	;;	2	any 2 correct 1 mark all 4 correct 2 marks
observation			calcium												
			magnesium												
			zinc												
		copper													
	metal	;;													
7(c)(i)	(a catalyst) increases the rate of a reaction ; and is unchanged at the end of a reaction ;	2	A is not used up during the reaction												
7(c)(ii)	high density ; forms coloured compounds ;	2													

Question	Answer	Marks	Guidance
8(a)	same number of <u>outer shell</u> electrons / have 7 <u>outer shell</u> electrons ;	1	
8(b)(i)	(protons =) 35 ; (neutrons =) 45 ;	2	
8(b)(ii)	nucleus ;	1	
8(b)(iii)	any three from: particles in gas move quickly ; random motion / in all directions ; particles collide / particles bounce off each other ; movement of particles from higher concentration / movement of particles down a concentration gradient ; diffusion ;	3	
8(c)(i)	(dilute) hydrochloric acid ; (aqueous) sodium hydroxide ;	2	in this order
8(c)(ii)	(use a suitable) indicator / pH meter ; (end-point) is at neutralisation / correct colour change of named indicator / pH meter reads 7 (at end-point) ;	2	
Question	Answer	Marks	Guidance
9(a)(i)	distance = speed \times time or $s = v \times t$ or 340×0.40 ; 130 (m) ;	2	A $d = s \times t$ A 136
9(a)(ii)	any value above 20 ; kHz ; OR any value above 20 000 AND Hz	2	A unit in words, e.g. kilohertz
9(a)(iii)	the second bat's ultrasound is higher frequency ;	1	ORA
9(b)	echo ;	1	
9(c)	evidence of conversion of 19 g to 0.019 kg ; $W = m \times g$ or 0.019×9.8 ; 0.19 (N) ;	3	A 0.186(2) A ecf max 2 marks if $g = 10 \text{ N / kg}$

Question	Answer	Marks	Guidance
10(a)(i)	$12\,000 \times 1500$;	1	
10(a)(ii)	power = $\frac{\text{work}}{\text{time}}$ or $P = \frac{W}{t}$ or $\frac{18\,000\,000}{90}$ 200 000 (W) ;	2	A $\frac{12\,000 \times 1500}{90}$
10(b)	gravitational potential (energy) ; kinetic (energy) ;	2	A GPE A KE
10(c)	pressure = $\frac{\text{force}}{\text{area}}$ or $P = \frac{F}{A}$ or $\frac{16\,000}{4 \times 0.020}$ 200 000 (N / m ²) ;	2	
10(d)(i)	correct symbols for switch and lamps ; lamps connected in parallel ; switch controls both lamps in a complete circuit ;	3	
10(d)(ii)	any one from: both lamps get full battery voltage ; if one lamp fails the other can still work ;	1	A e.m.f. / p.d.

Question	Answer	Marks	Guidance
11(a)(i)		2	1 mark for each correct position of visible light and ultraviolet A UV for ultraviolet
11(a)(ii)	all electromagnetic waves travel at the same speed (in a vacuum) (for the same distance) ;	1	
11(b)	Milky Way ;	1	
11(c)	hydrogen ; helium ;	2	A in either order
11(d)	(small mass star) → red giant → white dwarf + planetary nebula	2	1 or 2 correct 1 mark 3 correct 2 marks
11(e)(i)	horizontal double headed arrow drawn from lens axis to the plane of the principal focus ;	1	
11(e)(ii)	refraction ;	1	
Question	Answer	Marks	Guidance
12(a)(i)	lead-lined box / surround in concrete / AVP ;	1	
12(a)(ii)	neutron AND proton AND electron ; electron ;	2	A neutron AND electron AND proton
12(b)	power = voltage × current or $P = V \times I$ or $25\,000 \times 50$; 1 300 000 (W) ;	2	A 1 250 000
12(c)(i)	100 (°C) ;	1	
12(c)(ii)	liquid – particles touching and random arrangement ; gas – particles not touching, spaced out and random arrangement ;	2	
12(d)(i)	4(.0)(kWh) ;	1	
12(d)(ii)	\$1.60 ;	1	ecf (d)(i)