OCR
Oxford Cambridge and RSA

GCSE

Chemistry B

Unit **B742/02**: Modules C4, C5, C6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2017

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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.

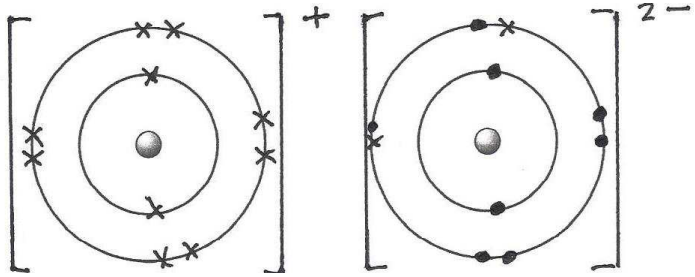
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations used in scoris

Annotation	Meaning
	correct response
	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt **not** given
ECF	error carried forward
^	information omitted
I	ignore
R	reject
CON	contradiction
L1	Level 1
L2	Level 2
L3	Level 3

Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/ = alternative and acceptable answers for the same marking point
(1) = separates marking points
allow = answers that can be accepted
not = answers which are not worthy of credit
reject = answers which are not worthy of credit
ignore = statements which are irrelevant
( ) = words which are not essential to gain credit
__ = underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated)
ecf = error carried forward
AW = alternative wording
ora = or reverse argument

Question	Answer	Marks	Guidance
1 a	Mg^{2+} (1)	1	
b	MgF_2 (1)	1	**allow** F_2Mg **allow** $Mg^{2+}(F^-)_2$ **not** $Mg^{2+}F_2^-$
c	lithium atom loses 1 electron (1) to gain a full outer shell / stable outer shell / full outer orbit / stable outer orbit (1)	2	**allow** lithium loses electrons **allow** it loses the outer shell electrons **not** reference to stable outer octet **allow** without a full outer shell it is unstable
d	 Na^+ O^{2-} correct electronic structure of sodium ion (1) correct electronic structure of oxide ion (1) both charges correct (1)	3	sharing of electrons = 0 marks for this question use of dots and crosses not necessary i.e. can be all crosses or all dots no need to show $2Na^+$ inner shell must be shown and correct inner shell must be shown and correct **allow** diagram showing transfer of electrons providing electrons are not shown twice
	Total	**7**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2 a</td><td>
<table>
<tr><th>Particle</th><th>Relative mass</th><th>Relative charge</th></tr>
<tr><td>electron</td><td>0.0005</td><td>-1</td></tr>
<tr><td>proton</td><td>1</td><td>+1 / positive</td></tr>
<tr><td>neutron</td><td>1</td><td>0 / neutral</td></tr>
</table>
four correct (2)

two or three correct (1)

one correct (0)</td><td>2</td><td>note the + sign must be present for the proton</td></tr>
<tr><td>b</td><td>idea that atoms have the same number, or amount, of electrons as protons / same number, or amount, of positive and negative charges (1)</td><td>1</td><td>allow the sum of the relative charges of the protons and electrons add up to neutral

ignore references to neutrons</td></tr>
<tr><td>c</td><td>C (1)</td><td>1</td><td>allow correct answer ticked, underlined or circled if answer line is blank
answer line takes precedence</td></tr>
<tr><td>d</td><td>(group) 6</td><td>1</td><td>allow VI / 16

not the name of an incorrect group</td></tr>
<tr><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
3	**any three from:**	3	
	idea of (thermal) decomposition (1)		
	zinc oxide made (1)		**allow** from an equation with zinc oxide or ZnO as a product if formulae and name given both must be correct solid left behind is **not** sufficient
	carbon dioxide made (1)		**allow** from an equation with carbon dioxide or CO_2 as a product if formulae and name given both must be correct gas given off is **not** sufficient
	changes colour (1)		**allow** turns from white to yellow when heated (1) turns yellow to white when cooled (1) **ignore** incorrect colour changes
	Total	**3**	

Question	Answer	Marks	Guidance
4	idea of low melting point or boiling point / (a liquid) or a gas at room temperature / volatile (1) as intermolecular forces are weak / needs little energy to break or overcome intermolecular forces / needs little energy to separate one molecule from another (1) does not conduct electricity / poor electrical conductor (1) as no free electrons present / no mobile electrons / no delocalised electrons / all electrons involved in bonding (1)	4	**note** the mark for the explanation is dependent on the correct property **allow** van der Waals' forces or VDW forces instead of intermolecular forces **allow** weak forces between molecules / intermolecular bonds / hydrogen bonds between molecules (1) **allow** heat instead of energy **ignore** covalent bonds are weak **allow** has no ions present **ignore** no charged particles present / no charge carriers **ignore** ions cannot move **allow** dissolves in water (1) forms intermolecular attractions with water / hydrogen bonds with water (1) **ignore** smell
	Total	**4**	

