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 2014

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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.

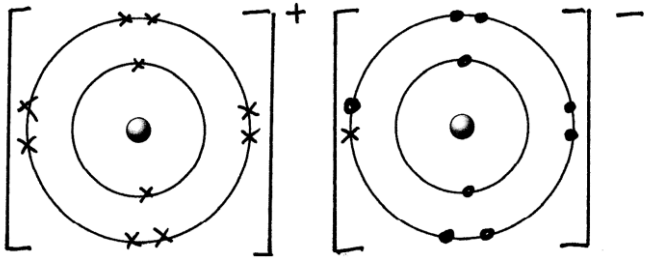
These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.

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	melting point of sodium – any value between 90 and 130 (1) atomic radius of rubidium – any value between 0.250 and 0.280 (1)	2	
b	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ correct formulae (1) balancing – dependent on correct formulae (1)	2	**allow** any correct multiple including fractions e.g. $4Na + 4H_2O \rightarrow 4NaOH + 2H_2$ **allow** = or ⇆ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors of case, subscript or superscript e.g. $2NA + 2H_2O \rightarrow 2NaOH + H^2$ (1)
c	all have one electron in their outer shell (1)	1	**allow** orbit or energy level rather than shell **allow** have same number of electrons in outer shell (1) **allow** all lose one electron to make an ion / all lose one electron to get a stable outer shell / all lose 1 electron to get a stable outer octet / all lose 1 electron to get a complete outer shell (1) they all lose 1 electron is **not** sufficient on its own all have a single electron is **not** sufficient **ignore** to make stable atom

Question	Answer	Marks	Guidance
d	 Na^+ F^- correct sodium ion / 2.8 (1) correct fluoride ion / 2.8 (1)	2	two correct electronic structures but no charges award one mark two correct charges with incorrect electronic structure award one mark one structure of 2,8 but unlabelled is **not** sufficient **but allow** both have a structure of 2,8 (1) the ionic charges must **not** be shown in the nucleus award 0 marks for structures with shared electrons One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks. **allow** answers showing the transfer of electrons providing the same electrons are not shown twice all electrons can be dots or crosses
	Total	**7**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2 a</td><td>relative mass of neutron (1)

relative charge of electron (1)</td><td>2</td><td>
<table>
<tr><th>Particle</th><th>Relative charge</th><th>Relative mass</th></tr>
<tr><td>proton</td><td>+1</td><td>1</td></tr>
<tr><td>neutron</td><td>0</td><td>1</td></tr>
<tr><td>electron</td><td>-1</td><td>0.0005</td></tr>
</table>
</td></tr>
<tr><td>b i</td><td>molecules (1)

high (1)</td><td>2</td><td>
<table>
<tr><th></th><th>Sodium chloride</th><th>Carbon dioxide</th></tr>
<tr><td>Formula</td><td>NaCl</td><td>CO_2</td></tr>
<tr><td>Type of particles present</td><td>ions</td><td>molecules</td></tr>
<tr><td>Melting point</td><td>high</td><td>low</td></tr>
</table>
</td></tr>
<tr><td>ii</td><td>weak forces between molecules / weak intermolecular forces (1)</td><td>1</td><td>allow weak forces between particles, but not weak forces between ions or between atoms
allow weak intermolecular bonds / weak bonds between molecules

