OCR
Oxford Cambridge and RSA

GCSE (9-1)

Combined Science A (Gateway)

Unit **J250/03**: Chemistry

General Certificate of Secondary Education

Mark Scheme for June 2018

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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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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).

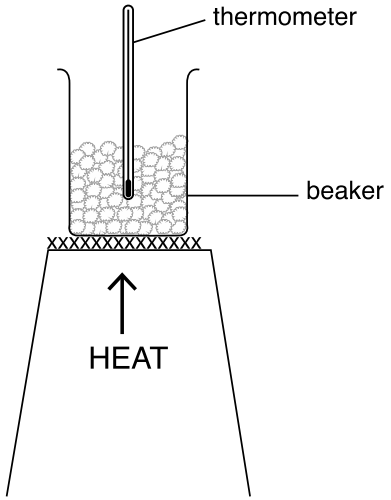
Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words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

The breakdown of Assessment Objectives for GCSE (9-1) in Biology/Chemistry/Physics/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.

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

SECTION A				
Question	**Answer**	**Marks**	**AO element**	**Guidance**
1	B✓	**1**	1.2	
2	C ✓	**1**	1.2	
3	B ✓	**1**	1.1	**ALLOW** 5
4	A ✓	**1**	1.2	
5	B ✓	**1**	1.1	
6	C ✓	**1**	1.1	
7	A ✓	**1**	2.1	**ALLOW** 9
8	A ✓	**1**	1.1	
9	B ✓	**1**	1.2	
10	B ✓	**1**	2.1	**ALLOW** -100

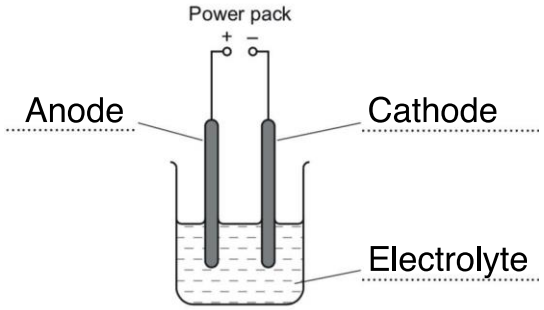
SECTION B						
Question			**Answer**	**Marks**	**AO Element**	**Guidance**
11	**(a)**		Correct apparatus chosen (either shown in diagram or in text): beaker **AND** thermometer (we assume ice will be present). ✓ **AND** **Any one from:** Heating/use a water bath/leave it at room temperature ✓ Crushing ice ✓ Stirring ✓ Keeping thermometer in the ice when reading ✓	**2**	2 x 2.2	**ALLOW** use of evaporating basin / (test) tube / (boiling) tube / (conical) flask instead of beaker Mark may be awarded from a labelled diagram e.g.  **ALLOW** do not let the thermometer touch the glass
	(b)		**Any one from:** Repeat the experiment ✓ **OR** Use more sensitive/digital thermometer ✓ **OR** Use computer controlled equipment ✓	**1**	3.3b	**ALLOW** valid answers from 11a if not used there e.g. stirring / use a water bath / crush ice **ALLOW** slow heating

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO Element</th><th>Guidance</th></tr>
<tr><td>12</td><td>(a)</td><td>(i)</td><td>The mean mass of an atom compared to 1/12th of the mass of an atom of Carbon-12 ✓</td><td>1</td><td>1.1</td><td>ALLOW The mean or average mass of an atom compared to Carbon-12</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(Number of) protons ✓

(Number of) electrons ✓</td><td>2</td><td>2 x 1.1</td><td>ALLOW position in the Periodic Table because you can identify the element

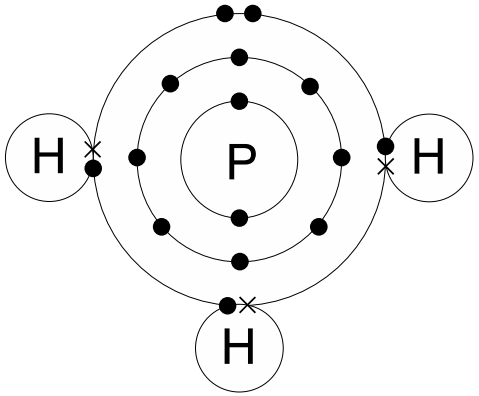
ALLOW number of electrons in the outer shell

