Version 1.3

General Certificate of Education
June 2011

Chemistry CHEM1

Foundation Chemistry

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates" responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates" scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

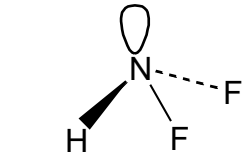
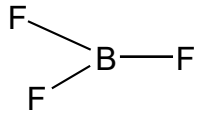
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates" reactions to a particular paper. Assumptions about future mark schemes on the basis of one year"s document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Question	Marking Guidance	Mark	Comments
1(a)(i)	Different number / amount of neutrons	1	Not different neutrons Ignore same protons and/or electrons CE incorrect statement relating to protons / electrons
1(a)(ii)	Same electron configuration / same number of electrons (in the outer shell)	1	Ignore same no of protons Ignore electrons determine chemical properties CE if wrong statement relating to protons / neutrons
1(b)	Average mass of 1 atom (of an element) 1/12 mass atom of ^{12}C OR Average/mean mass of atoms of an element 1/12 mass of one atom of ^{12}C OR (Average) mass of one mole of atoms 1/12 mass of one mole of ^{12}C OR (Weighted) average mass of all the isotopes 1/12 mass of one atom of ^{12}C OR Average mass of an atom/isotope compared to C-12 on a scale in which an atom of C-12 has a mass of 12	1 1	If moles and atoms mixes Max = 1 Mark top and bottom line independently 1/12 on bottom line can be represented as x 12 on top line This expression = 2 marks

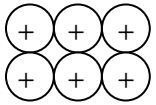
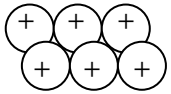
1 (c) (i)	$\frac{(64 \times 12) + (66 \times 8) + (67 \times 1) + (68 \times 6)}{27}$ ($= \frac{1771}{27}$) $= \underline{65.6}$	1 1 1	If not 27 max 1 mark (for top line) Mark is for dividing by 27 or string If **evidence** of arithmetic or transcription error seen in M1 or M2 allow consequential M3 and consequential 1(c)(ii) 65.6 = 3 marks
1(c)(ii)	$^{64}Zn^{+}$	1 1	M1 for identifying Zn / zinc M2 is for the + sign and the 64 M2 is dependent on M1
1(d)	Size of the charge (on the ion) / different charges / different *m/z*	1	Allow forms 2+ ions QWC
1(e)	(ions hit detector and) cause current/(ions) accept electrons/cause electron flow/electric pulse caused bigger current = more of that isotope/current proportional to abundance	1 1	 Implication that current depends on the number of ions M2 dependent on M1

Question	Marking Guidance	Mark	Comments
2(a)(i)	$\underline{0.0212}$	1	Need 3 sig figs Allow correct answer to 3 sig figs eg 2.12×10^{-2}
2(a)(ii)	0.0106	1	Mark is for 2(a)(i) divided by 2 leading to correct answer ≥ 2 sig figs
2(a)(iii)	$M_r = \underline{100.1}$ 1.06 g	1 1	Allow 100.1 as „string" Need 3 sig figs or more Consequential on 2(a)(ii) x 100(.1)
2(a)(iv)	Neutralisation or acid / base reaction	1	Allow acid / alkali reaction Apply list principle
2(b)(i)	T = 304(K) and P = 100 000 (Pa) $\frac{100\,000 \times 3.50 \times 10^{-3}}{8.31 \times 304}$ OR $n = \frac{PV}{RT}$ 0.139 (mol)	1 1 1	Only T and P correctly converted Allow $\underline{0.138 – 0.139}$
2(b)(ii)	0.0276 – 0.0278(mol)	1	Allow answer to 2(b)(i) divided by 5 leading to a correct answer Allow 0.028

2(c)	4.20 g $Ca(NO_3)_2$ $Ca(NO_3)_2$ H_2O 4.20 1.84 164(.1) 18 0.0256 0.102 1 : 3.98 x = 4	1 1 1	 Mark is for dividing by the correct M_r values M2 and M3 dependent on correct M1 M2 can be awarded here instead If $Ca(NO_3)_2.4H_2O$ seen with working then award 3 marks Credit alternative method which gives x = 4

