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GCSE (9–1)

**Combined Science A (Chemistry) A (Gateway
Science)**

J250/10: Paper 10 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science A:















	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

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Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
<u>—</u>	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions**INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

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For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	A	1	1.1	
2	A	1	1.1	
3	C	1	2.1	
4	A	1	1.1	
5	B	1	2.2	
6	D	1	1.1	
7	A	1	1.1	
8	C	1	1.1	
9	B	1	1.1	
10	D	1	2.2	

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Question		Answer	Marks	AO element	Guidance
11	(a)	<p>Less waste sent to landfill ✓ (Because) more is recycled / more is burned (to produce energy) / public more aware of recycling/environmental issues due to landfill / want to reduce greenhouse gases/conserve finite resources / less bin collections for landfill ✓</p> <p>Or</p> <p>More waste recycled ✓ (because) less waste sent to landfill / public more aware of recycling/environmental issues due to landfill / conserve finite resources / government promotion / less bin collections for landfill ✓</p> <p>Or</p> <p>More is burned (to produce energy) ✓ (because) less waste sent to landfill / Save fossil fuels / (it is an) alternative/renewable resource ✓</p>	2	<p>3.1a 2.1</p> <p>3.1a 2.1</p> <p>3.1a 2.1</p>	<p>Description and explanation are required for 2 marks</p> <p>ALLOW other valid explanations</p>

Question		Answer	Marks	AO element	Guidance
	(b)	<p>Any one from: expensive ✓ (hot) water wasted/used ✓ (material) needs cleaning ✓ need collecting/transporting/sorting/separating ✓ lots of/more energy/fuel wasted/used ✓ time consuming ✓ pollution/emissions produced ✓ quality deteriorates ✓</p>	1	1.1	IGNORE not all materials can be recycled

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Question		Answer	Marks	AO element	Guidance	
12	(a)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ Formulae ✓ Balancing ✓	2	2.1 2.2	<p>ALLOW any correct multiple, including fractions</p> <p>ALLOW = / \rightleftharpoons instead of \rightarrow</p> <p>NOT and / & instead of +</p> <p>balancing mark is dependent on the correct formulae but</p> <p>ALLOW 1 mark (MP2) for a balanced equation with a minor error in subscripts / formulae eg $\text{MG} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$</p>	
	(b)	(i)	Concentration (of the acid) ✓	1	3.3a	IGNORE volume/amount
		(ii)	<p>Any two from:</p> <p>(Keep) mass/amount of Mg (constant/ the same) ✓</p> <p>(Keep) temperature (constant/ the same) ✓</p> <p>(Keep) surface area (of Mg the constant/ the same) ✓</p>	2	2×3.3a	<p>IGNORE volume of acid</p> <p>ALLOW (Keep) size/length of Mg (constant/ the same)</p> <p>ALLOW (Keep) type of acid (the same) ✓</p> <p>ALLOW 1 mark for magnesium unqualified if no other mark given.</p>

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Question		Answer	Marks	AO element	Guidance
	(c)	<p>Any one from: Stopwatch not reset ✓</p> <p>Equipment not washed out (properly after use) ✓</p> <p>Concentration of acid incorrect ✓</p> <p>Volume/amount of acid incorrect or mass/amount Mg added incorrect ✓</p> <p>reaction mixture not stirred consistently / AW ✓</p>	1	3.3a	<p>ALLOW stopwatch started or stopped late/early ALLOW stopwatch misread ALLOW timed incorrectly</p> <p>ALLOW different sizes of Mg</p> <p>IGNORE references to temperature</p>
	(d)	<p>As concentration increases, rate of reaction increases / time for reaction decreases / ORA ✓</p> <p>(Greater concentration means) more particles in same volume / ORA ✓</p> <p>So more collisions per second / greater chance of a collision / more frequent collisions / ORA ✓</p>	3	<p>3.2a</p> <p>1.1</p> <p>1.1</p>	<p>ALLOW molecules/ions/atoms for particles throughout</p> <p>ALLOW Rate stays constant after 0.8 (mol/dm³) / at higher concentration</p> <p>ALLOW more crowded particles / AW</p> <p>DO NOT ALLOW particles have more energy</p> <p>AW</p>

