

Cambridge IGCSE™

CO-ORDINATED SCIENCES**0654/62**

Paper 6 Alternative to Practical

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MARK SCHEME

Maximum Mark: 60

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **21** printed pages.

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: - the specific content defined in the mark scheme - the specific skills defined in the mark scheme or in the level descriptions - the standard of response required as exemplified by the standardisation scripts.
2	Examiners must award whole marks (not half marks, or other fractions).
3	Examiners must award marks positively . This means that: - marks are not deducted for errors or omissions - marks are awarded for correct/valid answers as defined in the mark scheme and also for other valid answers which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate - the quality of spelling, punctuation and grammar are judged only when the mark scheme indicates that these features are specifically assessed in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must consistently apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the full range of marks defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and must not award marks 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	<u>'List rule' guidance</u> For questions that require <i>n</i> responses (e.g. State two reasons ...): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>. • Incorrect responses should not be awarded credit but will still count towards <i>n</i>. • 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 <i>n</i> 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
	incorrect point or mark not awarded
	benefit of the doubt given
	follow through
	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied.
	response is too vague or there is insufficient detail in response
	error carried forward applied
	information missing or insufficient for credit
	unclear response
	incorrect or insufficient point ignored while marking the rest of the response

Annotation	Meaning
R	incorrect point or mark not awarded
CON	contradiction in response, mark not awarded
LNK	two statements are linked
SEEN	point has been noted, but no credit has been given or blank page seen
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
BP	blank page

Mark Scheme Abbreviations

;	separates marking points
/	separates alternative responses for the same marking point
Allow	accept (a less-than-ideal answer which should be marked correct)
Ignore	ignore (mark as if this material was not present)
AND	indicates that two or more parts of a response are required for the mark
AVP	alternative valid point
AW	alternative wording (where responses vary more than usual)
NOT	indicates an incorrect response that would contradict another otherwise correct alternative
OR	alternative responses for the same marking point
owtte	or words to that effect
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
ecf	error carried forward
ORA	or reverse argument
()	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)(i)	M1 5.0 ; M2 3.5 ; M3 both to 1dp ;	3	ALLOW ± 0.1 for both values ALLOW 5 ALLOW ecf for M2 if M1 given in mm
1(a)(ii)	5.2 AND 3.4 ;	1	ecf on 1(a)(i) The two values must be to the same number of significant figures ALLOW 5.15 and 3.35 OR 5.1 and 3.3
1(a)(iii)	as (enzyme / celery) volume increases height increases ORA ;	1	NOTE both variables need to be comparative DO NOT ALLOW proportional / negative IGNORE positive correlation / positive
1(a)(iv)	as volume increases rate increases ORA ;	1	NOTE both variables need to be comparative ALLOW as volume increases reaction is faster IGNORE (directly) proportional / positive / positive correlation DO NOT ALLOW negative

Question	Answer	Marks	Guidance
1(a)(v)	lower (total) <u>height</u> ;	1	NOTE needs to be comparative ALLOW smaller heights / height decreases IGNORE no increase in height IGNORE smaller results IGNORE slower
1(b)(i)	ensure celery cells are evenly distributed ;	1	ALLOW even distribution (of celery) / even spread of celery / enzyme ALLOW even enzyme distribution ALLOW hydrogen peroxide in contact with all celery / enzyme / all hydrogen peroxide in contact with enzyme / celery ALLOW the concentration (of celery / enzyme) is even IGNORE ensure celery cells have not settled (at the bottom of the tube) IGNORE evenly mix – mix is in the Question / evenly combined IGNORE to react / to get complete reaction / speed up the reaction / increase collision of particles IGNORE dissolving the enzyme / celery

Question	Answer	Marks	Guidance
1(b)(ii)	to increase surface area (for enzyme action) / to release enzyme (from the cells) ;	1	ALLOW (to form a) large surface area ALLOW to break open the cells IGNORE mixing / increase rate of reaction / increase the surface area of a molecule