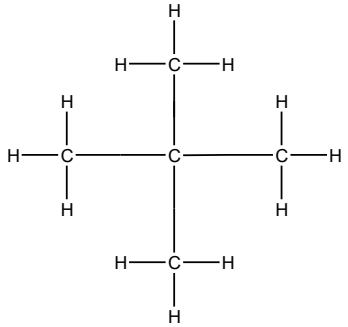
Question	Marking Guidance	Mark	Comments
3(a)	Iodine has more electrons / iodine is bigger (atom or molecule) / iodine has bigger M_r / bigger surface area	1	
	Stronger / more van der Waals forces / vdw / London / temporarily induced dipole / dispersion forces between molecules	1	Stronger VdW intermolecular forces = M2 If stated VdW between atoms lose M2
3(b)(i)		1	Mark is for 3 bp and 1 lp attached to N (irrespective of shape)
		1	Mark is for 3 bp and 0 lp attached to B (irrespective of shape)
	NHF_2 shape - pyramidal / trigonal pyramid	1	Accept tetrahedral / triangular pyramid
	BF_3 shape - trigonal planar	1	Not triangular or triangular planar
3(b)(ii)	107°	1	Allow 106-108°
3(c)	Hydrogen bonds	1	Allow H-Bonds Not just Hydrogen Apply list principle eg Hydrogen bonding and dipole-dipole = 0

3(d)	Coordinate / dative covalent / dative	1	If covalent mark on If ionic / metallic CE = 0
	Lone pair / both electrons/ 2 electrons <u>on $N(HF_2)$</u> donated (to BF_3)	1	Direction of donation needed here

Question	Marking Guidance	Mark	Comments
4(a)(i)	Metallic	1	Allow body centred cubic
4(a)(ii)	 OR  Na^+ Na^+ Na^+ Na^+ Na^+ Na^+	1 1	One mark for regular arrangement of particles. Can have a space between them Do not allow hexagonal arrangement One mark for + in each Ignore electrons If it looks like ionic bonding then CE = 0/2
4(b)(i)	Ionic	1	CE = 0 for 4(b)(i) and 4(b)(ii) if not ionic
4(b)(ii)	Strong (electrostatic) attraction Between oppositely charged ions / particles	1 1	Any mention of IMF or molecules / metallic / covalent in 4(b)(ii) then CE 0/2 Or + and – ions
4(c)	Iodide / I^- bigger (ion) (so less attraction to the Na+ ion)	1	Need comparison Do not allow iodine is a bigger atom Ignore I^- has one more e- shell CE = 0 if IMF / covalent / metallic mentioned

Question	Marking Guidance	Mark	Comments
5(a)	$Li(g) \rightarrow Li^+(g) + e^-(g)$ $Li(g) - e^-(g) \rightarrow Li^+(g)$ $Li(g) + e^-(g) \rightarrow Li^+(g) + 2e^-$	1	One mark for balanced equation with state symbols Charge and state on electron need not be shown
5(b)	Increases Increasing nuclear charge / increasing no of protons Same or similar shielding / same no of shells / electron (taken) from same (sub)shell / electron closer to the nucleus / smaller atomic radius	1 1 1	If trend wrong then CE = 0/3 for 5(b). If blank mark on. Ignore effective with regard to nuclear charge
5(c)	Lower Paired electrons in a (4) p orbital (Paired electrons) repel	1 1 1	If not lower then CE = 0/3 If incorrect p orbital then M2 = 0 If shared pair of electrons M2 + M3 = 0
5(d)	Kr is a bigger atom / has more shells / more shielding in Kr / electron removed further from nucleus/ electron removed from a higher (principal or main) energy level	1	CE if molecule mentioned Must be comparative answer QWC
5(e)	2 / two / II	1	
5(f)	Arsenic / As	1	

Question	Marking Guidance	Mark	Comments
6(a)	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	1	Accept multiples Ignore state symbols even if incorrect
	Not enough oxygen / air	1	
	CMM / methane is a greenhouse gas / contributes to global warming	1	Do not allow formation of CO_2 / CO_2 is a greenhouse gas Apply list principle, eg CH_4 is a greenhouse gas and toxic = 0 CH_4 is a greenhouse gas and damages ozone = 0 Allow CH_4 and CO_2 are greenhouses gases Allow collect to use as a fuel so fossil fuels do not run out (as quickly)
6(b)	$CH_3SH + 3O_2 \rightarrow CO_2 + 2H_2O + SO_2$	1	Accept multiples Ignore state symbols even if incorrect
	Calcium oxide is basic (and SO_2 is acidic) / CaO neutralises SO_2 / CaO reacts with SO_2 to form gypsum / salt / solid / $CaSO_4$ / $CaSO_3$ Allow $CaO + SO_2 \rightarrow CaSO_3$	1	**M2 and M3 can only be scored if SO_2 seen somewhere in the answer**
	Acid rain	1	Allow consequence of acid rain eg increased rusting of iron / fish in lakes die / problems for asthmatics Apply list principle Ignore air pollution