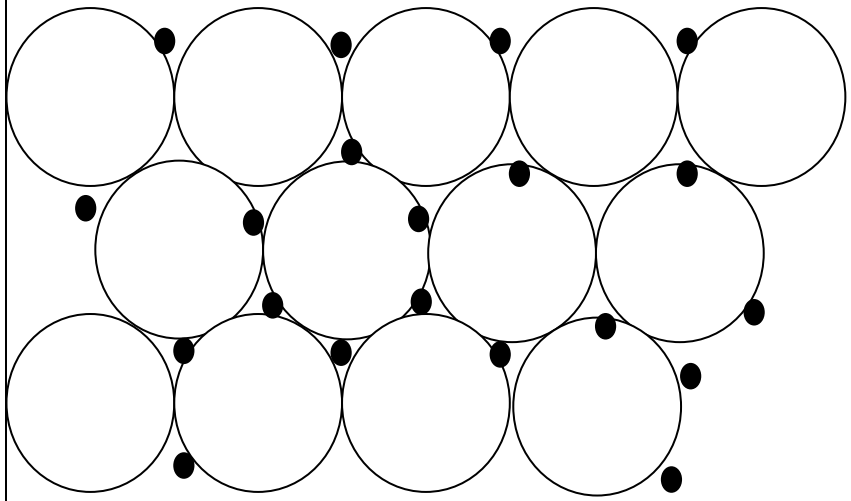
not weak intermolecular forces between atoms / weak covalent bonds

weak forces and weak bonds on their own are not sufficient</td></tr>
<tr><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
3 a	**Level 3** **Deduce the number of protons, neutrons and electrons and the electronic structure for the atom of aluminium** **AND** **Identifies both the group and period for aluminium** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Deduce the number of protons, neutrons and electrons in the aluminium atom or the electronic structure and identifies the group or the period of aluminium** **OR** **Deduce the number of protons and neutrons in the aluminium atom and the electronic structure of aluminium** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Deduce the number of protons and neutrons** **OR** **Deduce the electronic structure for aluminium** **OR** **Identifies the group or the period of aluminium** Quality of written communication impedes communication of the science at this level. (1 – 2 marks)	6	**This question is targeted at grades up to A*.** **Indicative scientific points may include:** • number of protons is 13 / bottom number is number of protons • number of neutrons is 14 / difference between mass number and atomic number • number of electrons is 13 / same as number of protons • electronic structure is 2.8.3 – this also shows 13 electrons • Al is in the 3rd period / the number of (occupied) shell electrons is the period number • Al is in Group 3 / the number of electrons in the outer shell is the group number **Allow** row for period and column for group **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

Question	Answer	Marks	Guidance
	Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks*)*		

Question	Answer	Marks	Guidance
b	**Any two from:** Fired alpha particles at gold foil (1) Geiger and Marsden's experiment gave unexpected results / some alpha particles rebounded (1) led to theory of nuclear atom / idea of atoms having a nucleus (1)	2	 **Allow** wrong particle rebounded if mentioned already at MP1 **Allow** reflected rather than rebounded **Ignore** reference to electrons, protons and shells Atoms have a dense centre is **not** sufficient
		8	

Question	Answer	Marks	Guidance
4 a	**C** high(est) heat conductivity (1) high melting point (1)	2	no mark for choice **allow** a (very) good heat conductor **allow** will not melt when heated on a stove / does not melt easily **allow A** due to a (fairly) high melting point (1) **allow D** due to good heat conductivity (1) and either high melting point or low density / lightweight (1) ignore light **ignore** other properties
b	idea of (close packed) positive metal ions (1) idea electrons interspersed within the particles drawn / sea of electrons / delocalised electrons (1) electrons can move / free electrons / electrons can carry the current (1)	3	 Large circle labelled positive ion / metal ion / cation Small circle labelled electron / e / e^- **but** just a negative sign is not sufficient Mention of intermolecular forces / covalent bonds / ionic bonds can only score the electrons can move mark
	Total	**5**	

