



GCSE

Chemistry B

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

General Certificate of Secondary Education

Mark Scheme for June 2016

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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

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

Subject-specific Marking Instructions

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

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Question	Answer	Marks	Guidance
1 a	atom Y – no of protons = 3 and no of neutrons = 4 (1) atom Z – mass number = 12 (1) atom Z – electronic structure is 2.4 (1)	3	
b	isotopes (1) same atomic number but different mass numbers / same number of protons but different numbers of neutrons (1)	2	<p>allow an element with the same atomic number but different mass number / same type of atom with different numbers of neutrons</p> <p>allow same element with different numbers of neutrons is sufficient</p> <p>ignore references to electrons</p> <p>ignore halogens</p> <p>ignore wrong number of neutrons quoted</p>
	Total	5	

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Question	Answer	Marks	Guidance
2 a	<p>any two from:</p> <p>idea of loss free power transmission (1)</p> <p>(super) fast electronic circuits (1)</p> <p>(powerful) electromagnets (1)</p>	2	<p>allow transfer electricity with high efficiency / no energy loss / low energy lost / low energy wasted / no heat loss / little heat lost</p> <p>ignore uses less fossil fuel in electricity generation</p> <p>allow fast electric circuits</p> <p>ignore electricity transferred quicker / conducts better than ordinary conductors</p> <p>fast computers is not sufficient</p> <p>ignore references to high speed trains / cars</p>
b	(idea that need to maintain) low temperatures (1)	1	<p>allow temperatures below – 100 °C if temperature quoted</p> <p>allow cold temperature</p> <p>allow answers that refer to the use of a low temperature e.g. low temperatures are expensive</p> <p>ignore they are expensive</p>
	Total	3	

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Question	Answer	Marks	Guidance
3 a	appearance of iodine – grey solid / black solid (1) melting point of astatine – anywhere in the range 200 to 310 (1) boiling point of fluorine – anywhere in the range -80 to -150 (1)	3	both colour and state required
b	idea of electron gained (1) but (Group 7 elements) going up the group easier to gain electrons / fluorine gains electrons more readily / ora for astatine (2)	2	assume unspecified comments refer to fluorine electrons lost = 0 for the question allow fluorine has a smaller atom / astatine has a larger atom / fluorine has less (electron) shielding / astatine has more (electron) shielding / stronger attraction between outer electrons and nucleus in fluorine / ora where appropriate (1)
	Total	5	

