

# Cambridge IGCSE™

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**COMBINED SCIENCE****0653/42**

Paper 4 Theory (Extended)

**May/June 2024****MARK SCHEME**Maximum Mark: 80

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**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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This document consists of **11** 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.

**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)	<table><tr><td>label</td><td>name of part</td><td>function</td></tr><tr><td><b>B</b></td><td>(stomach)</td><td>(digestion of protein)</td></tr><tr><td><b>(E)</b></td><td>small intestine</td><td>(digestion of insoluble molecules and) <b>absorption</b> (of soluble molecules)</td></tr><tr><td><b>(C)</b></td><td>pancreas</td><td>(secretion of lipase)</td></tr></table> <p>one mark for each correct row</p>			label	name of part	function	<b>B</b>	(stomach)	(digestion of protein)	<b>(E)</b>	small intestine	(digestion of insoluble molecules and) <b>absorption</b> (of soluble molecules)	<b>(C)</b>	pancreas	(secretion of lipase)	3
label	name of part	function														
<b>B</b>	(stomach)	(digestion of protein)														
<b>(E)</b>	small intestine	(digestion of insoluble molecules and) <b>absorption</b> (of soluble molecules)														
<b>(C)</b>	pancreas	(secretion of lipase)														
1(b)	small(er) ; mechanical ; chemical ; amino acids ;			4												
1(c)	<p>any <b>three</b> from:</p> <p>lipase activity between pH6–pH12 / lipase inactive below pH6 / lipase inactive in acidic conditions / stomach pH low / stomach is (very) acidic / stomach pH from 1.5 to 3.5 ;</p> <p>(so) lipase would <b>denature</b> (in stomach) ;</p> <p>active site, changes shape / is no longer complementary (to the substrate) ;</p> <p>lipase is unable to, bind to / fit, substrate ;</p>			3												

Question	Answer	Marks
2(a)	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>separation process</b></p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">crystallisation</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">filtration</div> <div style="border: 1px solid black; padding: 5px;">chromatography</div> </div> <div style="text-align: center;"> <p><b>description</b></p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">separating an insoluble solid from a mixture of a solid in water</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">separating dyes from a mixture of dyes in a coloured ink</div> <div style="border: 1px solid black; padding: 5px;">separating a salt from an aqueous solution</div> </div> </div> <p><i>all three correct = (2) one or two correct = (1)</i></p>	<b>2</b>
2(b)	<p>water, boils / is heated <b>and</b> evaporates / becomes steam / becomes water vapour / leaves the flask ;</p> <p>steam / vapour / it is, cooled in the condenser OR steam / vapour / it, condenses ;</p> <p>salt is left behind / salt does not evaporate (with the water) / <b>only</b> water evaporates ;</p>	<b>3</b>
2(c)(i)	<p><i>any <b>two</b> from:</i></p> <p>is <b>ionic</b> / has <b>ionic</b> bonds ;</p> <p>strong attraction / force, <b>between ions</b> (in ionic lattice) ;</p> <p>due to opposite charges / ions have opposite charges ;</p> <p>need lots of <b>energy</b> to, break bonds / separate the ions / separate the particles (therefore high mp) ;</p>	<b>2</b>

Question	Answer	Marks
2(c)(ii)	<b>energy is needed</b> to, change state / make particles <b>move</b> (more) ; more energy needed to, overcome forces between / separate particles when, changing from liquid to gas than from solid to liquid ;	<b>2</b>
2(c)(iii)	particles in solid ( $-10^{\circ}\text{C}$ ) in regular arrangement, consistent size and touching ; fewer particles in gas ( $+110^{\circ}\text{C}$ ), consistent size and <b>not</b> touching ;	<b>2</b>

Question	Answer	Marks
3(a)	chemical ; thermal ;	<b>2</b>
3(b)	air (above flame) is heated ; less dense air rises ;	<b>2</b>
3(c)(i)	number of wavelengths, per <u>unit</u> time / per second ;	<b>1</b>
3(c)(ii)	microwaves / radio waves ;	<b>1</b>
3(c)(iii)	$(\lambda = ) v \div f$ <b>or</b> $3.0 \times 10^8 \div 0.95 \times 10^{14}$ ; $3.2 (3.16) \times 10^{-6} \text{ (m)}$ ;	<b>2</b>

Question	Answer	Marks
4(a)(i)	vacuole <b>and</b> cytoplasm circled ;	<b>1</b>
4(a)(ii)	large surface area / <b>elongated</b> shape ; increases, <b>rate</b> of absorption / uptake of water / uptake of mineral (ions) ;	<b>2</b>