Question	Answer	Marks	Guidance
5	**Level 3** **Interprets data to identify the correct order of reactivity AND** **explains the relative reactivity of three halogens AND** **constructs a balanced symbol equation.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Interprets data to identify the correct order of reactivity AND** **gives an explanation for the relative reactivity of two halogens or attempts a symbol equation.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Interprets data to identify the correct order of reactivity OR** **Interprets data and explains the relative reactivity of two halogen OR** **Attempt to write a symbol equation for one reaction** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0marks)	6	**This question is targeted at grades up to grade A/A*.** **allow** reference to **X**, **Y** and **Z** instead of the diatomic molecule throughout **allow** correct name of halogen or halide instead of **Z**, **Y** and **X** except in order of reactivity **Indicative scientific points may include:** **order of reactivity** • **Z** > chlorine > **Y** > **X** **Explanation** • idea that **Z** displaces chlorine from sodium chloride so is more reactive than chlorine • idea that chlorine displaces bromine from sodium bromide so more reactive than both **X** and **Y** • idea that chlorine displaces iodine from sodium iodide • **X** displaces nothing so must be least reactive • **Y** displaces iodine from sodium iodide so more reactive than **X** but less reactive than chlorine • idea that Z_2 reacts or displaces with all the solutions • idea that Cl_2 reacts or displaces with two solutions • idea that Y_2 only reacts or displaces with halide containing X / reacts or displaces with one solution • idea that X_2 does not react / no displacement happens **Indicative scientific point needed for level 3** **Balanced symbol equation** $Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$ **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
		6	

Question	Answer	Marks	Guidance
6 a i	any answer in the range 21.5 – 22.5 (cm^3) (1)	1	
ii	20 (cm^3) (1)	1	
b i	$\frac{30 \times 0.3}{1000}$ (1)	1	**allow** 0.030 x 0.3 **allow** $30 \times 10^{-3} \times 0.3$ **allow** other substitution and rearrangement of moles = conc x volume e.g. 0.009/0.30 = 0.03dm^3 = 30cm^3", and "0.009 x 30 = 0.3
ii	0.45 (mol/dm^3) (2) **but if answer incorrect then** $\frac{0.009 \times 1000}{20}$ **or** $\frac{0.009}{20 \times 10^{-3}}$ **or** $\frac{0.009}{0.020}$ (1)	2	**allow** ecf from (a)(ii) i.e. $\frac{0.009 \times 1000}{\text{volume}}$ **or** $\frac{0.009}{\text{volume} \times 10^{-3}}$ **or** $\frac{0.009}{\text{volume in } cm^3}$
	Total	**5**	

Question	Answer	Marks	Guidance
7 a	**average** mass of an <u>atom</u> (of the element) compared to the mass of 1/12th of an atom of carbon-12 (1)	1	**allow average** mass of an <u>atom</u> (of the element) in atomic mass units **allow** average mass of an atom compared to the mass of a carbon-12 atom that has been assigned a mass of 12
b	28.6 (%) (2) **but if answer incorrect then** <u>12 x 100</u> (1) 42	2	**allow** 28.5 (1)
	Total	**3**	

Question	Answer	Marks	Guidance
8 a	**any three from:** idea that a closed system is needed (1) idea that initially rate of forward reaction decreases / initially concentration of reactant decreases (1) idea that initially rate of backward reaction increases / initially concentration of product increases (1) (idea that eventually) rate of forward reaction = rate of backward reaction (1) so that concentration of reactant and of products do not change (1)	3	 **ignore** reference to closed conditions / reference to temperature and pressure **not** the concentration of reactant = concentration of product **allow** amount of reactant and of product instead of concentration
b	moves to right / more products made (1)	1	**allow** more sulfur trioxide made
c	catalyst (of V_2O_5) (1) (temperature of) 450 °C (1)	2	**allow** V_2O_5 / vanadium pentoxide / vanadium(V) oxide / vanadium oxide **not** incorrect named catalyst e.g. vanadium catalyst **allow** high temperature / any temperature between 300 and 500 °C (1)
	Total	**6**	

