H

GCSE (9-1)

Chemisty B (Twenty First Century Science)

J258/03: Breadth in chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

© OCR 2019

Annotations available in RM Assessor

Annotation	Meaning
✓	Correct response
✗	Incorrect response
^	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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.

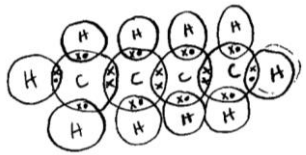
The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry B:

	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.

Question			Answer	Marks	AO element	Guidance
1	(a)	(i)	strong (covalent) bonds / bonds need a lot of energy to break / each atom bonded to 4 others / lots of bonds/ giant covalent structure ✓	1	1.1	**DO NOT ALLOW –** incorrect type of bonding **DO NOT ALLOW** 'strong intermolecular forces / strong intermolecular bonds'
		(ii)	One mark for each property linked to its correct explanation: PROPERTY • Slippery / soft / lubricating / marks paper / flakes easily • (Electrical / thermal) conductivity • Strength (along layer) EXPLANATION • layers (with weak bonds between) • delocalised/free electrons / sea of electrons / electrons can move • strong bonds (within layers)	2	2×2.1	**ALLOW** one mark for two independent properties OR two independent explanations OR one property and one explanation **IGNORE** 'intermolecular' **IGNORE** melting point, boiling point
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.4 (g) award 2 marks** mass = 1 / 0.29 OR 3.448 / 3.45 / 3.5 etc✓ mass = 3.4 (g) ✓	2	2×2.2	Answer must be to two sig figs
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.0037 (g) award 2 marks** 44/12 ✓ Mass = 0.0037 (g) / 3.7×10^{-3} (g)✓	2	2×2.2	Answer must be to two sig figs

		(ii)	Idea that volume or density of diamond and graphite are different / volume or density are irrelevant ✓ Both contain the same amount (12g) of carbon / graphite is pure carbon and thus makes 44g / same mass of CO_2 produced as same mass of C in each / same number of carbon atoms present in each ✓	**2**	**2×3.2a**	**ALLOW** distance between atoms is irrelevant

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	propanone and ethanol ✓	1	1.1	**ALLOW** propanone only
		(ii)	propanone ✓	1	2.2	
	(b)	(i)	(Filter) paper ✓	1	1.2	
		(ii)	solvent is above line / dot ✓ otherwise dot will (mostly) dissolve / spread out / dot/dye does not travel up paper✓	2	2×3.3b	
		(iii)	yellow spot ✓ R_f = distance moved by spot ÷ distance moved by solvent front / largest distance moved by a spot / nearest solvent front ✓	2	1.1 2.2	
	(c)		Kareem/it is not pure **AND** because there is more than one spot / ORA✓	1	3.2b	**ALLOW** 'several spots / dots / colours **ALLOW** contains 3 or 4 components/substances/chemicals **ALLOW** idea of can be separated **IGNORE** 'more than one dye' **IGNORE** it is a mixture
	(d)		Sharp (AW) melting point / temperature / melting point same as reference value ✓	1	2.2	**IGNORE** melting point high **IGNORE** melts at the same time

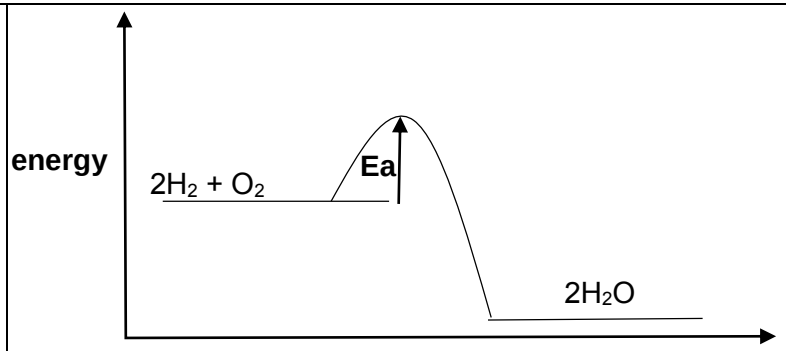
Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	Fully correct dot and cross for butane with 8 electrons around all four carbons and 2 around all ten hydrogens ✓	1	1.2	e.g.  **ALLOW** all dots/all crosses
	(a)	(ii)	ball and stick: shows spatial arrangement / shape / bond angles / is 3D / (relative) sizes of atoms ✓ dot and cross shows (shared) electrons / shows how bonds form / shows type of bond / shows bonds are covalent ✓	2	1.2 x 2	**IGNORE** 'Shows the bonds / structure' **ALLOW** shows electrons transferred/shows if compound is ionic **ALLOW** 'shows if bonds are single or double' in either answer, but not in both
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 83 (%) award 3 marks** RFM of butane = 58 / C_4 = 48 ✓ % of C = 48/58 × 100 ✓ = 83 (%) 2 sf ✓	3	 2.2x2 1.2	 **ALLOW** mark point three for incorrect answer to two sig figs with working shown.