Question	Answer	Marks
4(b)(i)	(as light intensity increases) rate of photosynthesis increases, <b>and</b> then levels off / is constant ;	1
4(b)(ii)	more light / less competition for light ; more CO <sub>2</sub> / less competition for CO <sub>2</sub> / CO <sub>2</sub> is released by combustion ;	2
4(c)	magnesium is required to <b>make</b> chlorophyll ; chlorophyll is a green pigment ;	2

Question	Answer	Marks
5(a)	(overall) energy change is endothermic <b>or</b> more energy taken in than given out ; <b>and either</b> bond breaking is endothermic / energy is taken in to break bonds <b>or</b> bonds forming is exothermic / energy is given out when bonds form ;	2
5(b)(i)	$2\text{NO(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{NO}_2\text{(g)} ; ;$ <i>correctly balanced equation = (1)</i> <i>state symbols (g) (g) (g) = (1)</i>	2
5(b)(ii)	reactants higher than products <b>and</b> maximum shown ; activation energy and up-arrow <b>and</b> energy change of reaction and down-arrow ;	2



Question	Answer	Marks
6(a)(i)	max. speed = $0.010 \text{ m/s}$ <b>OR</b> $3600$ <b>OR</b> $1000$ ; both conversions seen $3600 \text{ (s)}$ <b>and</b> $1000 \text{ (m)}$ and correct substitution ;	<b>2</b>
6(a)(ii)	$(a =) \Delta v \div t$ <b>or</b> $0.005 \div 50$ ; $0.0001(0) / 1 \times 10^{-4}$ ; $\text{m/s}^2$ ;	<b>3</b>
6(a)(iii)	acceleration ; acceleration is not constant ;	<b>2</b>
6(b)(i)	$\text{KE} = \frac{1}{2} mv^2$ ( <i>in any form</i> ) <b>or</b> $\frac{1}{2} \times 890 \times 0.05 \times 0.05$ ; $= 1.1125$ ; ( $\approx 1.1$ )	<b>2</b>
6(b)(ii)	$\text{GPE (gained)} = 1.1 \text{ J}$ ; ( $\text{GPE} =) mgh$ <b>or</b> $890 \times 3.8 \times h$ <b>or</b> $h = 1.1 \div (890 \times 3.8)$ ; $0.33 \text{ mm}$ ;	<b>3</b>

Question	Answer	Marks
7(a)(i)	<b>X</b> pulmonary vein ; <b>Y</b> aorta ;	<b>2</b>
7(a)(ii)	septum labelled ;	<b>1</b>
7(a)(iii)	separates blood with and without oxygen ; blood to lungs at lower pressure <b>or</b> blood to body at higher pressure ;	<b>2</b>

Question	Answer	Marks
7(b)(i)	any <b>two</b> from: large surface / large area ; thin (surface) ; good blood supply ; good ventilation ; AVP, e.g. moist ;	<b>2</b>
7(b)(ii)	Carbon dioxide is a product of respiration. ;  Water evaporates from the lining of the alveoli. ;  <i>three ticks and two correct = 1 mark</i> <i>three ticks and one correct = 0 marks</i> <i>more than three ticks = 0 marks</i>	<b>2</b>

Question	Answer	Marks
8(a)	hydrogen / H <sub>2</sub> ;  magnesium oxide / MgO / magnesium hydroxide / Mg(OH) <sub>2</sub> ;  hydrochloric acid / HCl ;  carbon dioxide <b>AND</b> water / CO <sub>2</sub> <b>AND</b> H <sub>2</sub> O ;	<b>4</b>
8(b)(i)	sulfuric acid / hydrochloric acid ;	<b>1</b>
8(b)(ii)	water ;	<b>1</b>

Question	Answer	Marks
8(c)	<p>any <b>three</b> from:</p> <p>magnesium is in Group II ;</p> <p>magnesium has two electrons in the outer shell ;</p> <p>metals are on left of the Periodic Table ;</p> <p>metals have, low / 1–3, electrons in the outer shells ;</p>	<b>3</b>

Question	Answer	Marks
9(a)	a.c. power supply ;	<b>1</b>
9(b)(i)	<p><math>(R =) V \div I</math> in any form <b>or</b> <math>240 \div 25</math> ;</p> <p>9.6 (A) ;</p>	<b>2</b>
9(b)(ii)	<p><math>(P =) V \times I</math> in any form <b>or</b> <math>240 \times 9.6</math> ;</p> <p>2300 (W) / 2.3 kW ;</p>	<b>2</b>
9(c)	<p>lamp symbol connected in parallel with heater ;</p> <p>lamp symbol in parallel and connected to left of heater <b>and</b> to the left of the heater's switch ;</p>	<b>2</b>