GCSE (9–1) H

Combined Science B (Twenty First Century Science)

J260/06: Chemistry (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.

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
__	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.

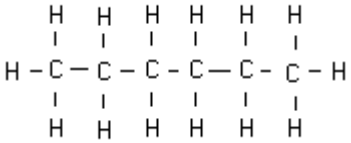
You should ensure that you have copies of these materials.

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.

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

	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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>Empirical Formulae = C_3H_8 AND C_2H_5 ✓
Molecular Formula = C_6H_{14} ✓
Structural Formula = ✓
  </td><td>3</td><td>2.2</td><td>All bonds must be shown</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th></th><th>True</th><th>False</th></tr><tr><td>It shows the simplest ratio of atoms in a molecule.</td><td></td><td>✓</td></tr><tr><td>It shows how many atoms are in a molecule.</td><td>✓</td><td></td></tr><tr><td>It shows how atoms in a molecule are arranged.</td><td>✓</td><td></td></tr><tr><td>It shows the molecule in 3D.</td><td></td><td>✓</td></tr></table></td><td>2</td><td>1.1</td><td>4 correct = two marks
3 or 2 correct = one mark
1 or 0 correct = zero marks</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>60 to 100°C ✓
(actual value 69°C)</td><td>1</td><td>3.2b</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>The values go up and down ✓</td><td>1</td><td>3.2a</td><td>ALLOW fluctuate/ not regular/not flowing in a steady correlation/no trend
IGNORE does not change/does not vary</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Liquid ✓
Above melting point AND below boiling point ✓</td><td>2</td><td>3.2b</td><td>ALLOW between melting point and boiling point
IGNORE melting point and boiling point quoted without reference to above/below/between etc.</td></tr>
</table>

		(iv)	**Any two from:** Boiling points increase as number of carbons increases/Molecules get bigger ✓ Intermolecular forces get stronger / more intermolecular forces ✓ More energy needed to separate the molecules ✓	**2**	**2.1**	**IGNORE** boiling points increase down the table. **IGNORE** bonds if not clear that bonds are intermolecular. **DO NOT ALLOW** stronger intermolecular if between atoms/elements **ALLOW** more energy to break intermolecular forces **DO NOT ALLOW** more energy to break it down

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Their diameters are between 1 to 100nm ✓	1	1.1	
		(ii)	Bonds between carbon atoms are strong. ✓ Lots of bonds must be broken to break the tube. ✓	2	1.1	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2500(mm) award 3 marks** 2nm = 2 x 10^{-6} mm ✓ 0.001 ÷ 2 x 10^{-6} = 500 ✓ 500 x 5 = 2500 (mm) ✓	3	1.2 2.2x2	
	(b)		**Benefit** get to where it's needed / less harm to rest of body ✓ **Risk** possible side effects/ long term effects not known ✓	2	2.1	**ALLOW** keeps medicine in one place/non-invasive method/more effective/smaller doses needed/acts as a vector (for the drug) **ALLOW** not enough research/body may reject it/get lost inside body **IGNORE** references to infection, named side effects/ new science/ expensive

Question			Answer	Marks	AO element	Guidance
3	(a)		**Any two from:** Solid forms ✓ goes cloudy ✓ sulfur forms ✓	2	2.2	 **ALLOW** misty/no longer transparent/no longer clear
	(b)	(i)	Burette/pipette/measuring cylinder ✓	1	3.3a	**ALLOW** syringe
		(ii)	So (total) volume is the same ✓ concentration of sodium thiosulfate kept constant ✓	2	3.3a	**ALLOW** more water lowers concentration of <u>acid</u> **ORA** **IGNORE** affects the concentration of the acid without linking amount of water with effect on concentration **IGNORE** reference to solution without specifying acid or sodium thiosulfate.
		(iii)	As concentration of acid increases rate of reaction increases ✓ Particles/ions closer together / more particles in same volume **ORA** ✓ more collisions in same time / more frequent collisions ✓	3	3.1b 1.2x2	**IGNORE** as concentration increases the time taken decreases/more acid has faster rate **ALLOW** molecules/atoms for particles **DO NOT ALLOW** references to increased energy of particles **IGNORE** more particles, unqualified. **IGNORE** more likely to collide.