Question	Answer	Marks	Guidance
1(b)(iii)	M1 top of bubbles not level / flat / bubbles burst / M2 (add no detergent and) measure volume of gas given off (with a syringe) / OR M1 ruler doesn't start with 0 at the end / dead space at end of ruler ; M2 just measure the foam OR M1 boiling tube is curved (at the bottom) M2 do experiment in a measuring cylinder / beaker / conical flask / (add no detergent and) measure volume of gas given off (with a gas syringe) / measure the height of the foam only ;	2	IGNORE foam starts to fall IGNORE irregular shape ALLOW use a light sensor / use a light gate ALLOW measure to the topmost part of the foam each time ALLOW measure mass / film it IGNORE measure to the lowest level of the foam IGNORE levelling the foam with a ruler / measure volume not height meniscus If no marks awarded ALLOW 1 max for parallax (or described) and the description of how to read the measurement correctly: at eye level to the reading / at 90 ° to the reading / perpendicular to the reading / eye level to the measurement / measure at eye level IGNORE eye level to the scale

Question	Answer	Marks	Guidance
1(b)(iv)	measuring cylinder / syringe ;	1	ALLOW graduated pipette / volumetric pipette / burette IGNORE pipette unqualified DO NOT ALLOW dropping pipette / teat pipette / eye dropper
1(b)(v)	Benedict's and heat ;	1	

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Question	Answer	Marks	Guidance
2	one mark from each section and any two other marks 1 apparatus timer / stop-watch and it's use in the method ; pulse meter and it's use in the method ; tape measure and it's use in the method ; 2 method pulse rate at rest, exercise, time to return to resting pulse and at least 2 heights ; 3 measurements pulse before (and immediately after exercise) ; height (of the people) ; time to return to normal / resting pulse ; repeats at same height to identify / exclude anomalies ; at least 5 different heights used ; 4 constant variables (person) same gender / same age / (idea of) same fitness/health ; (exercise) same time for exercise / same type of (named) exercise ; 5 processing results/conclusion plot graph of recovery time against height ; description of how to interpret the graph e.g. straight line through origin is proportional etc. ; look to see if increasing height increases or decreases (or doesn't affect) the recovery time ;	7	ALLOW ECG / smart watch / heart rate monitor / BPM tracker / BPM monitor / heart monitor / pulse rate counter IGNORE pulse rate detector / BPM machine IGNORE manual counting for apparatus ALLOW rule(r) IGNORE weight IGNORE exercise to same bpm IGNORE stated conclusion ALLOW just time provided they have explained earlier it is the recovery time

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Question	Answer	Marks	Guidance
3(a)(i)	tare / zero the balance ;	1	ALLOW reset the balance / start balance from 0 IGNORE clean the balance / make sure nothing is on the balance / restart the balance IGNORE reset the values
3(a)(ii)	doesn't leave soot on the bottom of the evaporating basin ;	1	ALLOW yellow flame sends bottom of basin black IGNORE faster reaction/evaporation IGNORE to see the colour change
3(a)(iii)	51.1 ; 45.7 ;	2	
3(b)(i)	5.4 / 5.45 ;	1	ecf on 3(a)(iii) IGNORE 5.40
3(b)(ii)	0.30 ;	1	ecf, ALLOW 0.3 ALLOW 0.303 / 0.3027777777 any sf (using 5.45) rounded or truncated IGNORE 0.300

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Question	Answer	Marks	Guidance
3(b)(iii)	3.6 ;	1	ecf min 2sf, rounded or truncated ALLOW 3.57 (using balance readings) ALLOW 3.60
3(b)(iv)	0.034 ;	1	ecf 0.0339622641 min 2sf, rounded or truncated ALLOW 0.033679245 minimum 2sf IGNORE 0.0340
3(b)(v)	8.8 ; 9 ;	2	ecf 8.82352941 any sf rounded or truncated 1sf and correctly rounded NOTE 9 scores both marks
3(c)	water still there and heat to constant mass ;	1	ALLOW water still there and heat again / water still there and heat for longer

Question	Answer	Marks	Guidance
3(d)	(heat) to evaporate half / some water / heat to saturate (solution) and leave to crystallise / cool ;	1	ALLOW (heat to) evaporate half / some water and leave solution somewhere warm ALLOW heat until crystals just form and leave to cool / crystallise ALLOW evaporate some of the water and leave ALLOW heat and leave the solution (to cool) DO NOT ALLOW heat to dryness DO NOT ALLOW leave to dryness NOTE crystallisation is insufficient
3(e)	M1 anhydrous copper sulfate ; M2 white to blue ; OR M1 anhydrous cobalt chloride ; M2 blue to pink ;	2	M2 is dependent on M1 unless M1 is missing (or a near miss e.g. copper sulfite / cobalt chlorine) ALLOW white copper sulfate read anhydrous if starting colour is white ALLOW blue cobalt chloride read anhydrous if starting colour is blue