ALLOW number of (electron) shells/period number</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th>Particle</th><th>Relative Charge</th><th>Relative Mass</th></tr><tr><td>Proton</td><td>+1</td><td>1 ✓</td></tr><tr><td>Neutron</td><td>0 ✓</td><td>1</td></tr><tr><td>Electron</td><td>-1 ✓</td><td>Almost 0</td></tr></table></td><td>3</td><td>3 x 1.1</td><td>ALLOW neutral or no charge instead of 0 for neutron</td></tr>
</table>

Question			Answer	Marks	AO Element	Guidance
13	(a)	(i)	Anode (+) **AND** cathode (–) ✓ Electrolyte ✓  	**2**	2 x 1.1	**ALLOW** for electrolyte: solution of metal salt / metal salt / solution containing ions / salt solution / molten salt / named electrolyte such as sodium chloride **DO NOT ALLOW** solvent, water **IGNORE** solution unless qualified
		(ii)	The **ions** cannot move in NaCl solid ✓ The **ions** are free to move in NaCl solution ✓	**2**	2 x 2.1	**DO NOT ALLOW** electrons instead of ions **But ALLOW** electrical conduction requires the movement of ions and the ions cannot move in NaCl solid / ora for 2 marks **IGNORE** charged particles
	(b)		bromine✓ bromine ✓ chlorine ✓	**3**	3 x 2.1	**ALLOW** Br_2 **DO NOT ALLOW** bromide or Br **ALLOW** Br_2 **DO NOT ALLOW** bromide or Br **ALLOW** Cl_2 **DO NOT ALLOW** chloride or Cl

Question			Answer	Marks	AO Element	Guidance
	(c)		**Any two from:** Circuit not complete/wire not connected to ring ✓ Silver/ring connected to wrong electrode/side of battery ✓ Water will not work/idea that metal ions needed in solution ✓	**2**	2 x 3.3a	**ALLOW** The silver should be on the positive side / the ring should be on the negative / Silver should not be at cathode / Anode & cathode wrong way round **ALLOW** any named metal salt solution **ALLOW** use an electrolyte

Question			Answer	Marks	AO Element	Guidance
14	(a)		CH_2O	1	2.1	**ALLOW** elements in any order **DO NOT ALLOW** CH2O / CH^2O
	(b)		60 ✓	1	2.2	
	(c)		Only 2D for 3D molecule ✓ Size of atoms not indicated ✓	2	2 x 2.1	**ALLOW** it is not 3D / does not show shape **ALLOW** not to scale

Question			Answer	Marks	AO Element	Guidance
15	(a)		Period 3 as 3 (electron) shells ✓ Group 5 as 5 (electrons) in **outer** shell ✓	**2**	2 x 1.1	**ALLOW** the three numbers show it is in Period 3 **IGNORE** it is in Group 5 unless qualified / the number 5 shows it is in Group 5
	(b)		One shared pair of electrons correctly shown ✓ Rest of structure correct ✓	**2**	2 x 2.2	Electrons on inner two shells NOT required but **must be correct if shown** Lone pair of electrons do not need to be together **ALLOW** all dots, all crosses or a mixture of dots and crosses 

Question			Answer	Marks	AO Element	Guidance
16	(a)		Hydrochloric acid + sodium hydroxide → sodium chloride + water ✓	1	2.1	**ALLOW** = for → **DO NOT ALLOW** and, or, & for + **ALLOW** mix of correct formulae and words eg HCl + NaOH → NaCl + H_2O equation does not need to be balanced Reactants can be in either order, products can be in either order
	(b)	(i)	34.8 (^oC) ✓	1	2.1	**ALLOW** answer written in the table.
		(ii)	The temperature increases (from experiment A to C / as volume of HCl increases / as volume of NaOH decreases / as pH decreases) ✓	1	3.1a	**DO NOT ALLOW** any other qualification e.g. the temperature increase from 1 to 3
		(iii)	(pH) decreases (as the volume of HCl increases / as the volume of NaOH decreases / as the ratio of HCl to NaOH increases) / **ORA** ✓	1	3.1a	
		(iv)	Use of universal indicator (solution / paper) ✓ **OR** reference to pH meter/probe ✓	1	1.2	**DO NOT ALLOW** use of litmus paper or other indicators **IGNORE** universal (on its own)
	(c)		**Any one from:** The largest temperature rise occurred at pH 7 (neutral) ✓ The largest temperature rise occurred when the volume of HCl and NaOH are equal ✓ The final solution is neutral when the volume of HCl and NaOH are equal ✓ The mixture becomes acidic when more than 30 cm^3 HCl is added ✓ The temperature drops again after it has become neutral ✓ It is an exothermic reaction ✓	1	3.2b	**ALLOW** any correct conclusion including any valid pattern (please refer to table). **IGNORE** balanced amounts of solution