Question			Answer	Marks	AO element	Guidance
4	(a)		Evaporation ✓ Faster (at higher temperature) ✓	2	2.2	**ALLOW** quickly **IGNORE** easier
	(b)	(i)	add water ✓ filter and collect filtrate ✓ leave to crystallise AND dry / evaporate off the water ✓ weigh salt produced ✓	4	2.2	**IGNORE** make a solution alone **ALLOW** filter to remove the sand (from solution) **IGNORE** 'find amount' without reference to mass/weighing **IGNORE** find mass if no attempt at method of separation
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 25.1 (%) award 3 marks** (1.36 ÷ 5.42) x 100✓ = 25.09225 ✓ = 25.1 (%) 3 significant figures ✓	3	**2.2x2** **1.2**	**ALLOW** one mark for 3SF provided it has been produced correctly from an incorrect calculation.

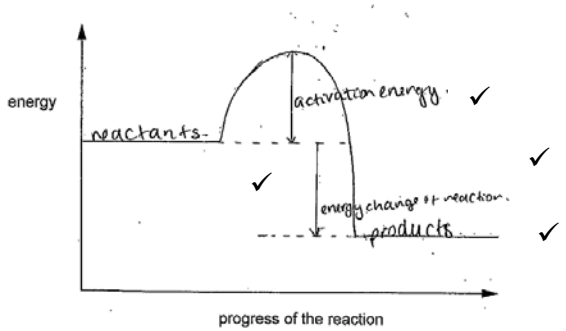
Question			Answer	Marks	AO element	Guidance
5	(a)		Similarity – all have 1 (electron) in outer shell/same number **(**of electrons) in outer shell/all have 2 (electrons) in 1st shell ✓ Difference – different number of shells ✓	2	1.1	 **IGNORE** have different number of electrons
	(b)		Small number of electrons in outer shell ✓ lose electrons / form positive ions ✓	2	1.1	
	(c)	(i)	hydrogen ✓ lithium hydroxide ✓	2	2.1	**ALLOW** correct formulae if no name given. **IGNORE** incorrect formulae
		(ii)	**Any two from:** fizz/effervesce/bubbles ✓ (Indicator) turns blue/purple ✓ Lithium gets smaller ✓	2	2.2	 **IGNORE** gas formed **IGNORE** starting colour of indicator/unspecified colour **ALLOW** disappears **IGNORE** dissolves
		(iii)	more reactive down the group **ORA** ✓ faster fizzing/sodium darts around/potassium has flame ✓	2	1.2	**ALLOW** more violent/ more vigorous down group **IGNORE** reference to other Group 1 metals

Question			Answer	Marks	AO element	Guidance
6	(a)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes reactions in the engine **AND** reactions in the converter **AND** Refers to data in the table to describe the changes in emissions. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes reactions in the engine **AND** reactions in the converter **OR** Describes the reactions in the engine **AND** Refers to data in the table to describe the changes in emissions **OR** Describes the reactions in the converter **AND** Refers to data in the table to describe the changes in emissions *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	1.1 x 4 3.1 x 2	**AO1.1 Demonstrates knowledge and understanding of reactions in converter and engine** Reactions in converter: • CO turned to CO_2 • NO turned to N_2 • $2CO + 2NO \rightarrow 2CO_2 + N_2$ Reactions in engine: • CO by incomplete combustion of hydrocarbons • NO from nitrogen and oxygen from the air • NO at high temperatures in engine • $N_2 + O_2 \rightarrow 2NO$ **AO3.1a Analyse information and ideas to interpret the data in the table** Changes in emissions: • both increase until 1990 • both decrease after 1990 • increase as number of cars increases • decrease after catalytic converters introduced • bigger decrease for CO than NO • reference to data • overall decrease from1980 to 2015

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Describes the reactions in the engine **OR** Describes reactions in the converter **OR** Refers to data in the table to describe the changes in emissions *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*			
	(b)		Modern cars have gas scrubbers fitted. [ ] Modern petrol contains less sulfur. [✓] Sulfur dioxide forms when sulfur gas reacts with oxygen. [ ] Sulfur dioxide forms when sulfur compounds burn. [✓] Sulfur dioxide formed in the catalytic converter. [ ] The catalytic converter absorbs solid sulfur. [ ]	**2**	**1.1x2**	

