OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry B

General Certificate of Secondary Education

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

Mark Scheme for June 2013

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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.

1. Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt **not** given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	Level 3

2. **ADDITIONAL OBJECTS:** You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

When you open the script if the message appears that there are additional objects you must check these additional objects.

The additional objects are normally additional sheets of answers that must be marked. You should immediately link each extra answer with the appropriate question using the paper clip icon.

PLEASE ASK YOUR TEAM LEADER IF YOU DO NOT KNOW HOW TO DO THIS.

It is vitally important that all parts of the candidate's answer are marked.

3. **Subject-specific Marking Instructions**

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

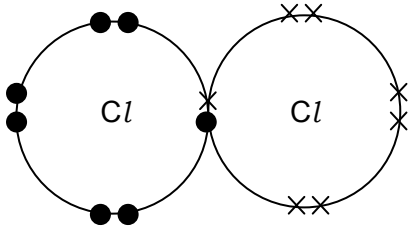
/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant
( )	=	words which are not essential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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>$^{32}_{15}$P (1)

18 electrons (1)</td><td>2</td><td>
<table>
<tr><th>atom or ion</th><th colspan="3">number of</th></tr>
<tr><th></th><th>electrons</th><th>neutrons</th><th>protons</th></tr>
<tr><td>$^{1}_{1}$H</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>$^{2}_{1}$H</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>$^{31}_{15}$P</td><td>15</td><td>16</td><td>15</td></tr>
<tr><td>$^{32}_{15}$P</td><td>15</td><td>17</td><td>15</td></tr>
<tr><td>$^{32}_{16}S^{2-}$</td><td>18</td><td>16</td><td>16</td></tr>
</table>
allow ^{32}P

not $_{32}$P</td></tr>
<tr><td></td><td>(b)</td><td></td><td>same atomic number and different mass number (1)</td><td>1</td><td>allow same proton number or number of protons and different number of neutrons or atomic mass
allow same element but different mass number / same type of atom and different number of neutrons
ignore same number of electrons
not different relative atomic mass</td></tr>
</table>

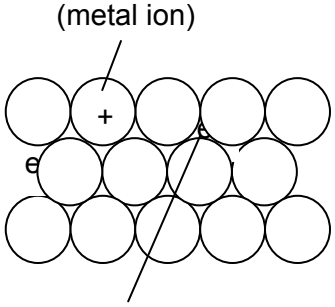
Question			Answer	Marks	Guidance
	(c)		**any two from:** so results can be replicated / so work does not need to be duplicated (1) so further evidence can be collected (1) idea of peer review / work can be checked (1) to provide information to other scientists or public or other organisations / AW (1) so he can get recognition for his work (1)	2	 allow work can be developed further (1) allow so work can be evaluated (1) allow idea that information can be used by other scientists (1) allow idea of to increase the sum of human knowledge / to educate people (1) allow so other scientists cannot take credit (1)
			Total	**5**	

Question			Answer	Marks	Guidance
2	(a)		(add up number of electrons) and this is the atomic number (and check on periodic table) (1)	1	**allow** has 20 electrons and on periodic table element number 20 is calcium **allow** element is in Group 2 and Period 4 it has 20 electrons on its own is **not** sufficient
	(b)		one shared pair of electrons between the chlorine atoms (1) rest of outer shells correct (1)	2	**allow** electrons to be all crosses or all dots  **ignore** inner shell electrons even if incorrect **do not allow** diagams with charges / diagrams with double bonds = 0 marks
	(c)		sodium (atoms) lose electrons (1) chlorine (atoms) gain electrons (1)	2	**allow** sodium ions have more protons than electrons **not** sodium ions lose electrons **allow** chloride ions have more electrons than protons **not** chloride ions gain electrons

	(d)		(chlorine molecule) gains electron(s) (1)	1	
	(e)		$Cl_2 + 2KI \rightarrow 2KCl + I_2$ **OR** $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ correct formulae (1) correct balancing – dependent on correct formulae (1)	2	**ignore** state symbols **allow** = instead of → **allow** any correct multiple including fractions **not** & or and instead of + **allow** one mark for correct equation with minor errors of subscript, superscript and case eg cl2 + 2KI → 2KCl + I^2
			Total	**8**	

