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General Certificate of Education (A-level)
January 2012

Chemistry CHEM1

(Specification 2420)

Unit 1: 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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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.

Further copies of this Mark Scheme are available from: aqa.org.uk

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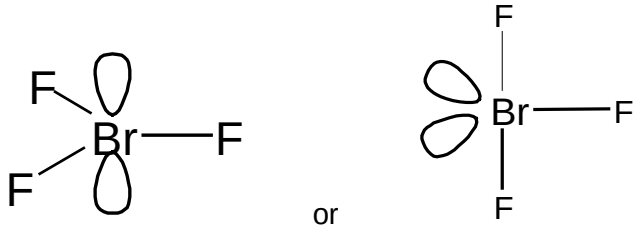
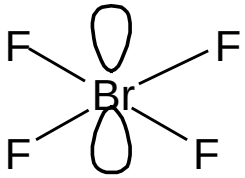
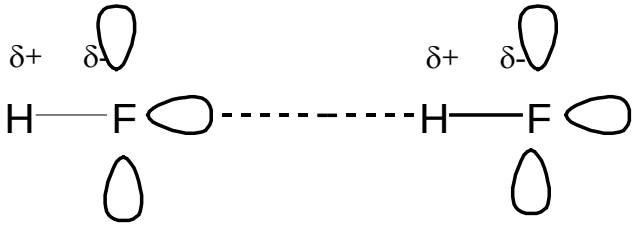
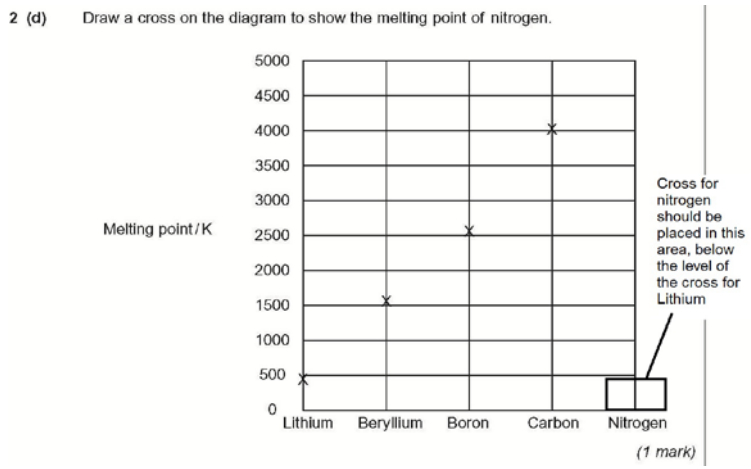
Question	Marking Guidance	Mark	Comments
1(a)	Covalent	1	If not covalent CE = 0/2 If dative covalent CE = 0/2 If blank mark on Ignore polar If number of pairs of electrons specified, must be 3
	Shared <u>pair</u>(s) of electrons / one electron from Br and one electron from F	1	Not 2 electrons from 1 atom Not shared pair between ions/molecules
1(b)(i)	 or BrF_3 if trigonal planar shown = 120° or if T shape shown 84 - 90°	1 1	BrF_3 should have 3 bp and 2 lp and correct atoms for the mark Penalise Fl Allow 84 - 90° or 120° and ignore 180° Irrespective of shape drawn

1(b)(ii)	 BrF_4^- 90°	1 1	BrF_4^- should have 4 bp and 2 lp and all atoms for the mark (ignore sign) Allow Fl Only Ignore 180°
1(c)	Ionic or (forces of) attraction between ions / bonds between ions Strong (electrostatic) attraction / strong bonds / lots of energy needed to break bonds Between K^+ and BrF_4^- ions/oppositely charged ions / + and - ions	1 1 1	If molecules, IMF, metallic, CE =0 If covalent bonds mentioned, 0/3, unless specified <u>within</u> the BrF_4^- ion and not broken Ignore atoms If ions mentioned they must be correct Strong bonds between + and – ions =3/3
1(d)(i)	Hydrogen <u>bonds</u>/hydrogen <u>bonding</u>/H <u>bonds</u>/H <u>bonding</u>	1	Not just hydrogen
1(d)(ii)		3	One mark for 4 partial charges One mark for 6 lone pairs One mark for H bond from the <u>lone pair to the Hδ+</u> Allow Fl If more than 2 molecules are shown they must all be correct. Treat any errors as contradictions within each marking point. CE = 0/3 if incorrect molecules shown.