Question			Answer	Marks	AO element	Guidance
7	(a)		$2H_2O_2 \rightarrow O_2 + 2H_2O$ Formulae correct ✓ Balancing correct ✓	2	2.2	**IGNORE** inclusion of enzyme **ALLOW** multiples **DO NOT ALLOW** balancing of incorrect formulae
	(b)	(i)	**Any two from:** volume of peroxide / solution✓ concentration of peroxide / solution✓ amount of enzyme ✓ particle size of enzyme ✓	2	1.2	**ALLOW** same amount of peroxide **DO NOT ALLOW** concentration of enzyme **DO NOT ALLOW** references to temperature/time **IGNORE** references to pH
		(ii)	**Any two from:** increase concentration of hydrogen peroxide solution ✓ smaller particle size of enzyme ✓ larger amount of enzyme ✓ use best pH for enzyme ✓	2	3.3b	
	(c)	(i)	particles move faster/have more energy ✓ more have activation energy/ more collisions have enough energy for reaction/ more successful collisions ✓	2	1.1	**IGNORE** particles vibrate faster **ALLOW** molecules for particles
		(ii)	(Rate increases) then rate decreases as temperature increase / idea of reaching a peak ✓ Enzyme is denatured/ broken down ✓ Fewer active sites/ higher activation energy / fewer successful collisions ✓	3	2.2 1.2x2	**DO NOT ALLOW** temperature increases then decreases **ALLOW** no catalyst present.
		(iii)	42(°C) ✓	1	2.2	

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	Reduction ✓	1	1.1	**ALLOW** oxygen has been lost **ALLOW** zinc displaced **IGNORE** it has been displaced **DO NOT ALLOW** zinc is lost
		(ii)	No oxygen present ✓ So zinc does not react (to form zinc oxide) ✓ **OR** Oxygen in air ✓ Zinc would react (to form zinc oxide) ✓	2	2.1	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8(.03) (tonnes) award 3 marks** (65.4+16=) 81.4 ✓ (10 ÷ 81.4) = 0.123 ✓ x 65.4 = 8(.03)(tonnes) ✓	3	2.2	**ALLOW** use of 65 instead of 65.4 for relative atomic mass of zinc to get 81 instead of 81.4 and then consequentially for other marks.
	(b)	(i)	Electrolysis ✓	1	1.1	**ALLOW** description of electrolysis
		(ii)	aluminium more reactive than carbon/it ✓ zinc less reactive than carbon/it ✓	2	2.2	**ALLOW** references to reactivity series
	(c)		**Any three from:** Choose suitable plants tolerant to lead ✓ Planted (on waste heap) ✓ Plants remove lead ✓ Plants removed from site / lead removed from plants ✓	3	1.1	

Question			Answer	Marks	AO element	Guidance
9	(a)		Activation energy high/not enough particles have enough energy to react ✓ Firelighter supplies energy (to particles so react) ✓ Heat from reaction supplies energy to more charcoal / particles✓	3	1.1	**ALLOW** for two marks, firelighter supplies enough energy for charcoal to react/ overcome activation energy
	(b)		Reactants (on left) and products (on right) labelled and with products below reactants ✓ profile drawn up and down from reactants to products ✓ activation enthalpy labelled between the level of reactants and level of peak ✓ energy of reaction labelled with arrow pointing from reactants to products ✓	4	1.1 x 4	e.g. 
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (-)286 (kJ) award 4 marks** 2x1077 + 495 = 2649 ✓ 4x805=3220 ✓ 2649-3220= (-)571 ✓ ÷2 = (-)286(kJ) <u>3 significant figures</u> ✓	4	 **2.2x3** **1.2**	

<table>
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<tr><td>10</td><td>(a)</td><td></td><td>A ✓</td><td>1</td><td>2.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th></th><th>covalent</th><th>ionic</th><th>metallic</th></tr><tr><td>A</td><td></td><td>✓</td><td></td></tr><tr><td>B</td><td></td><td></td><td>✓</td></tr><tr><td>C</td><td>✓</td><td></td><td></td></tr><tr><td>D</td><td>✓</td><td></td><td></td></tr></table></td><td>2</td><td>3.2b</td><td>4 correct = two marks
3 or 2 correct = one mark
1 or 0 correct = zero marks</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Any three from:
Metals conduct when solid and ionic do not ✓
Ionic conducts by moving ions ✓
Metal conducts by moving electrons ✓

Ions cannot move in solid but electrons can ✓</td><td>3</td><td>1.1x3</td><td>ALLOW delocalised electrons/sea of electrons for moving electrons</td></tr>
</table>

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