Question			Answer	Marks	Guidance
3			**Level 3 (5–6 marks)** **Candidate applies knowledge of the reaction of alkali metals to predict some observations or comments of the reaction of caesium with water including a comparison of the rate of reaction with lithium** **AND** **Constructs the balanced symbol equation for the reaction between caesium or lithium and water.** Quality of written communication does not impede communication of science at this level. **Level 2 (3–4 marks)** **Candidate applies knowledge of the reaction of alkali metals to predict some observations or makes comments about the reaction between caesium and water** **AND** **gives the names or formulae of products formed in the reaction between caesium and water.** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Candidate applies knowledge of the reaction of alkali metals to predict some observations or makes comments about the reaction between caesium and water** **OR** **gives the names or formulae of products formed in the reaction between caesium and water.** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A** **Indicative scientific points at level 3 must include:** • $2Cs + 2H_2O \rightarrow 2CsOH + H_2$ **OR** $2Li + 2H_2O \rightarrow 2LiOH + H_2$. • faster reaction than with lithium / more reactive / more violent **Indicative scientific points at levels 1, 2 and 3 may include:** • caesium + water → caesium hydroxide + hydrogen • lithium + water → lithium hydroxide + hydrogen • hydrogen made • caesium hydroxide made • bubbles • fizzes • floats • moves on the surface • gives a flame • gets smaller • forms a colourless solution • alkaline solution formed • explodes • caesium loses electrons more easily
			Total	**6**	

Question			Answer	Marks	Guidance
4			**D** (1) contains a sulfate because of white precipitate with barium chloride (1) contains a chloride because of white precipitate with silver nitrate (1)	3	**If any other letter given = 0 marks** **If no letter given maximum of two marks** **allow** barium chloride is a test for sulfate **allow** silver nitrate is a test for chloride **allow** for one mark contains a sulfate and a chloride / forms a precipitate with barium chloride and silver nitrate
			Total	**3**	

Question			Answer	Marks	Guidance
5	(a)		K (1)	1	**allow** potassium
	(b)		idea of an attraction or bond(ing) between positive ions and electrons (1) (closely packed) metal ions and delocalised electrons (1)	2	**do not allow** intermolecular forces / covalent bonding / ionic bonding / metal molecules = 0 for the question **allow** positive atoms, cations, positive ions instead of metal ions and free electrons instead of delocalised electrons. **allow** has electrons free to move instead of delocalised or free electrons / sea of electrons instead of delocalised electrons **allow** mark could be found on a labelled diagram 
			Total	**3**	

Question			Answer	Marks	Guidance
6	(a)	(i)	68 (cm^3) (1)	1	
		(ii)	37–39 (seconds) (1)	1	
		(iii)	line needs to level off at same height and be steeper initially (1)	1	By eye the line should go through the origin Line drawn to left of original and must not go above 79 cm^3 at any point but must end at 78 cm^3
	(b)		reactant not in excess / that is all used up (at the end of the reaction (1)	1	**allow** reactant that determines the volume of hydrogen given off (1) **allow** substance that causes the reaction to stop **allow** reagent that runs out (first)
			Total	**4**	

Question			Answer	Marks	Guidance
7	(a)		titration 1 is not consistent / only consistently close readings should be included / all the other volumes are close to one another / all the other volumes are within 0.2 cm^3 (1)	1	**allow** titration 1 is a rough titration / titration 1 is inaccurate / it is a practice titration **allow** titre 1 is an outlier or anomaly **allow** it is a very different from the other values e.g. it is (at least) 0.5 cm^3 different **ignore** it does not follow the pattern
	(b)		**LOOK FOR ANSWER FIRST OF ALL** **IF concentration = 0.08 (mol/dm^3) AWARD 3 MARKS** no of moles in acid = $\frac{20 \times 0.100}{1000}$ / 0.02×0.100 / 0.002 (1) moles of alkali = 0.002 / moles of acid = moles of alkali (1) concentration = 0.08 (mol/dm^3) (1)	3	If answer correct **ignore** any working out **allow** ecf from moles of acid **unit** not needed **allow** ecf from moles of alkali ie conc = $\frac{moles}{0.025}$ / $\frac{moles \times 1000}{25}$
	(c)		single indicator or phenolphthalein only gives a single **colour** change / gives a sudden **colour** change (1) mixed indicator or universal indicator can give several **colour** changes / mixed indicator gives a gradual **colour** change (1)	2	**The first mark awarded must refer to a colour change** **allow** phenolphthalein only has two **colours** / is either **pink** or **colourless** / phenolphthalein changes **colour** at the end-point **ignore** clear **allow** universal indicator shows many **colours** / universal indicator changes **colour** all the time
			Total	**6**	

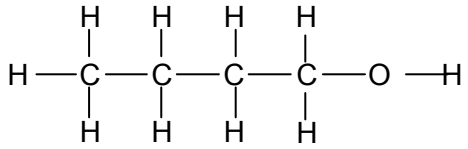
Question			Answer	Marks	Guidance
8			**Level 3 (5–6 marks)** **Manipulates the data to describe and explain how the position of equilibrium changes with pressure** **AND** **Manipulates the data to describe and explain how the position of equilibrium changes with temperature** Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** **Manipulates the data to describe and explain how the position of equilibrium changes with pressure** **OR** **Manipulates the data to describe and explain how the position of equilibrium changes with temperature** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Manipulates the data to describe how the position of equilibrium changes with pressure AND with temperature** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*.** **Relevant points at levels 2 and 3 include:** • increasing the pressure moves the equilibrium to the right because there are fewer molecules (or number of moles)on the rhs • increasing the temperature moves the equilibrium to the left because the forward reaction is exothermic or the backward reaction is endothermic. **Relevant points at level 1 include:** • as the pressure increases the position of equilibrium moves to the right or vice versa • as pressure increases percentage of ammonia increases • as the temperature increases the position of equilibrium moves to the left or vice versa • as temperature increases the percentage of ammonia decreases **ignore** references to rate
			Total	**6**	