Question	Answer	Marks	Guidance
5 a	does not give a sudden **colour** change / **colour** changes slowly / continually changes **colour** / (1)	1	**allow ora** if specified **allow** universal indicator is a mixed indicator / universal indicator is made up of different components / universal indicator has a range of colours **allow** universal indicator gives the pH rather than the end-point
b i	idea that average only uses titrations 2, 3 and 4 / titration 1 is not used to calculate the average (1) titrations 2, 3 and 4 have a consistent value / titration 1 is a rough estimate / titration 1 could be an anomalous value / titration 1 is a range-finder / titration 1 is an outlier (1)	2	**allow** calculation of the mean using the values from 2, 3 and 4 **not** just use titration 3 **not** titration 3 is the mid-value
ii	0.0015 **or** 1.5×10^{-3} (1)	1	**ignore** trailing zeroes
iii	moles of HNO_3 = 0.0015 **or** 1.5×10^{-3} (1) concentration of HNO_3 = 0.0595 (1)	2	**LOOK FOR THE ANSWER FIRST IF IT IS 0.0595 AWARD 2 marks** **allow** ecf from (b)(ii) **allow** one mark for 0.06 / 0.05952 or answers with more significant figures **allow** ecf providing answer has three significant figures i.e. mole/volume
	Total	**6**	

Question	Answer	Marks	Guidance
6 a	72 (1)	1	unit **not** needed **ignore** any unit given
b	C_4H_6 / H_6C_4 (1)	1	**not** if superscripts used for the numbers
c	C_2H_2 **and** C_6H_6 (1)	1	**both** needed if no answer on answer line **allow** other ways of indicating the correct answer e.g. circling, ticking or underlining
d	Mole ratio C : H is 0.1 : 0.4 (1) Empirical formula is CH_4 / H_4C(1)	2	**LOOK AT THE ANSWER FIRST IF CH_4 / H_4C AWARD 2 MARKS** **allow** moles of C = 0.1 and moles of hydrogen = 0.4 **allow** moles of C = 1.2/12 and moles of hydrogen = 0.4/1 **allow** C_1H_4 **allow** full marks despite any working out for correct empirical formula
	Total	**5**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>mass of water calculated (1)

prediction supported because as more copper hydroxide is used the mass of water increases (1)
but
prediction supported illustrated by examples showing the direct proportionality e.g. mass of $Cu(OH)_2$ doubles in expt 1 and expt 2 and so does the mass of water (2)</td><td>3</td><td>Maximum of two marks if no comment about whether data supports prediction

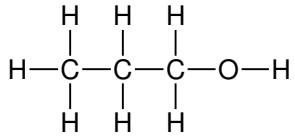
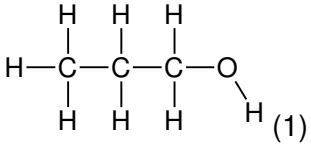
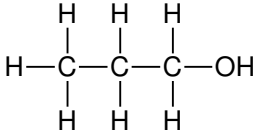
<table><tr><td>experiment number</td><td>Mass of water made in g</td></tr><tr><td>1</td><td>0.09</td></tr><tr><td>2</td><td>0.18</td></tr><tr><td>3</td><td>0.28</td></tr><tr><td>4</td><td>0.37</td></tr><tr><td>5</td><td>0.60</td></tr></table>
allow both explanation marks if answer based on mass of copper oxide rather than water