Question	Answer	Marks	AO element	Guidance
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Question	Answer	Marks	AO element	Guidance
13	<p data-bbox="309 236 1113 300">* Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p data-bbox="309 325 1113 357">Level 3 (5–6marks)</p> <p data-bbox="309 357 1113 446">Detailed explanation relating boiling points from graph in Fig. 13.2 to intermolecular forces and average number of carbon atoms per chain in Fig. 13.1.</p> <p data-bbox="309 472 1113 561"><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p data-bbox="309 587 1113 619">Level 2 (3–4 marks)</p> <p data-bbox="309 619 1113 683">Detailed explanation relating boiling points from graph in Fig. 13.2 to average number of carbon atoms per chain in Fig. 13.1.</p> <p data-bbox="309 683 1113 715">OR</p> <p data-bbox="309 715 1113 778">Detailed explanation relating boiling points from graph in Fig. 13.2 to intermolecular forces.</p> <p data-bbox="309 778 1113 810">OR</p> <p data-bbox="309 810 1113 874">Detailed explanation relating intermolecular forces and average number of carbon atoms per chain in Fig. 13.1.</p> <p data-bbox="309 890 1113 954"><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p data-bbox="309 979 1113 1011">Level 1 (1–2 marks)</p> <p data-bbox="309 1011 1113 1075">An attempt to relate boiling points from graph in Fig. 13.2 to average number of carbon atoms per chain in Fig. 13.1.</p> <p data-bbox="309 1075 1113 1107">OR</p> <p data-bbox="309 1107 1113 1171">An attempt to relate boiling points from graph in Fig. 13.2 to intermolecular forces.</p> <p data-bbox="309 1171 1113 1203">OR</p> <p data-bbox="309 1203 1113 1267">An attempt to relate intermolecular forces and average number of carbon atoms per chain in Fig. 13.1.</p> <p data-bbox="309 1283 1113 1347"><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p data-bbox="309 1362 1113 1394">0 marks No response or no response worthy of credit.</p>	6	3x1.1 3x3.1a	<p data-bbox="1444 236 2060 373">AO1.1 Demonstrate knowledge and understanding of scientific ideas concerning the separation of crude oil by fractional distillation</p> <ul data-bbox="1460 373 2049 654" style="list-style-type: none"> • Longer hydrocarbons have stronger intermolecular forces between them • Stronger intermolecular forces result in a higher boiling points • More energy needed to overcome stronger intermolecular forces • Different fractions condense at different heights/ boiling points so get separated <p data-bbox="1444 683 2060 756">AO3.1a Analyse information and ideas to interpret data from Fig. 13.1 and Fig. 13.2</p> <ul data-bbox="1460 756 2049 1075" style="list-style-type: none"> • Fractions with lower boiling points condense further up column • as temperature decreases with height • As column height increases, boiling points decrease / ORA • As column height increases, number of carbon atoms per chain decreases /ORA • Larger molecules have higher b.pt. / ORA • Quantifiable analysis of graph in Fig. 13.2

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Question		Answer	Marks	AO element	Guidance
14	(a)	Sodium/Na ✓	1	3.1a	IGNORE incorrect symbol if correct name given
	(b)	(i) Sodium bromide / NaBr ✓	1	3.1a	ALLOW ECF if group 1 metal selected in (a) IGNORE incorrect formula if correct name given
		(ii) $2\text{Na(s)} + \text{Br}_2\text{(l)} \rightarrow 2\text{NaBr(s)}$ 1 mark for correct formulae and state symbols ✓ 1 mark for correct balancing ✓	2	2×2.2	ALLOW ECF if group 1 metal selected in (a)
	(c)	(i) Sodium chloride / NaCl ✓	1	3.1a	ALLOW ECF if group 1 metal selected in (a) IGNORE salt IGNORE incorrect formula if correct name given
		(ii) NaOH neutralises HCl / acid + alkali gives salt + water ✓ Or Chlorine more reactive than bromine / chlorine displaces bromine (from a salt) ✓	1	1.1	IGNORE references to chloride and bromide
	(d)	Carbon dioxide: (Bubble / pass gas through) limewater / Ca(OH)_2 and (limewater) stays colourless/does not turn milky / AW ✓ Hydrogen: (Insert) lit splint/flame (into gas) and pop / AW ✓ Oxygen: (Insert) glowing splint (into gas) and (splint) does not relight / AW ✓	3	3×2.2	IGNORE squeaky pop test DO NOT ALLOW using splint that is completely blown out