1(e)	vdw / van der Waals forces between molecules	1	QoL Not vdw between HF molecules, CE = 0/2 vdw between atoms, CE = 0/2 If covalent, ionic, metallic, CE=0/2
	IMF are weak / need little energy to break IMF / easy to overcome IMF	1	

Question	Marking Guidance	Mark	Comments
2(a)	Lithium / Li	1	Penalise obvious capital I (second letter).
2(b)(i)	Increase / gets bigger	1	Ignore exceptions to trend here even if wrong
2(b)(ii)	Boron / B Electron removed from (2)p orbital /sub-shell / (2)p electrons removed Which is higher in energy (so more easily lost) / more shielded (so more easily lost) / further from nucleus	1 1 1	If not Boron, CE = 0/3 If p orbital specified it must be 2p
2(c)	C / carbon	1	
2(d)	Below Li 	1	The cross should be placed on the diagram, on the column for nitrogen, below the level of the cross printed on the diagram for Lithium.

2(e)	Macromolecular / giant molecular / giant atomic	1	Allow giant covalent (molecule) = 2
	Covalent bonds in the structure	1	
	Strong (covalent) bonds must be broken or overcome / (covalent) bonds need a lot of energy to break	1	Ignore weakening / loosening bonds If ionic / metallic/molecular/ dipole dipole/ H bonds/ bonds between molecules, CE = 0/3 Ignore van der Waals forces Ignore hard to break

Question	Marking Guidance	Mark	Comments
3(a)(i)	Crude oil / oil / petroleum	1	Do not allow **'**petrol'
3(a)(ii)	Fractional distillation / fractionation / fractionating	1	Not distillation alone
3(b)(i)	5	1	Allow five / V
3(b)(ii)	Chain (isomerism)	1	Allow branched chain / chain branched / side chain (isomerism) Ignore position (isomerism) Do not allow straight chain **/** geometric / branched / function
3(c)(i)	$C_{12}H_{26}$ / $H_{26}C_{12}$	1	Only
3(c)(ii)	Thermal cracking High temperature (400°C ≤ T ≤ 900°C) or (650 K ≤ T ≤ 1200 K) **and** High pressure (≥ 10 atm, ≥ 1 MPa, ≥1000 kPa)	1 1	If not thermal cracking, CE = 0/2 If blank mark on Allow 'high heat' for 'high temperature' Not 'heat' alone If no T, units must be 650 - 900
3(c)(iii)	To produce substances which are (more) in demand / produce products with a high value / products worth more	1	Ignore 'to make more useful substances'

3(d)(i)	Corrosive or diagram to show this hazard symbol	1	Ignore irritant, acidic, toxic, harmful
3(d)(ii)	$\left(\frac{120.5}{86 + 71} \times 100\right)$ =76.75(%) or 76.8(%)	 1	 Allow answers > 3 sig figs
3(e)	2,2-dichloro-3-methylpentane C_3H_6Cl	1 1	Ignore punctuation Any order

Question	Marking Guidance	Mark	Comments
4(a)(i)	$C_8H_{18} + 8\frac{1}{2} O_2 \rightarrow 8CO + 9H_2O$	1	Accept multiples
4(a)(ii)	Not enough oxygen or air (available for complete combustion) /lack of oxygen or air / too much octane	1	Ignore poor ventilation, low temp, poor mixing, incomplete combustion
4(b)(i)	$2CO + 2NO \rightarrow 2CO_2 + N_2$	1	Allow multiples
4(b)(ii)	Pt / Pd / Rh / Ir or names Big(ger) surface area / increased reaction rate / removes more of the gases / ensures complete reaction	1 1	Apply list principle Allow (ceramic) withstands high temperatures
4(c)(i)	Acid rain	1	Allow consequence of acid rain Ignore greenhouse gas / global warming / ozone
4(c)(ii)	CaO/ lime / $CaCO_3$ /limestone Neutralises the gas or words to that effect/it is basic/ SO_2 is acidic	1 1	Allow chemical names Allow ‘reacts with it’ or ‘it is alkaline’ Ignore ‘absorb’