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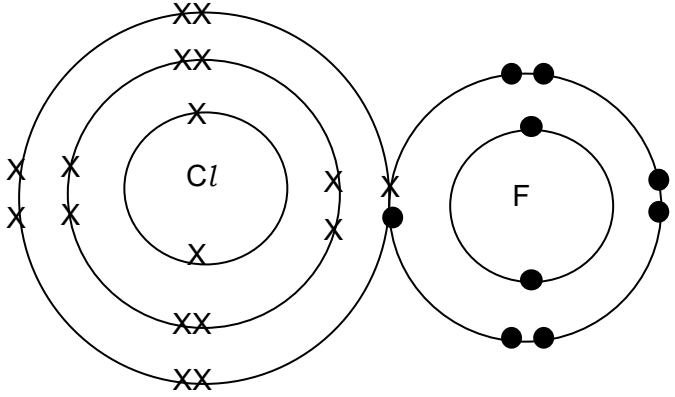
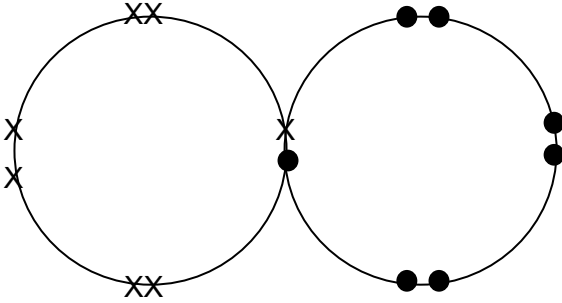
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Question	Answer	Marks	Guidance
	<p>Level 3 Identifies (by name or by the ions present) both compounds A and B, with one explanation for each compound AND writes the balanced symbol equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>Level 2 Identifies one ion or one compound (in either A or B) AND writes the balanced symbol equation. OR Identifies one compound (either A or B) with one explanation OR Identifies two ions present (either/or in A and B) with one explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 Identifies one ion or one compound in (either A or B) OR writes the balanced symbol 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. (0 marks)</p>	6	<p>This question is targeted at grades up to A.</p> <p>Indicative scientific points may include: Symbol equation $\text{FeCl}_3 + 3\text{AgNO}_3 \rightarrow 3\text{AgCl} + \text{Fe}(\text{NO}_3)_3$ allow any correct multiple e.g. $2\text{FeCl}_3 + 6\text{AgNO}_3 \rightarrow 6\text{AgCl} + 2\text{Fe}(\text{NO}_3)_3$ allow = or \rightleftharpoons for arrow not 'and' or & for + allow correctly balanced equation with minor errors of case, subscript or superscript at level 1 e.g. $\text{FeCl}_3 + 3\text{AgNO}_3 \rightarrow 3\text{AgCl} + \text{Fe}(\text{NO}_3)_3$</p> <p>Compound A</p> <ul style="list-style-type: none"> • compound A contains copper (ions) / Cu^{2+} • compound A contains chloride (ions) / Cl^- • compound A is copper chloride / CuCl_2 <p>Reasons</p> <ul style="list-style-type: none"> • because copper (ions) give a blue ppt with sodium hydroxide or hydroxide (ions) • because chloride (ions) give a white ppt with silver nitrate or silver ions <p>Compound B</p> <ul style="list-style-type: none"> • compound B contains iron(II) (ions) • compound B contains bromide (ions) • compound B is iron(II) bromide <p>Reasons</p> <ul style="list-style-type: none"> • iron(II) (ions) give a green ppt with sodium hydroxide or hydroxide (ions) • bromide (ions) give a cream ppt with silver nitrate or silver ions <p>allow ppt or solid allow reference to chlorine and bromine (ions) Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		6	

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Question	Answer	Marks	Guidance
5 a	<p>all correct (2)</p> 	2	<p>allow one mark for bonding pair if the answer is incorrect</p> <p>allow diagrams using all dots or all crosses circles need not be drawn</p> <p>allow answer with outer shell electrons only i.e.</p>  <p>If inner shells shown they must be correct</p> <p>ignore any atomic symbol given in answer – just focus on the electrons</p> <p>ionic structure = 0 marks for the question</p>

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Question	Answer	Marks	Guidance
b	<p>any two from: low melting point (1) low boiling point (1)</p> <p>does not conduct electricity (1) does not conduct heat (1)</p>	2	<p>ignore it is a gas or a liquid but if melting point or boiling point not awarded allow it is a gas at room temperature / is a liquid at room temperature (1)</p> <p>allow low density ignore lightweight</p> <p>allow it is a poor conductor of electricity</p> <p>allow it is a poor conductor of heat</p> <p>allow it is a poor conductor / a bad conductor for one mark if does not conduct heat and electricity not given</p> <p>ignore references to colour</p>
c	<p>any two from: arranged elements in order of (relative) atomic mass (1) left gaps in his table (for elements not yet discovered) (1) predicted properties of elements (1) arranged elements in periods (1) arranged elements in groups (1) realised that there was a periodic behaviour in the properties of the elements (1)</p>	2	<p>ignore reference to atomic number ignore reference to mass number</p> <p>allow predicted properties of 'missing' elements for two marks</p> <p>allow arranged elements together with similar chemical properties</p>
Total		6	

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Question	Answer	Marks	Guidance
6	<p>A – chloride (ions) B – iodide (ions) and sulfate (ions) C – sulfate (ions) all correct (2) BUT one or two correct (1)</p> <p>then one correct explanation from (1) white ppt with lead nitrate indicates chloride (ions) yellow ppt with lead nitrate indicates iodide (ions) white ppt with barium chloride indicates sulfate (ions)</p>	3	<p>allow correct formulae of ions</p> <p>allow chlorine and iodine (ions) ignore names of compounds</p> <p>allow lead ions rather than lead nitrate</p> <p>allow barium ions rather than barium chloride</p>
Total		3	