	(c)		**Any two from:** MP1 - Butane has bigger/heavier molecules/more carbons/longer chain ✓ MP2 - Butane has stronger/more intermolecular forces/forces between molecules ✓ MP3 -more <u>energy</u> required to separate/break/overcome forces between butane molecules ✓	**2**	**2×2.1**	**ALLOW ORA** throughout For MP2 **ALLOW** ‘intermolecular bonds’ or ‘bonds between molecules’ For MP3 **DO NOT ALLOW** implication that bonds <u>within</u> molecules break **IGNORE** ‘harder to break’

Question			Answer	Marks	AO element	Guidance
4	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 62 (%) award 2 marks** Decrease = 343 – 132 = 211 ✓ % decrease = 211 / 343 × 100 = 62 (%) 2sf ✓	**2**	**2×2.2**	Answer must be to two sig figs **ALLOW** one mark for 54% to two sig figs – this is for calculation of decrease in Use data.
	(b)		(energy for) disposal of product ✓ collection/sorting/landfill/reuse/recycle/incinerate ✓	**2**	**1.2** **1.1**	**ALLOW** thrown away/grave

Question			Answer	Marks	AO element	Guidance
5	(a)		atomic mass fitted ✓ reactions fitted / properties fitted / is similar to Al ✓	2	2×1.1	 **ALLOW** it has the same number (three) electrons in its outer shell/atomic number fitted **IGNORE** more/less reactive or higher/lower named physical property **IGNORE** the same properties
	(b)		atomic numbers were measured ✓	1	1.2	
	(c)		Ga^{3+} with eight or zero electrons depending on number of shells shown ✓ O^{2-} with eight electrons ✓ Charges on ions 3+ and 2- ✓	3	3×1.2	**DO NOT ALLOW** shared electrons/covalent structure **IGNORE** subscripts

Question			Answer	Marks	AO element	Guidance
6	(a)		**Advantage:** less produce CO_2 / less produce greenhouse gases / less named pollutant / less CO / less NOx / less C particulates / less SO_2 / less unburnt hydrocarbons / <u>only</u> produces water ✓	2	2×1.2	**ALLOW** 'does not produce CO_2/greenhouse gases etc. **IGNORE** references to pollution / harmful gases **ALLOW** reasonable points relating to convenience of use **ALLOW** reasonable points relating to energy efficiency
			Disadvantage: **Any one from:** • there are fewer places to refuel cars ✓ • fuel cells not as durable ✓ • cost of cars/cost of fuel more expensive ✓ • difficult to store hydrogen/gas / takes up large volume ✓ • tank of hydrogen does not last as long as petrol / does not produce as much power / does not give out as much energy ✓ • safety concerns about use of hydrogen / it is (more) flammable / explosive ✓			**ALLOW** fossil fuels still used to produce (electricity which produces) hydrogen **IGNORE** 'costs more' alone

	(b)		 product line below reactant line and 'hump; ✓ labelled activation energy with arrow starting on reactant line and ending at top of hump by eye ✓ the formulae of reactants and products balanced ✓	**3**	**1.2x2** **2.1**	**IGNORE** state symbols **ALLOW** double arrow for Ea (activation energy) **DO NOT ALLOW** arrow if it is too short
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 240 (kJ) award 2 marks** RFM H_2 = 2 ✓ Energy = 1200 × 2/10 = 240 (kJ) ✓	**2**	**2×2.2**	 **ALLOW** one mark for 120 (kJ) (ECF on RFM H_2= 1) or 480 (kJ) (ECF for x2)

