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 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.

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

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.

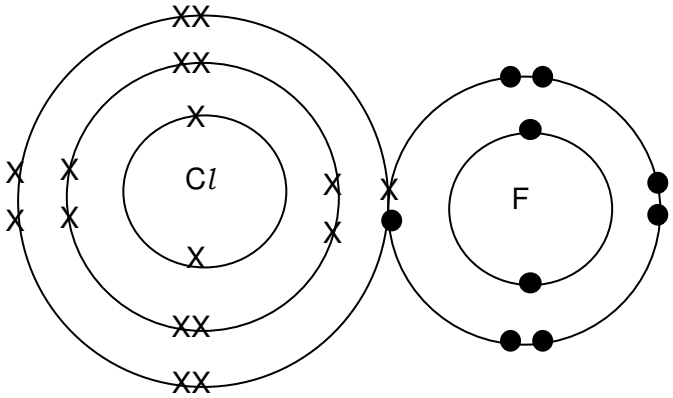
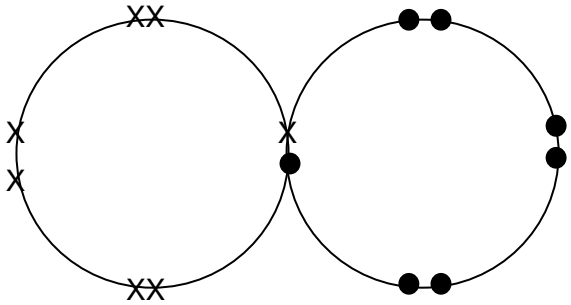
/ = alternative and acceptable answers for the same marking point
(1) = separates marking points
allow = answers that can be accepted
not = answers which are not worthy of credit
reject = answers which are not worthy of credit
ignore = statements which are irrelevant
( ) = words which are not essential 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

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	**allow** an element with the same atomic number but different mass number / same type of atom with different numbers of neutrons **allow** same element with different numbers of neutrons is sufficient **ignore** references to electrons **ignore** halogens **ignore** wrong number of neutrons quoted
	Total	**5**	

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

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**	

Question	Answer	Marks	Guidance
	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) **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) **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) **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:** **Symbol equation** $FeCl_3 + 3AgNO_3 \rightarrow 3AgCl + Fe(NO_3)_3$ **allow** any correct multiple e.g. $2FeCl_3 + 6AgNO_3 \rightarrow 6AgCl + 2Fe(NO_3)_3$ **allow** = or ⇆ for arrow **not** 'and' or & for + **allow** correctly balanced equation with minor errors of case, subscript or superscript at level 1 e.g. $FECl_3 + 3AgNO^3 \rightarrow 3AgCl + Fe(NO_3)_3$ **Compound A** • compound **A** contains copper (ions) / Cu^{2+} • compound **A** contains chloride (ions) / Cl • compound **A** is copper chloride / $CuCl_2$ **Reasons** • 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 **Compound B** • compound **B** contains iron(II) (ions) • compound **B** contains bromide (ions) • compound **B** is iron(II) bromide **Reasons** • 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 **allow** ppt or solid **allow** reference to chlorine and bromine (ions) **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
		6	

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

Question	Answer	Marks	Guidance
b	**any two from:** low melting point (1) low boiling point (1) does not conduct electricity (1) does not conduct heat (1)	2	 **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) **allow** low density **ignore** lightweight **allow** it is a poor conductor of electricity **allow** it is a poor conductor of heat **allow** it is a poor conductor / a bad conductor for one mark if does not conduct heat and electricity not given **ignore** references to colour
c	**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)	2	 **ignore** reference to atomic number **ignore** reference to mass number **allow** predicted properties of 'missing' elements for two marks **allow** arranged elements together with similar chemical properties
	Total	**6**	

Question	Answer	Marks	Guidance
6	**A** – chloride (ions) **B** – iodide (ions) and sulfate (ions) **C** – sulfate (ions) **all correct (2)** **BUT** **one or two correct (1)** **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)	3	**allow** correct formulae of ions **allow** chlorine and iodine (ions) **ignore** names of compounds **allow** lead ions rather than lead nitrate **allow** barium ions rather than barium chloride
	Total	**3**	

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**	

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

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**	

Question	Answer	Marks	Guidance
10	**Level 3** **Interprets graph to make at least two deductions one of which correctly identifies end-point** **AND** **correctly calculates the concentration of NaOH.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **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.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Candidate interprets graph to make a simple deduction e.g. volume at end-point.** 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/A*.** **Indicative scientific points may include:** **Deductions** • neutralised at or end-point is 20 cm^3 • 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 **Calculation** • no of moles of acid = $\frac{\text{volume}}{1000} \times 0.1$ • no of moles of acid = $\frac{20}{1000} \times 0.1$ or $0.020 \times 10^{-3} = 0.002$ • 25cm^3 of NaOH contains 0.002 moles • concentration of NaOH = $\frac{\text{moles}}{\text{volume}} \times 1000$ or $\frac{\text{moles}}{\text{volume in dm3}}$ • concentration of NaOH = $\frac{0.002}{25} \times 1000$ or $\frac{0.002}{0.025}$ • concentration = 0.08 mol/dm^3 **allow** ecf from incorrect end-point 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 **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
		6	

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**	

Question	Answer	Marks	Guidance
12 	**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) **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) **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) **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 at levels 3 must include:** • $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ • 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 **Indicative scientific points for all levels could include:** • oxidation is loss of electrons (OIL) • reduction is gain of electrons (RIG) • electrons are transferred • iron + copper(II) sulfate → copper + iron(II) sulfate **ignore** missing oxidation states in the names **do not allow** copper(II) instead of copper in RHS of equation **Use the L1, L2, L3 annotations in Scoris, do not use ticks**
	Total	**6**	

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	**any two from:** idea that C—C*l* bond breaks (1) homolytic fission (1) one electron (from bond) goes to one atom (1) and the other electron (from bond) to the chlorine (1)	2	 **allow** C—C*l* $\rightarrow$ C + C*l* breaking a chlorine atom from the molecule is **not** sufficient reference to formation of chlorine (free) radicals is **not** sufficient **allow** leaving chlorine (atom) with an unpaired electron **not** chlorine has a free electron covalent bond splits evenly is **not** sufficient
c	reference to reactions **2 and 3** (1) chlorine atom is regenerated (at end) / chlorine atom is a catalyst / (the two reactions are a) chain reaction / chlorine atoms are not destroyed (1)	2	**allow** reference in terms of quoting the equations or reference in word form **allow** chlorine (free) radical for a chlorine atom

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

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**	

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) × 8 e.g. 60.8 if 7.6g and 59.2 if 7.4 **allow** ecf
	Total	**3**	

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_2O 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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