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Question	Answer	Marks	Guidance
7 a	acid strength – idea that acid strength or strong or weak is a measure of the degree of ionisation of the acid (1) concentration – idea of the number of moles (of acid) in 1dm ³ (1)	2	allow strong acid –dissociation is complete / weak acid-dissociation is partial (1) reference to concentration or number of hydrogen ions is not sufficient reference to pH is not sufficient ignore proportion of hydrogen ions that ionise in water but allow proportion of molecules that ionise allow amount of particles in a given or fixed volume / amount in 1 dm ³ ignore amount of particles in an area allow amount, mass or moles is any specified volume e.g. cm ³ or litre
b i	any one from idea that there are more hydrogen ions in the hydrochloric acid / hydrogen ions more concentrated / hydrogen ions more crowded / hydrogen ions are closer together (1) idea that there are more collisions (between hydrogen ions and calcium carbonate) (1)	1	ignore references to particles for marking point 1 ignore hydrochloric acid is more ionising / references to kinetic energy allow greater collision frequency / collisions more likely / more chance of collision
ii	idea that both acids have the same concentration / amount of gas is determined by amounts of acids and calcium carbonate (not strength of acid) (1)	1	allow same amount of acid / both give same amount of H ⁺ (eventually) / same amount of calcium carbonate / same amount of reactants (1) allow calcium carbonate is limiting reactant / acid is limiting reactant ignore same volume of acid not same concentration of H ⁺ not same mass of acid
	Total	4	

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Question	Answer	Marks	Guidance
8 a	catalyst / vanadium(V) oxide / V_2O_5 (1)	1	<p>allow vanadium pentoxide</p> <p>if a named catalyst is given it must be correct including oxidation number except allow vanadium oxide catalyst</p> <p>if formula and name given both must be correct</p>
b	<p>any three from:</p> <p>catalyst increases rate of reaction (1)</p> <p>catalyst does not change position of equilibrium (1)</p> <p>increasing temperature - increases rate of reaction / temperature used to have a high rate of reaction (1)</p> <p>but increasing temperature position of equilibrium to left / temperature used to not shift the equilibrium to the left (1)</p> <p>at low pressure position of equilibrium is already on right (1)</p> <p>so expensive high pressures are not needed / at low pressure rate is low so reaction is easier to control (1)</p>	3	<p>allow ora where appropriate</p> <p>allow catalyst does not change (percentage) yield</p> <p>allow increasing temperature decreases (percentage) yield / increasing temperature favours backward reaction (1)</p> <p>reference to it is a compromise temperature is not sufficient</p> <p>allow good product (percentage) yield at low pressure</p> <p>not use low pressure to shift equilibrium to the right</p>
	Total	4	

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Question	Answer	Marks	Guidance
9 a i	75 (cm ³) (1)	1	allow any value between 74 – 76 cm ³
ii	any value between 50 and 52 (seconds) (1)	1	
iii	line remains on or below original line and levels off at a lower volume (1) BUT line remains on or below original line and levels off at 48 ± 2 cm ³ (2)	2	line with a steeper gradient = 0 marks for the question
b i	LOOK FOR ANSWER FIRST OF ALL IF mass = 50 g AWARD 2 MARKS idea of 1 x 10 / 2 x 5 / 0.5 x 20 (1)	2	allow 10 x 10/2 or 10 x 5/1 or 10 x 2.5/0.5
ii	0.08 (moles) (1)	1	
iii	1920 (cm ³) (1)	1	allow ecf from part (ii)
	Total	8	