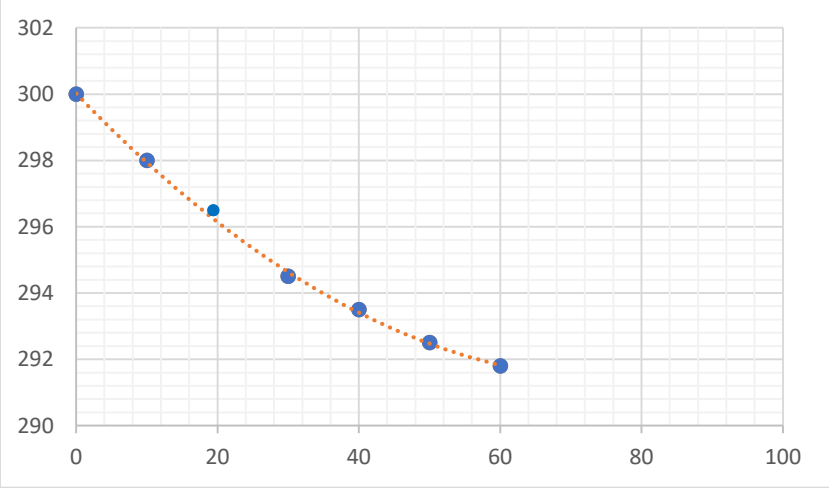
Question			Answer	Marks	AO element	Guidance
7	(a)		**Any one from:** • positive charge spread over atom / sea of positive charge ✓ • electrons spread out / electrons do not move ✓ • no 'empty space' ✓	1	1.1	**IGNORE** references to neutrons **ALLOW** protons for positive charges **ALLOW** 'electrons delocalised' **IGNORE** statements give in Q turned into negatives e.g. 'there is no positive nucleus' **DO NOT ALLOW** any reference the Thomson atom having a nucleus
	(b)		Very few positive particles 'bounced back' ✓	1	2.1	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4×10^{-7} (m) award 2 marks** conversion cm to m (2 cm = 0.02 m) ✓ diameter = 0.02/50000 = 4×10^{-7} (m) ✓	2	 1.2 2.2	 Answer must be in standard form for second mark. **ALLOW** one mark for 4×10^{x} if x is not -7 / incorrect place value but ends in 4 **ALLOW** one mark for 0.0000004

Question			Answer	Marks	AO element	Guidance
8	(a)		powder **AND** surface area is greater / more collisions per second ✓	1	3.2b	
	(b)		fizzing / reaction faster ✓ copper sulfate / blue colour unchanged at the end ✓	2	2×2.1	**ALLOW** 'more bubbles' but not 'more gas produced' **IGNORE** references to mass change **ALLOW** copper sulfate unchanged / not used up
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.4 (dm^3) award 2 marks** n = 6.5 / 65.4 = 0.1 / 0.099 mol Zn ✓ vol H_2 = 0.099 × 24 dm^3 = 2.4 dm^3 2sf ✓	2	2×2.2	Answer must be to two sig figs **ALLOW** mark point two for incorrect mol Zn x 24 correctly calculated to two sig figs **ALLOW** one mark for 160 (6.5 x 24 to two sig figs)
		(ii)	same ✓ catalysts do not affect yield / only affect rate ✓	2	2×1.2	

Question			Answer	Marks	AO element	Guidance
9	(a)		acidic ✓ bleaching action ✓	2	2×1.2	
	(b)	(i)	kills ✓ micro-organisms (that cause disease) ✓	2	2×1.2	 **ALLOW** bacteria/pathogens/microbes **ALLOW** one mark for 'sterilises water'
		(ii)	chlorine is poisonous / toxic / reacts with organic matter to produce harmful compounds ✓	1	1.2	**IGNORE** 'harmful' alone
	(c)	(i)	Brown / yellow / orange (colour) ✓	1	2.2	**IGNORE** 'red' alone
		(ii)	$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$ Correct formulae ✓ Balanced ✓	2	2×1.2	 **IGNORE** additional formulae for first mark only **ALLOW one** mark for fully correct symbol equation $Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$ **IGNORE** state symbols