Question	Marking Guidance	Mark	Comments
5(a)	N^{3-} / N^{-3}	1	
5(b)	F^-/ fluoride	1	Ignore fluorine/F Penalise Fl
5(c)	Li_3N / NLi_3	1	
5(d)	$\frac{81.1}{40.1}$ $\frac{18.9}{14}$ (=2.02 = 1.35) 1.5 1 or 3 : 2 Ca_3N_2	1 1 1	M1 for correct fractions M2 for correct ratio If Ca_3N_2 shown and with no working award 3 marks If Ca_3N_2 obtained by using atomic numbers then lose M1
5(e)	$3\ Si + 2\ N_2 \rightarrow Si_3N_4$	1	Accept multiples

Question	Marking Guidance	Mark	Comments
6(a)	Mol Pb = 8.14 / 207(.2) (= 0.0393 mol) Mol HNO_3 = 0.0393 x 8 / 3 =0.105 mol Vol HNO_3 = 0.105 / 2 = 0.0524 (dm^3)	1 1 1	M1 and M2 are process marks Allow mark for M1 x 8/3 or M1 x 2.67 Accept range 0.0520 to 0.0530 No consequential marking for M3 Answer to 3 sig figs required
6(b)	101000 (Pa) and 638 x 10^{-6} (m^3) n = pV/RT (= $\frac{101000 \times 638 \times 10^{-6}}{8.31 \times 298}$) 0.026(0) (mol)	1 1 1	Can score M2 with incorrect conversion of p and V If T incorrect lose M1 and M3 If answer correct then award 3 marks Allow answers to 2 sig figs or more 26.02 = 1 If transcription error lose M3 only
6(c)(i)	$2Pb(NO_3)_2(s) \rightarrow 2 PbO(s) + 4NO_2(g) + (1)O_2(g)$	1	Allow multiples Allow fractions
6(c)(ii)	Decomposition not complete / side reactions / by-products / some (NO_2) escapes / not all reacts / impure $Pb(NO_3)_2$	1	Ignore reversible / not heated enough / slow
6(c)(iii)	Hard to separate O_2 from NO_2 / hard to separate the 2 gases	1	Allow mixture of gases Not 'all products are gases'

Question	Marking Guidance	Mark	Comments
7(a)	$\frac{(82 \times 2) + (83 \times 2) + (84 \times 10) + (86 \times 3)}{17}$ $\left(\frac{1428}{17}\right)$	1 1	M1 for the top line M2 is for division by 17
	= 84.0	1	Not 84 No consequential marking from M1 or M2 Ignore units
	The A_r in the Periodic table takes account of the other isotopes / different amounts of isotopes (or words to that effect regarding isotopes)	1	Award independently Comparison implied Isotope(s) alone, M4 = 0
7(b)	(Beam of electrons from) an electron gun / high speed / high energy electrons	1	
	Knocks out electron(s) (to form a positive ion)	1	
	$Kr(g) + e^- \rightarrow Kr^+(g) + 2e(^-)$	1	State symbols must clearly be (g)
	OR		
	$Kr(g) \rightarrow Kr^+(g) + e(^-)$ / $Kr(g) - e(^-) \rightarrow Kr^+(g)$		
	The ^{84}Kr isotope	1	One mark for identifying the 84 isotope
	Has 2 electrons knocked out / gets a 2+ charge	1	One mark for the idea of losing 2 electrons (from this isotope)

General principles applied to marking CHEM1 papers by CMI+ (January 2012)

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 that 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** x x **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:-