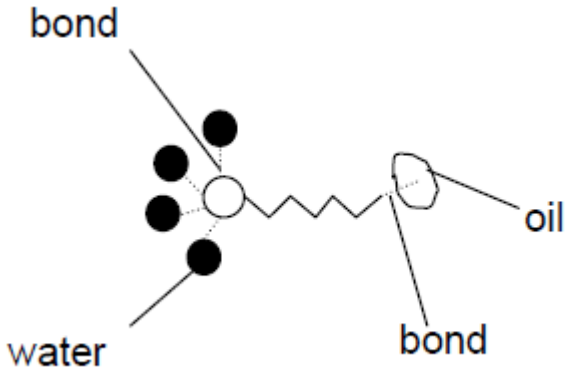
allow prediction not supported because the result for experiment 5 does not fit the pattern (2)</td></tr>
<tr><td></td><td>Total</td><td>3</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
8 a	**[Level 3]** **Deduces how increasing temperature and pressure affects the percentage yield** **AND** **Explains how addition of carbon dioxide will shift the position of equilibrium** Quality of written communication does not impede communication of the science at this level (5 – 6 marks) **[Level 2]** **Deduces how changing temperature and pressure affects the percentage yield** **AND** **Describes how adding carbon dioxide shifts the position of equilibrium** Quality of written communication partly impedes communication of the science at this level (3 – 4 marks) **[Level 1]** **Deduces how changing temperature affects the percentage yield and how changing pressure affects the percentage yield** **OR** **Describes how adding carbon dioxide shifts the position of equilibrium** 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 at level 3 must include:** • To minimise addition of carbon dioxide reaction uses up carbon dioxide i.e. shifts to the right **Relevant points at all levels could include explanations** • as temperature increases percentage yield decreases / as temperature increases position of equilibrium shifts to the left / ora • as pressure increases percentage yield increases / as pressure increases position of equilibrium shifts to the right / ora • Addition of carbon dioxide shifts position of equilibrium to the right / ora **Use the L1, L2, L3 annotations in scoris. Do not use ticks.**

Question	Answer	Marks	Guidance
b	**any two from:** can share ideas / have different views (1) can evaluate ideas / check results / can compare results (1) can collect more evidence (in a shorter time) / more productive / can do more approaches / can work faster / more ideas can be tested (1) can share cost of research (1)	2	**allow** small discoveries can be combined into a large one **allow** help to make new predictions **allow** results would be more reliable **ignore** results are more accurate
	Total	**8**	

Question	Answer	Marks	Guidance
9 a	**any one from:** fewer collisions (1) less crowded particles (1) fewer hydrogen ions / less concentrated H^+ (1)	1	**ignore** any extra qualification about collisions **but not** particles have more energy fewer ions / fewer particles is **not** sufficient **not** atoms or molecules as particles if particles are named **allow** weak acids do not fully ionise (but strong acids do) / weak acids do not completely dissociate (but strong acids do) / weak acids are less ionised **allow** ora if strong acid specified
b	correct measuring equipment to measure volume of gas in diagram e.g. gas syringe / displacement of water using measuring cylinder or upturned burette (1) equipment will work and it is gas tight (1)	2	The measuring apparatus does not have to be set up or part of a correct diagram
	Total	**3**	

Question	Answer	Marks	Guidance
10 a i	any value between 12 and 13 (cm^3) (1)	1	
ii	44°C (1) idea of highest point on the curve / where most carbon dioxide is made (1)	2	**allow** 42-45 (°C) (1) **second mark is dependent on the correct temperature** **allow** optimum temperature (1)
b	$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$ formulae (1) balancing – dependent on correct formulae (1)	2	**allow** C_2H_6O as formula for ethanol **allow** any correct multiple e.g. $2C_6H_{12}O_6 \rightarrow 4CO_2 + 4C_2H_5OH$ **allow** = or ⇆ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors of case, subscript or superscript e.g. $C^6H^{12}O^6 \rightarrow 2Co_2 + 2C_2H_5OH$
c i	C_3H_7OH / C_3H_8O (1)	1	
ii	 (1)	1	**allow**  (1) **allow**  (1) **allow** displayed formula for propan-2-ol
	Total	**7**	

Question	Answer	Marks	Guidance
1 a 1	**C** (1) it removes blood / food stains (1)	2	 **allow** it removes organic materials **not** any reference to removing paint **ignore** reference to grease
b	**any three from** detergent has a hydrophilic (head) (1) idea that detergent is bonded to water molecules (1) hydrophobic end bonds with grease (1) idea that hydrophobic or tail lifts off grease (1)	3	**USE TICKS FOR THIS QUESTION** **marks may be awarded for a labelled diagram** **allow** idea of hydrophilic end or hydrophilic part (1) **allow** hydrophilic (end) is bonded to water / hydrophilic (end) is attracted to water (molecules) (2) water surrounds the hydrophilic end is **not** sufficient **allow** hydrophobic (end) is attracted to grease (molecules) grease surrounds the hydrophobic end is **not** sufficient for MP2 and MP3 **allow** attached to, clings to, connected, stick on or stick to instead of bonded, but **do not allow** stick into or stick out 