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Question		Answer	Marks	AO element	Guidance
15	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.12 (g) award 4 marks</p> <p>$M_r(\text{SO}_2) = 64.1 / M_r(\text{SO}_3) = 80.1 \checkmark$</p> <p>Mass of $\text{SO}_3 = 100 \times 10^{-3} \times \frac{80.1}{64.1} \checkmark$</p> <p>Mass = 0.124960998 (g) \checkmark</p> <p>Mass = 0.12(g) (2dp) \checkmark</p>		<p>3×2.2</p> <p>1.2</p>	<p>ALLOW alternative method</p> <p>$M_r(\text{SO}_2) = 64.1 / M_r(\text{SO}_3) = 80.1$</p> <p>Moles SO_2: $\frac{0.1}{64.1} = 0.00156$ so SO_3: 0.00156×80.1</p> <p>Mass = 0.124960998 (g)</p> <p>Mass = 0.12 (g) (2dp)</p> <p>ECF if processing of data has given an incorrect value but expressed as 2DP</p> <p>ALLOW 125 for 2 marks</p> <p>ALLOW 124.96 (2dp) for 3 marks</p>
	(b)	Concentration \checkmark	1	1.1	ALLOW change in reactants or products
	(c)	(i)	2	2×2.1	IGNORE rate
		<p>Equilibrium moves to left / moves to endothermic side / backward reaction favoured / less SO_3 produced / more SO_2 produced / AW \checkmark</p> <p>As reaction is exothermic \checkmark</p>			

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Question		Answer	Marks	AO element	Guidance
	(ii)	Equilibrium moves to right / forward reaction favoured / more SO ₃ produced / less SO ₂ produced / AW ✓ Fewer molecules on the RHS / fewer moles on RHS / ORA / As decrease in volume / volume of products < volume of reactants ✓	2	2×2.1	IGNORE rate
	(d) (i)	Any two from: Burning fossil fuels (in power plants/industry) ✓ (Using) diesel/petrol (in vehicles) ✓ (using) diesel/petrol (in generators) ✓ (using) fuel oil (in ships) ✓ volcanoes ✓	1	1.1	TWO sources required ALLOW named fossil fuel
	(ii)	Any two from: damage to fish / wildlife / habitats / trees / crops ✓ corrosion of buildings / statues / limestone / marble ✓ corrodes metals ✓ respiratory problems AW ✓	2	2×1.1	IGNORE pollution IGNORE acid rain ALLOW plants ALLOW deforestation ALLOW erodes AW

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Question		Answer	Marks	AO element	Guidance
16	(a)	CH ₄ AND C ₂ H ₆	1	1.2	
	(b)	(i)	2	2×2.2	Points plotted correctly to within ±½ square on appropriate scale ✓ Line of best fit is a straight line ✓ DO NOT ALLOW straight lines through the origin IGNORE line drawn before/after plots
		(ii)	2	1.2 ×2.2	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 650 (kJ / mol / CH₂ unit per molecule) award 2 marks Gradient = $\frac{\text{rise}}{\text{run}} / \frac{\text{increase in y}}{\text{increase in x}}$ ✓ Gradient = 650 (kJ / mol / CH ₂ unit per molecule) ✓ ALLOW equation shown as numbers from graph ± 1 square If written equation given ignore numbers from graph ECF from line of best fit on graph
		(iii)	2	2×2.2	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6770(kJ / mol) award 2 marks E = energy of combustion of octane + 2×650 ✓ E = 6770 (kJ/mol) ✓ ALLOW ECF from (b)(ii) i.e. answer = 2 × answer to (b)(ii) + 5470 ALLOW answers using other enthalpies of combustion in table. ALLOW alternative method (Rise from 0 to line on y axis) + (8 x answer to (b)(ii))

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Question		Answer	Marks	AO element	Guidance
	(c)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 392 (kJ / mol) award 4 marks</p> <p>E (released) = bonds broken – bonds made ✓ OR $-2220 = 8 \times (\text{C-H}) + 2(347) + 5(498) - 6(805) - 8(464)$ ✓</p> <p>AND $8 \times (\text{C-H}) = -2220 - 3184 + 8542 = 3138$ ✓</p> <p>$(\text{C-H}) = 3138/8 = 392.25$ ✓</p> <p>$= 392$ (kJ / mol) (to 3 sf) ✓</p>	4	<p>3×2.2</p> <p>1.2</p>	<p>ECF if processing of data has given an incorrect value but expressed as 3SF</p>

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