Question	Answer	Marks	Guidance
9 a	Pete is correct (no mark) because reaction faster (at start) / more gas is made (1) Sue is correct (no mark) because half as much gas made (at end) / half the volume is made (at end) (1)	2	**not** if Pete is incorrect **allow** ora **not** if Sue incorrect but **allow** Sue is **not** correct since the result at three or four minutes is not half **allow** ora
b	the results are still increasing / the reaction has not yet stopped / it is still reacting (1)	1	**allow** idea that the last two volumes are not the same **ignore** it changes after every minute **ignore** all the results are different
c	0.004 (2) **but if answer incorrect** $\frac{48 \times 2}{24000}$ **or** $\frac{0.048 \times 2}{24}$ **or** moles of H_2 = 0.002 (1)	2	**allow** one mark for 4 g **allow** one mark for moles of H_2 x 2 as an ecf
	Total	**5**	

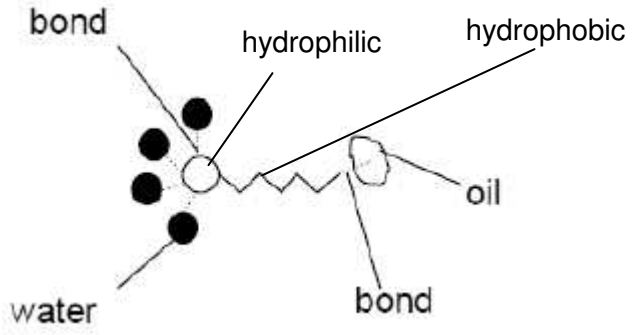
Question	Answer	Marks	Guidance
10	**Level 3** **Candidate mixes lead nitrate and sodium iodide solution, filters the mixture, washes and dries the precipitate** **AND** **writes a correct ionic equation.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Candidate mixes lead nitrate and sodium iodide solution, filters the mixture and either washes or dries the precipitate** **OR** **writes a correct ionic equation.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Candidate mixes lead nitrate and sodium iodide solutions <u>and</u> filters the mixture** **OR** **writes an unbalanced ionic equation** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0marks)	6	**This question is targeted at grades up to A/A*.** **Indicative scientific points at levels 3 must include:** • $Pb^{2+} + 2I^- \rightarrow PbI_2$ **Indicative scientific points at levels 2 and 3 may include:** • mixing of solutions • filtration • washes precipitate / residue • dries precipitate • drying in an oven or on window sill **any two correct points about the procedure AND a correct ionic equation level 3 (5 marks)** **Indicative scientific points at level 1 include:** • mixing or reacting of solutions • filtration **marks can be scored from labelled diagrams** **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
		6	

Question	Answer	Marks	Guidance
11 a	**A** (1) **(A** is) softened by boiling (1)	2	**If any other letter given = 0 marks for the question** **allow** the amount of soap needed decreases / goes down / goes from 30 to 1 / easier to form a lather after it has been boiled / after boiling gives the same result as distilled water / removes (most of) the hardness / only needs 1 drop of soap to get a lather the amount of soap changes is **not** sufficient as a reason
b	calcium sulfate (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
c	$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ correct formulae (1) balancing - conditional on correct formulae (1)	2	**allow** any correct multiple including fractions e.g. $2CaCO_3 + 4HCl \rightarrow 2CaCl_2 + 2CO_2 + 2H_2O$ **allow** = or ⇌ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with incorrect use of case, superscript or subscript e.g. CacO3 + $2HCl \rightarrow CACL_2 + CO_2 + H_2O$
	Total	**5**	

Question	Answer	Marks	Guidance
12 a	alkanes (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
b	a chlorine atom with an unpaired electron is made (1)	1	**allow** homolytic fission / (bond breaks with) one electron going to each atom **allow (**covalent bond breaks) to give (free) radical **ignore** leaves chlorine with a lone electron **not** to form a chlorine with only one electron in outer shell
c	**any two from:** scientist enthusiastic to start with due to inertness of CFCs (1) later ozone depletion was linked with CFCs (1) leading to a ban (in the 1990's) / scientists try to find alternatives (1)	2	 **ignore** burns a hole in the ozone layer they are harmful is **not** sufficient
	Total	**4**	

Question	Answer	Marks	Guidance
13 a	exothermic (no mark) as energy is given out (1)	1	**not** endothermic = 0 marks **allow** energy (level) of product lower than that of reactant / energy goes down after reaction / as the arrow goes downwards **allow** heat instead if energy **allow** energy is lost (to the surroundings) **ignore** more energy given out than absorbed
b	$4H^+ + 4e^- + O_2 \rightarrow 2H_2O$ correct formulae – ignore electrons (1) balancing - conditional on correct formulae including electrons (1)	2	**allow** any correct multiple including fractions e.g. $2H^+ + 2e^- + ½O_2 \rightarrow H_2O$ **allow** = or ⇌ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with incorrect use of case, subscript or superscript e.g. $4H^+ + 4e^- + O2 \rightarrow 2h_2O$
	Total	**3**	