Question			Answer	Marks	AO element	Guidance
10	(a)		there is a mixture of N_2, H_2 and NH_3 ✓ The reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is going in both directions. ✓	2	2×1.2	
	(b)		hydrogen is made from natural gas and steam ✓ ammonia is separated and the nitrogen and hydrogen are recycled ✓	2	2×1.2	
	(c)		Advantage: low temperature increases the yield / moves equilibrium to the right / favours forward reaction ORA ✓ however it is produced very slowly / less is produced per day / reactions are slower at lower temperatures ORA ✓ 450 is a compromise between rate and yield / compromise conditions are used ✓	3	3×3.2a	**IGNORE** 'more ammonia' for 'more yield' **DO NOT ALLOW** 'more ammonia is produced per day'
	(d)		FOR: enters watercourses / eutrophication / increased plant or algal growth ✓ AGAINST: there are not enough natural fertilisers / ammonium compounds can be manufactured (in large quantities) / need to grow more food/crops ✓	2	2×3.1b	**ALLOW** nitrates in drinking water are harmful **IGNORE** makes plants grow faster

Question			Answer	Marks	AO element	Guidance
11	(a)	(i)	**A** and it is most reactive / fast(est) reaction ✓	1	2.1	
		(ii)	**A** $\rightarrow$ A^{2+} + 2e ✓	1	1.2	**ALLOW A** - 2e $\rightarrow$ A^{2+}
		(iii)	**A** is oxidised as it loses electrons ✓	1	2.1	
	(b)		$C(s) + CuSO_4(aq) \rightarrow CSO_4(aq) + Cu(s)$ Equation ✓ State symbols ✓	2	2×1.2	**ALLOW** ionic equation: $C(s) + Cu^{2+}(aq) \rightarrow C^{2+}(aq) + Cu(s)$ **ALLOW** (s) on metal formula + (aq) on compounds formulae for state symbol mark even if equation wrong.
	(c)		delocalised electrons ✓ electrons can move ✓	2	2×1.1	**ALLOW** free/sea of electrons as AW for 'delocalised' **IGNORE** 'carry charge' unless movement is clearly implied

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	 Single, continuous line of best fit that ignores point at 20s ✓	1	2.2	Line should be within 1 square of every point except point at 20s **IGNORE** the curve after 60s
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer is between 0.18 - 0.22 (g / s) award 2 marks** Draw tangent on graph / reads value of mass and time ✓ Gradient (e.g. 10 / (value between 45 and 55) = Gradient in the range 0.22 to 0.18 (g / s) ✓	2	 2.2 1.2	 Commonly seen values are 300 (- 290) and ~ 50 / 10 and 2;
		(iii)	gets slower / decreases with time / gradient decreases ✓	1	3.1a	
		(iv)	Best fit line extended (to 100) or gives readings between 290.4 and 291.6 ✓ Mass loss = (300 – 291) = 9 ✓	2	3.2a 1.2	**ALLOW** 'curve/best fit line extended' appropriately drawn on graph or stated **ALLOW** 8.4 to 9.6

	(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.18 (mol) award 2 marks** Mr CO_2 = 44 / 12 + 2 x16 ✓ n = 0.18 (mol) 2sf ✓	**2**	**2×2.2**	Answer must be to two sig figs
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 15 (g) award 2 marks** Mr($NaHCO_3$) = 84 / 23 + 1 + 12 + 3x16 ✓ m = n × Mr = 0.18 × 84 = 15 (g) 2sf ✓	**2**	**2×2.2**	**ALLOW** one mark for **ECF**(b)(i) x 84 correctly calculated Answer must be to two sig figs
	(c)	**(i)**	(volumetric) pipette / burette ✓	**1**	**3.3a**	
	(c)	**(ii)**	do another titration/more repeats (until concordant) ✓	**1**	**3.3b**	**ALLOW** improvements to technique e.g. adding acid dropwise (near the end point)

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

© OCR 2019