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Question	Answer	Marks	Guidance
10	<p>Level 3 Interprets graph to make at least two deductions one of which correctly identifies end-point AND correctly calculates the concentration of NaOH.</p> <p>Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>Level 2 Interprets graph to make at least two deductions one of which correctly identifies end-point AND attempts calculation OR correctly calculates the concentration of NaOH from the wrong end-point.</p> <p>Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 Candidate interprets graph to make a simple deduction e.g. volume at end-point.</p> <p>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/A*.</p> <p>Indicative scientific points may include:</p> <p>Deductions</p> <ul style="list-style-type: none"> • neutralised at or end-point is 20 cm³ • pH at start, of NaOH, is any value between 12.8 to 13.2 • range for rapid rate of change of pH is about 12 to 3 • correctly reads pH for a stated volume of acid • correctly reads volume of acid for a stated pH • strong acid / strong base <p>Calculation</p> <ul style="list-style-type: none"> • no of moles of acid = $\frac{\text{volume}}{1000} \times 0.1$ • no of moles of acid = $\frac{20}{1000} \times 0.1$ or $0.020 \times 10^{-3} = 0.002$ • 25cm³ of NaOH contains 0.002 moles • concentration of NaOH = $\frac{\text{moles}}{\text{volume}} \times 1000$ or $\frac{\text{moles}}{\text{volume in dm}^3}$ • concentration of NaOH = $\frac{0.002}{25} \times 1000$ or $\frac{0.002}{0.025}$ • concentration = 0.08 mol/dm³ <p>allow ecf from incorrect end-point</p> <p>an attempt at a calculation is one of the partial steps in the calculation e.g. working out moles of acid or working out a concentration of NaOH</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		6	

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Question	Answer	Marks	Guidance
11 a	ester (1)	1	allow other ways of indicating correct answer e.g. ticks or answer circled but answer line takes precedence
b	$C_3H_8O_3$ (1)	1	allow any order of atoms ignore $C_3H_5(OH)_3$ etc.
c i	contains a (carbon-carbon) double bond (1)	1	allow has a C=C in its formula allow (has a) double bonded carbon
ii	bromine (water) (1) goes (from brown to) colourless / is decolourised (1)	2	allow Br_2 not bromide this marking point is dependent on correct reagent or bromide allow colour fades allow any colour from orange-red, orange, brown-red, brown for colour of bromine ignore clear not if wrong starting colour of bromine is given not discoloured
d	react with hydrogen (1) and any one of nickel (catalyst) (1) use of high pressure (1) use of an unsaturated fat or oil (1)	2	allow hydrogenation not hydrated allow any quoted pressure above atmospheric pressure / under pressure allow use of a fat with a C=C bond ignore reference to temperature
	Total	7	

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Question	Answer	Marks	Guidance
<p>12 </p>	<p>Level 3 Correct word and symbol equation AND explanation that reaction involves both oxidation and reduction. Quality of communication does not impede communication of science at this level. (5-6 marks)</p> <p>Level 2 Correct word and symbol equation OR explanation that reaction involves both oxidation and reduction. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 Correct word equation OR Correct symbol equation OR Correct statement about OIL RIG OR explains why iron is oxidised OR explains why copper ions are reduced. Quality of 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 at levels 3 must include:</p> <ul style="list-style-type: none"> • $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$ • oxidation because Fe loses electrons – could be shown as a half equation • reduction because Cu^{2+} gains electrons – could be show as a half equation <p>Indicative scientific points for all levels could include:</p> <ul style="list-style-type: none"> • oxidation is loss of electrons (OIL) • reduction is gain of electrons (RIG) • electrons are transferred • iron + copper(II) sulfate \rightarrow copper + iron(II) sulfate <p>ignore missing oxidation states in the names</p> <p>do not allow copper(II) instead of copper in RHS of equation</p> <p>Use the L1, L2, L3 annotations in Scoris, do not use ticks</p>
	Total	6	