Question	Answer	Marks	Guidance
3(f)	carbon dioxide also given off AND CO ₂ has mass ;	1	ALLOW loses mass as carbon dioxide ALLOW CO₂ has mass ALLOW CO₂ leaves the evaporating basin / CO₂ escapes / CO₂ is given off / CO₂ is released IGNORE CO₂ evaporates / CO₂ is made DO NOT ALLOW CO given off / CO² IGNORE the oxide is formed

Question	Answer	Marks	Guidance
4(a)	zinc and iodide and sulfate / correct symbols ;	1	ALLOW Zn^{2+} , I^- , SO_4^{2-} NOTE If both names and formulae are given they must match DO NOT ALLOW iodine
4(b)	to breakdown any carbonate ;	1	ALLOW remove carbonate / so carbonate cannot give a precipitate
4(c)	HCl gives white ppt and would mask colour of iodide ppt ;	1	ALLOW HCl gives (also) a (white) precipitate NOTE HCl contains chloride ions is insufficient
4(d)	wire / splint into solution and into a flame ; blue/roaring (Bunsen) flame ;	2	ALLOW cotton bud / stick / rod / loop IGNORE spraying into flame IGNORE spoon / spatula IGNORE into Bunsen burner ALLOW non-luminous flame IGNORE into Bunsen burner

Question	Answer	Marks	Guidance
5(a)(i)	5.6 ; 7.0 ;	2	
5(a)(ii)	0.56 and 0.70 ;	1	ecf 5(a)(i) $\div 10$ ALLOW 0.56 and 0.7
5(a)(iii)	0.31 and 0.49 ;	1	DO NOT ALLOW 0.50 from 0.7
5(b)(i)	axes labelled with quantity and unit ; sensible linear scales and plotted points cover $\geq \frac{1}{2}$ grid and all must be able to be plotted ; points plotted correctly $\pm \frac{1}{2}$ small square ;	3	y axis T^2 and s^2 and x axis m / mass and g ALLOW 1 error
5(b)(ii)	straight line of best fit ;	1	points both sides of the line but ALLOW if they put through the origin and miss point at 200, OR the other points join a line and miss point at 100
5(b)(iii)	triangle using at least half of the line ; gradient correct ;	2	quality mark expect 0.0013 – 0.0017 ecf on 3(b)(ii)
5(b)(iv)	k correct ;	1	ecf on 5(b)(iii) min 2sf rounded or truncated

Question	Answer	Marks	Guidance
5(b)(v)	yes and straight line passes through origin / $T^2 \div m$ OR $m \div T^2 = \text{constant}$;	1	correct statement and explanation accept ecf from (b)(ii) incorrect line of best fit If their line passes through the origin ALLOW yes and the (straight) line passes through the origin OR if their line doesn't pass through the origin ALLOW no as the (straight) line does not go through the origin ALLOW no and $T^2 \div m$ OR $m \div T^2$ is not constant ALLOW no and as m doubles T^2 doesn't double IGNORE as T^2 increases so m increases IGNORE straight line unqualified
5(c)	reaction time spread over more oscillations ;	1	ALLOW reduces / smaller random error / smaller % error / error has less effect (on 20 swings than 10 swings) / reaction time has less effect (on 20 swings than 10 swings) / reaction time is less significant IGNORE early oscillations are faster / slower IGNORE 20 swings takes longer unqualified IGNORE accuracy IGNORE 20 are easier to measure

Question	Answer	Marks	Guidance
6(a)	68.0 ; 29.5 ;	2	ALLOW 68
6(b)	10.5 and 38.5 ;	1	ecf from (a)
6(c)	no and $10.5 \times 2 = 21$ (not 38.5 / not within 10%) / $38.5 \div 2 = 19.25$ (not 10.5 not within 10%) ;	1	ecf from 6(b) calculation needed ALLOW $38.5 \div 10.5 = 3.67$ (not 2) / it is 3.67 times larger (allow value truncated or rounded)
6(d)	suitable hazard AND precaution ; e.g. hot water / hot beaker and hands / eyes / skin and use (heatproof) gloves / goggles	1	ALLOW hot beaker / hot water and hands and use tongs
6(e)	bulb not fully submerged AND thermometer (bulb) touching the beaker ;	1	IGNORE thermometer should be in the middle
6(f)	reading higher than 4 °C and less than 19 AND liquid level / thermometer has not stopped falling ;	1	ALLOW thermometer hasn't reached lowest temperature ALLOW thermometer takes time to get to 4 °C