Question	Answer	Marks	Guidance
14 a	iron + oxygen + water → hydrated iron(III) oxide (1)	1	**not** iron(II) or iron(III) as a reactant
b	**any two from:** provides a barrier (to water and oxygen) (1) idea that zinc corrodes or reacts preferentially (1) zinc more reactive (than iron) / zinc is a better reducing agent (than iron) / zinc loses electrons more easily (than iron) / zinc is easier to oxidise (than iron) (1)	2	any mention of zinc rusting is one mark maximum for the question **allow** protective layer / protective coat if a metal is mentioned it must be zinc layer over the surface is **not** sufficient **allow** acts as a sacrificial metal
c	magnesium (atoms) lose electrons (to form magnesium ions) so oxidation (1) iron(III) (ions) gain electrons (to form iron atoms) so reduction (1)	2	**If no other mark, award one mark for** just electron transfer happens / just electrons are gained and lost **but not** if contradicted by incorrect reference to either oxidation or reduction **allow** iron(II) (ions) or iron ions gain electrons (to form iron atoms) so reduction **not** iron gains electrons **ignore** reference to gain or loss of oxygen
	Total	**5**	

Question	Answer	Marks	Guidance
15 a	**Level 3** **Gives three reasons why washing powder C is the best AND** **gives a complete explanation of how detergents work** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Gives two reasons why washing powder C is the best AND** **gives a partial explanation of how detergents work** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Gives one reason why washing powder C is the best OR** **attempts to explain how detergents work** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A** **Indicative scientific points may include:** **Explanations for C** Pete is correct because • best or excellent stain removal • best or excellent whiteness • best or good for preventing fading **ignore** just quoting data **How detergents remove oil stains** • molecule has hydrophilic or water loving head • which attaches to water molecules • molecule has hydrophobic or water hating tail • which attaches to oil molecules • oil is lifted off the fabric **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.** 
b	(dry cleaning) does not involve water / solvent is not water / washed in organic solvent (1) stain will not dissolve in water / stain will only dissolve in organic solvent (1)	2	**ignore** references to washing machine **allow** water will damage fabric (1) **ignore** references to temperature of wash

	Total	8	

Question	Answer	Marks	Guidance
16 a i	25 - 27 (^{o}C) (1)	1	
ii	yes (no marks) idea that 1 kg can dissolve 2.5 g (1) so 3 kg can dissolve 3 x 2.5 (g) (1)	2	if no = 0 marks for the question no marks for 7.5 kg on its own – marks are for the working out
b i	quoting a solubility for carbon dioxide at a particular temperature and the solubility of sulfur dioxide at the same temperature (1) divide solubility of sulfur dioxide by solubility of carbon dioxide to get a number bigger than 50 / AW	2	the solubilities quoted must be within ±5 for sulfur dioxide and ±0.5 for carbon dioxide **allow** showing that 50 x CO_2 solubility is less than that of SO_2 **allow** at 0 ^{o}C (solubility of) SO_2 is 69 times that of CO_2 = 2 marks **allow** at 10 ^{o}C (solubility of) SO_2 is 68 times that of CO_2 = 2 marks **allow** at 40 ^{o}C (solubility of) SO_2 is 60 times that of CO_2 = 2 marks
ii	20 – 40 (g) (1)	1	
iii	more gas dissolves (in Arctic Ocean) (1)	1	**allow** more gas dissolves (in cold water) **allow** solubility of gas is more (in Arctic) **allow** ora

Question	Answer	Marks	Guidance
16 c i	the mass of carbon dioxide dissolved (per kg of sea water) changes with temperature / solubility of carbon dioxide (in sea water) changes with temperature(1)	1	**allow** to have a fair test / to control all the variables **allow** a more general statement about the solubility of gases e.g. solubility of gases change with temperature **allow** change in temperature changes pH temperature is an important factor is **not** sufficient **not** temperature depends on the mass of carbon dioxide
ii	**any two from:** sulfur dioxide is also involved in making oceans acid / other factors involved in making oceans acid (1) idea that remote island not representative of whole ocean / could have tested more locations / AW (1) should have tested more years / reduce the gap between testing (1) should test at same time of year (1) did not repeat results (1) there is one anomalous result / identification of pH 7.96 as being an outlier (1)	2	**allow** one mark for not enough evidence collected if no other mark awarded she is only looking at one aspect of the ocean is **not** sufficient
	Total	**10**	

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