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Question	Answer	Marks	Guidance
13 a	reaction 4 / $O_3 \rightarrow O_2 + O$ (1)	1	allow makes oxygen atoms and oxygen molecules / makes O and O_2
b	<p>any two from:</p> <p>idea that C—Cl bond breaks (1)</p> <p>homolytic fission (1)</p> <p>one electron (from bond) goes to one atom (1)</p> <p>and the other electron (from bond) to the chlorine (1)</p>	2	<p>allow $C-Cl \rightarrow C + Cl$ breaking a chlorine atom from the molecule is not sufficient</p> <p>reference to formation of chlorine (free) radicals is not sufficient</p> <p>allow leaving chlorine (atom) with an unpaired electron</p> <p>not chlorine has a free electron</p> <p>covalent bond splits evenly is not sufficient</p>
c	<p>reference to reactions 2 and 3 (1)</p> <p>chlorine atom is regenerated (at end) / chlorine atom is a catalyst / (the two reactions are a) chain reaction / chlorine atoms are not destroyed (1)</p>	2	<p>allow reference in terms of quoting the equations or reference in word form</p> <p>allow chlorine (free) radical for a chlorine atom</p>

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Question	Answer	Marks	Guidance
d	<p>any two from:</p> <p>took a long time to collect evidence / needed to do lots of research / it was difficult to collect the evidence (1)</p> <p>difficult to convince government of the disadvantages of CFCs / lots of money had been put into developing CFCs (1)</p> <p>needed agreement of other scientists / lots of scientists had to work on the task (1)</p> <p>(time needed) to develop alternatives to CFCs (1)</p>	2	<p>allow took a long time to realise CFCs were 'reactive in the stratosphere' / took a long time for CFCs to have an effect on the ozone layer</p> <p>allow initially technology not available to test the effects in the stratosphere</p> <p>allow slow action / inertia by government</p> <p>allow political clout of the manufacturers prevented immediate action</p> <p>allow took a long time to get agreement between different countries / UK government only responded after other governments had banned CFCs</p>
	Total	7	

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Question	Answer	Marks	Guidance
14	(No or an implication of no) temporary hard water reduces volume (of lather) in soap (1) temporary hard water does not reduce volume (of lather) in washing-up liquid (1)	2	If yes no marks for this question magnesium sulfate or sodium chloride cause temporary hardness in water = 0 for the question just quoting results is not sufficient. answers must specify that the results used are for temporary hard water or for calcium hydrogencarbonate allow calcium hydrogencarbonate reduces volume (of lather) in soap solution allow calcium hydrogencarbonate does not reduce volume (of lather) in washing up liquid allow one mark for idea that calcium hydrogencarbonate causes temporary hard water if no other mark awarded in the question
	Total	2	

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Question	Answer	Marks	Guidance
15 a	7.5 (g) (1)	1	allow 7.4 to 7.6
b	LOOK FOR ANSWER FIRST OF ALL IF mass = 60 g AWARD 2 MARKS idea that must multiply (7.5) by 4 / idea that must multiply (30) by 2 / idea that must multiply (7.5) by 8 (1)	2	allow ecf answer to (a) \times 8 e.g. 60.8 if 7.6g and 59.2 if 7.4 allow ecf
	Total	3	

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Question	Answer	Marks	Guidance
16 a i	34 - 36 (1)	1	units not needed
ii	Controls effective because gradient is less (than it would have been) after 1977 / controls effective since the use of fertilisers has grown at a much greater rate than the pollution / controls effective because of the sudden decrease at 1977 (1)	1	allow controls effective since concentration of nitrate less after 1977 allow figures quoted from graph to show decrease of nitrate concentration allow not (very) effective since little change in the gradient of graph before and after 1977
b i	1 260 000 000 (1)	1	unit not needed allow 1.26×10^9 or 1.3×10^9
ii	(percentage of) land available (for agriculture) is (much) less (1) so need to get very high crop yield from the land (1)	2	assume answers apply to country B but allow ora for A if specified ignore country small / 4% used for agriculture / 4% available unlike (another quoted value) allow B has lots of pests (1)
c i	nitrous oxide (1) largest source from farming (1)	2	N ₂ O it is 88% is not sufficient but allow 88% from farming allow fertilisers contain nitrogen and this gas contains nitrogen ignore just quoting numbers
ii	more carbon dioxide produced by farming (1) more nitrous oxide produced by farming (1) more methane produced by farming (1)	3	allow all (three greenhouse) gases are in greater percentage from farming than from residential use (3) must compare data and not just quote the data allow farming is 147 and residential is 17 for one mark if no other mark awarded
	Total	10	

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