



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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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.

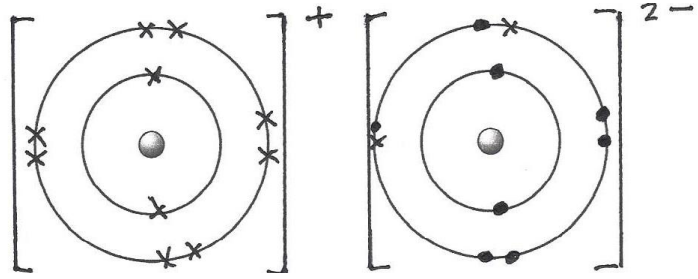
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Annotations used in scoris

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

Question	Answer	Marks	Guidance												
2 a	<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> <p>four correct (2)</p> <p>two or three correct (1)</p> <p>one correct (0)</p>	Particle	Relative mass	Relative charge	electron	0.0005	-1	proton	1	+1 / positive	neutron	1	0 / neutral	2	<p>note the + sign must be present for the proton</p>
Particle	Relative mass	Relative charge													
electron	0.0005	-1													
proton	1	+1 / positive													
neutron	1	0 / neutral													
b	idea that atoms have the same number, or amount, of electrons as protons / same number, or amount, of positive and negative charges (1)	1	<p>allow the sum of the relative charges of the protons and electrons add up to neutral</p> <p>ignore references to neutrons</p>												
c	C (1)	1	<p>allow correct answer ticked, underlined or circled if answer line is blank</p> <p>answer line takes precedence</p>												
d	(group) 6	1	<p>allow VI / 16</p> <p>not the name of an incorrect group</p>												
	Total	5													

Question	Answer	Marks	Guidance
3	<p>any three from:</p> <p>idea of (thermal) decomposition (1)</p> <p>zinc oxide made (1)</p> <p>carbon dioxide made (1)</p> <p>changes colour (1)</p>	3	<p>allow from an equation with zinc oxide or ZnO as a product</p> <p>if formulae and name given both must be correct</p> <p>solid left behind is not sufficient</p> <p>allow from an equation with carbon dioxide or CO₂ as a product</p> <p>if formulae and name given both must be correct</p> <p>gas given off is not sufficient</p> <p>allow turns from white to yellow when heated (1) turns yellow to white when cooled (1)</p> <p>ignore incorrect colour changes</p>
	Total	3	

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

Question	Answer	Marks	Guidance
5	<p>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)</p> <p>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)</p> <p>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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0marks)</p>	6	<p>This question is targeted at grades up to grade A/A*.</p> <p>allow reference to X, Y and Z instead of the diatomic molecule throughout</p> <p>allow correct name of halogen or halide instead of Z, Y and X except in order of reactivity</p> <p>Indicative scientific points may include:</p> <p>order of reactivity</p> <ul style="list-style-type: none"> • Z > chlorine > Y > X <p>Explanation</p> <ul style="list-style-type: none"> • 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 Z₂ reacts or displaces with all the solutions • idea that Cl₂ reacts or displaces with two solutions • idea that Y₂ only reacts or displaces with halide containing X / reacts or displaces with one solution • idea that X₂ does not react / no displacement happens <p>Indicative scientific point needed for level 3</p> <p>Balanced symbol equation $\text{Cl}_2 + 2\text{NaBr} \rightarrow 2\text{NaCl} + \text{Br}_2$</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		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	<p>allow 0.030 x 0.3</p> <p>allow 30 x 10⁻³ x 0.3</p> <p>allow other substitution and rearrangement of moles = conc x volume e.g. 0.009/0.30 = 0.03dm³ = 30cm³, and “0.009 x 30 = 0.3”</p>
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	<p>allow ecf from (a)(ii) i.e.</p> <p>$\frac{0.009 \times 1000}{\text{volume}}$ or $\frac{0.009}{\text{volume} \times 10^{-3}}$ or $\frac{0.009}{\text{volume in cm}^3}$</p>
	Total	5	

Question	Answer	Marks	Guidance
7 a	average mass of an <u>atom</u> (of the element) compared to the mass of $1/12^{\text{th}}$ 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 $\frac{12 \times 100}{42}$ (1)	2	allow 28.5 (1)
	Total	3	