Question			Answer	Marks	Guidance
9	(a)		**LOOK FOR ANSWER FIRST OF ALL** **IF percentage = 27.4 (%) OR 27(%) AWARD 2 MARKS** $\frac{19.2}{70} \times 100$ (1)	2	
	(b)	(i)	0.46 (g) (1)	1	**not** 0.5
		(ii)	idea that some of the sodium may have come from sources other than salt (1)	1	**allow** not all sodium is from sodium chloride / may be other sodium compounds present
			Total	**4**	

Question			Answer	Marks	Guidance
10	(a)		strong acid is fully ionised (in water) (1) weak acid is only partially ionised (1)	2	**allow** dissociated for ionised
	(b)	(i)	ethanoic acid contains a low**er** concentration of hydrogen ions (than hydrochloric acid) (1) so lower collision frequency (1)	2	**allow** ethanoic acid contains less crowded hydrogen ions / hydrogen ions in ethanoic acid are further apart / ora **allow** ethanoic acid has a high**er** pH / ora **allow** collisions less often / less chance of a collision / fewer collisions per second / ora if specified for hydrochloric acid
		(ii)	both contain the same number of moles of magnesium (1)	1	**allow** both contain the same amount of magnesium / both contain same mass of magnesium (1) **ignore** magnesium is the limiting reagent **not** same number of moles of acid
			Total	**5**	

Question			Answer	Marks	Guidance
11	(a)	(i)	$2Cl^- \rightarrow Cl_2 + 2e^-$ / $2Cl^- - 2e^- \rightarrow Cl_2$ formulae correct including electrons (1) balancing – dependent on correct formulae (1)	2	**allow** = instead of → **not** and or & instead of + **allow** any correct multiples including fractions **allow** e^- or e for electrons **allow** $2Cl^- - e^- \rightarrow Cl_2 + e^-$ for two marks **allow** one mark for correct balanced equation with minor errors of case, subscript and/or superscript eg 2CL- → Cl2 + 2e- **allow** one mark for $Cl^- - e^- \rightarrow Cl$ / $Cl^- \rightarrow Cl + e^-$ **allow** one mark for $2Cl^- \rightarrow Cl_2$
		(ii)	solid sodium chloride has ions in fixed positions / ions do not move in a solid (1) liquid sodium chloride has ions that move (1)	2	**allow** solid does not have free ions **ignore** electrons cannot move in a solid **allow** liquid sodium chloride has free ions **not** electrons can move in a liquid **allow** if no other marks scored award one mark for particles can move in a liquid but not in a solid / liquid has mobile charge carriers but solid does not
			Total	**6**	

Question			Answer	Marks	Guidance
	(b)		experiments **1** and **3** show that as time doubles mass (of copper made) doubles (1) experiments **3** and **4** show that as the current quadruples, the mass also quadruples (1) **OR** experiments **1** and **2** show that as current doubles mass (of copper made) doubles (1)	2	**allow** reference to the correct data in the table to identify which experiments they are using **allow** when the time doubles and the current stays the same the mass doubles **allow** when the current doubles and the time stays the same the mass doubles **allow** if no other marks awarded then as time and current increase the mass (of copper) increases for one mark
			Total	**6**	

Question			Answer	Marks	Guidance
12	(a)		ethene + water → ethanol (1)	1	**allow** = instead of → **allow** correct symbol equation $C_2H_4 + H_2O \rightarrow C_2H_5OH$ or C_2H_6O **allow** steam for water
	(b)	(i)	C_3H_7OH (1)	1	**allow** C_3H_8O allow any order of atoms
		(ii)	correct displayed formula (1) 	1	**allow** displayed formula for methylpropan – 1 – ol or methylpropan – 2 – ol or butan-2-ol **allow** OH in displayed formula with no bond between O and H