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO Element</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>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)
Demonstrates knowledge of the formula for R_f and applies knowledge and understanding to calculate all R_f values correctly.
AND
Correctly analyses the results obtained and assigns spots to pigments.
AND
Analyses the results to suggest why further analysis of the plant pigments is needed

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)
Demonstrates knowledge of the formula for R_f and applies knowledge and understanding to calculate most of the R_f values correctly.
AND
Correctly analyses the results obtained and assigns at least 2 spots to pigments.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</td><td>6</td><td>1 x 1.2
1 x 2.2
2 x 3.2b
2 x 3.3b</td><td>AO1.2 Demonstrates knowledge of the formula to calculate R_f values.

R_f = <u>distance to spot</u>
distance to solvent front

AO2.2 Applies knowledge and understanding of formula to calculate R_f values for the 4 spots

<table>
<tr><th>Spot</th><th>R_f value</th><th>Allow</th></tr>
<tr><td>1</td><td>0.13</td><td>0.125</td></tr>
<tr><td>2</td><td>0.32</td><td>0.318 / 0.3182</td></tr>
<tr><td>3</td><td>0.65</td><td>0.648 / 0.6477</td></tr>
<tr><td>4</td><td>0.95</td><td>0.955 / 0.9545</td></tr>
</table>
At L1 & L2 IGNORE rounding errors

AO3.2b Analyses information to draw conclusions about the pigments:
Spot 1 = Could be Pigment E, because it is closest but cannot confirm, as R_f value does not match exactly.
Spot 2 = Pigment C
Spot 3 = unknown
Spot 4 = Pigment A

AO3.3b Analyses information to identify improvements that could be made in order to identify spot 3.
• Look up R_f values of other pigments in order to match to spot 3
• Further investigation needed if R_f value not found</td></tr>
</table>

Question			Answer	Marks	AO Element	Guidance
			Level 1 (1–2 marks) Demonstrates knowledge of the formula for R_f and applies knowledge and understanding to calculate some of the R_f values correctly. **OR** Analyses their results to suggest why further analysis of the plant pigments is needed *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.*			

Question			Answer	Marks	AO Element	Guidance
18	(a)		Covalent bonds identified in tubes✓ Idea that **bonds** are (very) strong / there are many bonds / bonds take lots of energy to break ✓	**2**	2 x 1.1	**DO NOT ALLOW either mark for** reference to intermolecular forces or ionic bonding Covalent bonds are strong(er) = 2 Giant covalent structures = 2
	(b)		(nanotubes contain) delocalised / free **electrons** ✓ (electrons) move ✓	**2**	2 x 1.1	**IGNORE** 'conduct electricity' as this is in the stem. **IGNORE** references to moving ions
	(c)	**(i)**	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 4.9 award 2 marks** 7.9÷1.6 ✓ = 4.9 ✓	**2**	2 x 2.2	 **ALLOW** 5 / 4.94 /4.938 / 4.9375 Check for incorrect rounding e.g. 4.93 would not score 2 marks
		(ii)	**Any one from:** Atoms are packed clos**er** together (in metals) / **ORA** ✓ Carbon nanotubes have hollow spaces / holes **ORA** ✓ RAM of iron much bigg**er** than RAM of C ✓	**1**	2.1	Assume 'it' refers to iron unless qualified. Beware of repeats of stem – 'iron is more dense than carbon' **ALLOW** (iron) layers are clos**er** together
		(iii)	(Covalent) **bonds** are strong**er** (than metallic bonds) / more energy needed to break (covalent) bonds / **ORA** ✓	**1**	3.2a	**DO NOT ALLOW** Intermolecular forces references Assume 'they' relates to carbon

Question			Answer	Marks	AO Element	Guidance
19	(a)		Al_2O_3 ✓	1	2.1	**ALLOW** O_3 Al_2 **DO NOT ALLOW** Al^2O^3
	(b)		Teacher is wrong / student is right (no mark) **Any one from:** Formula should be $Mg(NO_3)_2$✓ Idea that charges do not balance as Mg ion is 2+ and NO_3 is 1- ✓ The ratio of ions is 1:2 ($Mg:NO_3$) ✓	1	3.1b	**Mark is for explanation –** Who is right or wrong can be implied in response. **ALLOW** $MgNO_3$ would be charged (+)
	(c)	(i)	Al_2S_3 + **6**HCl → **2**$AlCl_3$ + **3**H_2S ✓	1	2.1	**ALLOW** correct multiples
		(ii)	(H_2S) is a gas ✓	1	2.1	**ALLOW** 'g'

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