Question	Answer	Marks	Guidance
c	test - add bromine (water) (1) result - idea that bromine water loses its colour (1) – this mark is dependent on the correct reagent or a near miss e.g. bromide	2	**allow** Br_2 (1) **allow** decolourised / loses its colour / goes colourless (1) **not** goes clear / discoloured **ignore** initial colour of bromine
	Total	**7**	

Question	Answer	Marks	Guidance
12	**Level 3** **Applies knowledge to identify with reasons the type of hardness in all of the samples** **AND** **explains in detail how washing soda softens hard water** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Applies knowledge to identify, with reasons, the type of hardness in two of the samples** **OR** **Applies knowledge to identify, with a reason, the type of hardness in one of the samples and attempts to explain how washing soda softens hard water** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Applies knowledge to identify, with a reason, the type of hardness in one of the samples** **OR** **attempts to explain how washing soda softens hard water** 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 may include:** Types of hardness and explanation • sample **A** contains permanent hardness • as not softened by boiling • sample **B** contains both temporary and permanent hardness • as some (but not all) of the hardness is removed by boiling • sample **C** contains only temporary hardness • as it completely softened by boiling How washing soda softens hard water • hard water contains dissolved calcium ions and /or magnesium ions • calcium ions and magnesium ions removed from water • calcium and magnesium ions removed by precipitation as insoluble carbonates **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
		6	

Question	Answer	Marks	Guidance
13 a	idea that amount of CFCs rises at first and then gradually decreases (1) use of CFCs banned (about 1992-1995) (1)	2	**allow** the amount peaked and then went down **ignore** reference to actual years **allow** laws introduced to ban use of CFCs **ignore** idea that there was evidence that CFCs were dangerous
b	**any three from:** (idea that at first CFCs were welcomed because) they had many uses (1) idea that they are inert / non-toxic / do not react (1) idea that later CFCs were linked to ozone depletion (1) idea that scientists wanted (use of) CFCs to be banned (1)	3	 **allow** CFCs were used as refrigerants, aerosols etc seems like a good thing when first discovered / were very useful are **not** sufficient harmless or safe to use are insufficient **allow** reacts with ozone in (upper) atmosphere / destroys the ozone layer / damages the ozone layer / makes ozone holes
	Total	**5**	

Question	Answer	Marks	Guidance
14 a i	**any one from** less used for in electricity generation (1) less used for other uses (1) less used for farming (1)	1	 **allow** new ways to generate electricity that do not use water **allow** less demand for rather than less used for fewer farmers or less farming is **not** sufficient
ii	percentage = $\frac{\text{volume for public watersupply}}{\text{total volume}} \times 100$ (1) **but** $\frac{13000}{42000} \times 100$ (2)	2	**allow** $\frac{13000}{42000}$ = 0.3095 (1) 0.3095 x 100 (1) No mark for 30.95% **allow** ecf from wrong interpretation of bar charts for the first mark **allow** alternative approaches for example showing that 30.95% of 42000 is 13000 i.e. 30.95 divided by 100 (1) and then 0.3095 x 42000 (1)
iii	increase (1)	1	**allow** went to 37.14 (%)
b	prediction made water meters increases (so less water used) (1) population increases so more water used (1) water leakage has not changed so no effect (1)	3	**no marks** for the prediction but without a prediction maximum two marks

Question	Answer	Marks	Guidance
c i	Albania (1)	1	
ii	Niger (1) Idea that the ratio of population to water used or availability is the highest of all the countries (1) This mark is dependent on the correct country	2	 **Allow** high population but very little water A population of 15 million is **not** sufficient Has the most population to share the water is **not** sufficient
	Total	**10**	

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