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

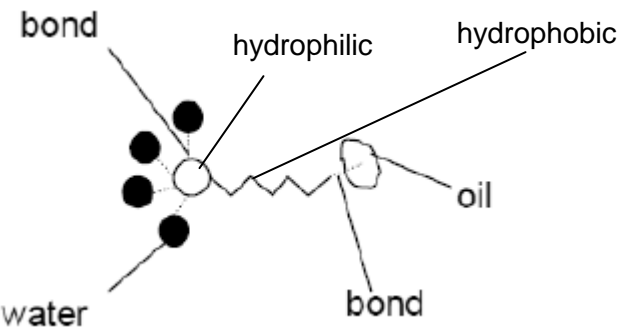
Question	Answer	Marks	Guidance
10	<p>Level 3 Candidate mixes lead nitrate and sodium iodide solution, filters the mixture, washes and dries the precipitate AND writes a correct ionic equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>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)</p> <p>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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0marks)</p>	6	<p>This question is targeted at grades up to A/A*.</p> <p>Indicative scientific points at levels 3 must include:</p> <ul style="list-style-type: none"> • $\text{Pb}^{2+} + 2\text{I}^- \rightarrow \text{PbI}_2$ <p>Indicative scientific points at levels 2 and 3 may include:</p> <ul style="list-style-type: none"> • mixing of solutions • filtration • washes precipitate / residue • dries precipitate • drying in an oven or on window sill <p>any two correct points about the procedure AND a correct ionic equation level 3 (5 marks)</p> <p>Indicative scientific points at level 1 include:</p> <ul style="list-style-type: none"> • mixing or reacting of solutions • filtration <p>marks can be scored from labelled diagrams</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		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	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ correct formulae (1) balancing - conditional on correct formulae (1)	2	allow any correct multiple including fractions e.g. $2\text{CaCO}_3 + 4\text{HCl} \rightarrow 2\text{CaCl}_2 + 2\text{CO}_2 + 2\text{H}_2\text{O}$ allow = or \Rightarrow for arrow not 'and' or & for + allow one mark for correct balanced equation with incorrect use of case, superscript or subscript e.g. $\text{CacO}_3 + 2\text{HCl} \rightarrow \text{CACL}_2 + \text{CO}_2 + \text{H}_2\text{O}$
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	$4\text{H}^+ + 4\text{e}^- + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ correct formulae – ignore electrons (1) balancing - conditional on correct formulae including electrons (1)	2	allow any correct multiple including fractions e.g. $2\text{H}^+ + 2\text{e}^- + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$ allow = or \rightleftharpoons for arrow not 'and' or & for + allow one mark for correct balanced equation with incorrect use of case, subscript or superscript e.g. $4\text{H}^+ + 4\text{e}^- + \text{O}_2 \rightarrow 2\text{h}_2\text{O}$
	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	<p>any two from:</p> <p>provides a barrier (to water and oxygen) (1)</p> <p>idea that zinc corrodes or reacts preferentially (1)</p> <p>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)</p>	2	<p>any mention of zinc rusting is one mark maximum for the question</p> <p>allow protective layer / protective coat</p> <p>if a metal is mentioned it must be zinc</p> <p>layer over the surface is not sufficient</p> <p>allow acts as a sacrificial metal</p>
c	<p>magnesium (atoms) lose electrons (to form magnesium ions) so oxidation (1)</p> <p>iron(III) (ions) gain electrons (to form iron atoms) so reduction (1)</p>	2	<p>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</p> <p>allow iron(II) (ions) or iron <u>ions</u> gain electrons (to form iron atoms) so reduction</p> <p>not iron gains electrons</p> <p>ignore reference to gain or loss of oxygen</p>
	Total	5	

Question	Answer	Marks	Guidance
15 a	<p>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)</p> <p>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)</p> <p>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)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A</p> <p>Indicative scientific points may include:</p> <p>Explanations for C Pete is correct because</p> <ul style="list-style-type: none"> • best or excellent stain removal • best or excellent whiteness • best or good for preventing fading <p>ignore just quoting data</p> <p>How detergents remove oil stains</p> <ul style="list-style-type: none"> • 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 <p>Use the L1, L2, L3 annotations in Scoris. Do not use ticks.</p> 
b	<p>(dry cleaning) does not involve water / solvent is not water / washed in organic solvent (1)</p> <p>stain will not dissolve in water / stain will only dissolve in organic solvent (1)</p>	2	<p>ignore references to washing machine</p> <p>allow water will damage fabric (1)</p> <p>ignore references to temperature of wash</p>

	Total	8	
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Question	Answer	Marks	Guidance
16 a i	25 - 27 (°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 °C (solubility of) SO ₂ is 69 times that of CO ₂ = 2 marks allow at 10 °C (solubility of) SO ₂ is 68 times that of CO ₂ = 2 marks allow at 40 °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	<p>allow to have a fair test / to control all the variables</p> <p>allow a more general statement about the solubility of gases e.g. solubility of gases change with temperature</p> <p>allow change in temperature changes pH</p> <p>temperature is an important factor is not sufficient</p> <p>not temperature depends on the mass of carbon dioxide</p>
ii	<p>any two from:</p> <p>sulfur dioxide is also involved in making oceans acid / other factors involved in making oceans acid (1)</p> <p>idea that remote island not representative of whole ocean / could have tested more locations / AW (1)</p> <p>should have tested more years / reduce the gap between testing (1)</p> <p>should test at same time of year (1)</p> <p>did not repeat results (1)</p> <p>there is one anomalous result / identification of pH 7.96 as being an outlier (1)</p>	2	<p>allow one mark for not enough evidence collected if no other mark awarded</p> <p>she is only looking at one aspect of the ocean is not sufficient</p>
	Total	10	

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