Question	Marking Guidance	Mark	Comments
7(a)	$C_n H_{2n+2}$	1	Allow x in place of n
7(b)		1	Must show every bond
	Chain	1	Allow branched chain
7(c)	C_9H_{20}	1	Only
	To break the (C-C and/or C-H) bonds	1	M2=0 if break C=C
	To make products which are in greater demand / higher value / make alkenes	1	Not more useful products Allow specific answers relating to question
7(d)	$C_5H_{12} + 3O_2 \rightarrow 5C + 6H_2O$	1	Allow other balanced equations which give C and CO/CO_2
	Causes global dimming / exacerbates asthma / causes breathing problems / makes visibility poor / smog	1	Apply list principle Ignore causes cancer / toxic

7(e)	106.5 (x 100) 143 74.48% 3	1 1 1	 Allow 74.5% Only
7(f)	2,3-dichloro-3-methylpentane C_3H_6Cl	1 1	Ignore punctuation Only

General principles applied to marking CHEM1 papers by CMI+ June 2011

It is important to note that the guidance given here is generic and specific variations may be made in the mark scheme.

Basic principles

- **Examiners should note that throughout the mark scheme, items that are underlined are required information to gain credit.**
- **Occasionally a response involves incorrect chemistry and the mark scheme records CE = 0, which means a chemical error has occurred and no credit is given for that section of the clip or for the whole clip.**

A. The "List principle" and the use of "ignore" in the mark scheme

If a question requires **one** answer and a candidate gives two answers, no mark is scored if one answer is correct and one answer is incorrect. There is no penalty if both answers are correct.

N.B. Certain answers are designated in the mark scheme as those which the examiner should "Ignore". These answers are not counted as part of the list and should be ignored and will not be penalised.

B. Incorrect case for element symbol

The use of an incorrect case for the symbol of an element should be penalised **once only** within a clip.
For example, penalise the use of "h" for hydrogen, "CL" for chlorine or "br" for bromine.

C. Spelling

In general

- The names of organic chemical compounds and functional groups **must be spelled correctly,** when specifically asked for, to gain credit.
- Phonetic spelling may be acceptable for some chemical compounds (eg amonia would be phonetically acceptable. However, ammoniam would be unacceptable since it is ambiguous).

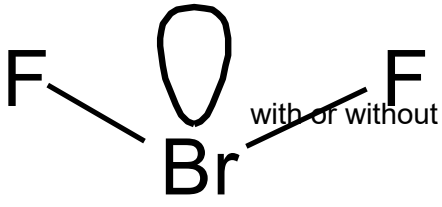
N.B. Some terms may be required to be spelled correctly or an idea needs to be articulated with clarity, as part of the "Quality of Language" (**QoL**) marking. These will be identified in the mark scheme and marks are awarded only if the QoL criterion is satisfied.

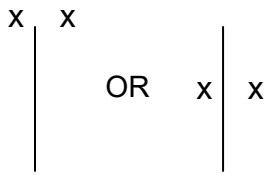
D. Equations

In general
- Equations **must** be balanced.
- State symbols are generally ignored, unless specifically required in the mark scheme.

E. Lone Pairs

The following representations of lone pairs in structures are acceptable.



with or without the 2 electrons shown OR  OR x x OR x x OR 

F. Reagents

The command word "Identify", allows the candidate to choose to use **either** the name or the formula of a reagent in their answer. In some circumstances, the list principle may apply when the name and formula contradict. Specific details will be given in mark schemes.

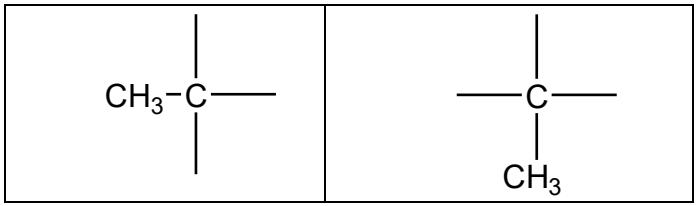
G. Marking calculations

In general
- A correct answer alone will score **full marks** unless the necessity to show working is specifically required in the question.
- If a candidate has made an arithmetic error or a transcription error deduct one mark, but continue marking (error carried forward).

H. Organic structures

In general
- Displayed formulae must show all of the bonds and all of the atoms in the molecule, but need not show correct bond angles.
- Bonds should be drawn correctly between the relevant atoms.

- Latitude should be given to the representation of C ─ C bonds in structures, given that CH_3─ is considered to be interchangeable with H_3C─ even though the latter would be preferred.
- The following representations are allowed:-



I. Additional sheets and blank clips

- Markers should **mark all that is seen** and carry on marking as normal. Clips which refer to the use of additional sheets should **not** be referred to the senior team.
- Clips which refer to other parts of the script must be referred to the senior team.
- When considering crossed out work, **mark it** as if it were not crossed out **unless** it has been replaced by a later version; this later version then takes priority.
- Mark a blank section with a dash (─) and **not with a score of zero**.

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