Question			Answer	Marks	Guidance
	(c)		**Level 3 (5–6 marks)** **Discusses at least one advantage and at least one disadvantage of each process** **AND** **identifies the better process fully justifying their choice.** Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** **EITHER** **Discusses at least one advantage and at least one disadvantage of each process** **OR** **Gives two comments (either advantages or disadvantages) about each process AND identifies the better process and gives a reason for that choice** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** **Gives two comments (either advantages or disadvantages) about each process** **OR** **identifies the better process and gives a reason for that choice** Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit	6	**This question is targeted at grades up to A/A*** **Indicative scientific points may include:** **Relevant points include for hydration process:** **advantages** • making ethanol from ethene is a much quicker process • ethanol can be produced 24/7 from ethene • pure ethanol made so it does not need to be purified • making ethanol from ethene does not produce any waste products as the atom economy is 100% • UK has access to North sea oil. • made by a continuous process **disadvantages** • ethene has to be manufactured from crude oil • crude oil (ethene) is a non renewable source • uses a lot of energy. **Relevant points include for fermentation process:** **advantages** • making ethanol from sugar is greener as the raw sugar is renewable / can be grown • energy costs are cheaper because a lower atmospheric pressure and a lower temperature than hydration is used • catalyst used is not corrosive since it is an enzyme found in yeast **disadvantages** • ethanol has to be purified • takes a long time to make • climate not suitable • uses large areas of arable land. • atom economy not 100% (if carbon dioxide not used) • made in a batch process **Use the L1, L2, L3 annotations in Scoris; do not use ticks**
			Total	**9**	

Question			Answer	Marks	Guidance
13	(a)		zinc + copper sulfate → copper + zinc sulfate (1)	1	**allow** = instead of → **not** and or & in equation **allow** reactants and products in any order **not** copper(II) as one of the products **allow** mix of words and correct formulae **ignore** state symbols **allow** correct symbol equation even if not balanced $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$ **allow** correct name with an incorrect formula but not incorrect name with correct formula
	(b)		iron or top reaction loses **electrons** which is oxidation (1) oxygen or bottom reaction gains **electrons** which is reduction (1)	2	no mark for identifying which reaction is oxidation and which is reduction **allow** water gains electrons which is reduction
			Total	**3**	

Question			Answer	Marks	Guidance
14	(a)		**Any two from:** Contains both temporary **and** permanent hardness (1) temporary because volume of soap goes down on boiling (1) permanent because boiled water needs more soap than distilled water (1)	2	
	(b)		Mg^{2+} removed / Ca^{2+} removed (1) are replaced by Na^{+} ions (1)	2	**not** magnesium removed / calcium removed **allow** Ca^{+} ions **not** are replaced by sodium **allow** magnesium or calcium ions swapped for sodium ions (2) **allow** calcium ions displace sodium ions / ora
			Total	**4**	

Question			Answer	Marks	Guidance
15	(a)		CFCs deplete the ozone (layer) (1) **(**population exposed to) high**er** levels of ultraviolet light (1)	2	**allow** forms ozone holes / damages the ozone (layer) **not** breaks down ozone atoms **ignore** global warming / is a greenhouse gas **allow** (population has a) great**er** risk of skin cancer
	(b)		C_2HF_5 (1)	1	**allow** other ways of indicating the correct answer e.g. underlining, ticking but answer line takes precedence
			Total	**3**	

Question			Answer	Marks	Guidance
16	(a)	(i)	**LOOK FOR ANSWER FIRST OF ALL** **IF year = 2078 AWARD 2 MARKS** in 2003 it is 8.0 so at 50% it will be 4.0 (1) 2078 (1)	2	look for working out on the graph **ALLOW** ecf from incorrect 50% value
		(ii)	(yes or no) 45 years after the ban still expect lots of CFCs (1)	1	**allow** the graph is not steep enough **allow** takes about 75 years to halve amount
		(iii)	**any two from:** not all countries may have banned CFC / more countries may ban the use / some countries may lift the ban (1) idea that not sufficient data to make firm prediction (1) new research to remove CFCs may be done (1) idea that concentration measurements may not be accurate until new technology introduced (1)	2	 **allow** CFCs are still being released into the atmosphere **allow** there is not enough evidence **allow** takes a long time to do research on CFCs **allow** the drop in concentration may not be constant
	(b)		**LOOK FOR ANSWER FIRST OF ALL** **IF age = 43 years AWARD 2 MARKS** 1970 is the year having 2.0 (1) so age is 43 years (1)	2	 **allow** ecf from wrong year from graph ie 2013 – year

Question			Answer	Marks	Guidance
	(c)	(i)	2.2% (1)	1	**allow** 2% **allow** 2.22 / 2.23% **allow** 2.3 %
		(ii)	**any two from:** (no because) CFC12 decrease is much later / no apparent decrease (1) initial concentration of CFC12 much lower so more difficult to tell if any effect (1) CFC12 may have a much longer lifetime in the air (1) idea that the ban may not have been a universal one (1) rate of decrease of CFC11 is greater (than CFC12) (1)	2	 **allow** CFC11 peaked in 1993 and CFC12 in 2000 **allow** ora **allow** ora
			Total	**10**	

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