2811 Foundation Chemistry

June 2003

Mark Scheme

The following annotations may be used when marking:

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which must be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

1. (a) (i) P ✓

[1]

(ii) $1s^2 2s^2 2p^6 3s^2 3p^3$ ✓

[1]

(iii) charge on ion: 3– ✓

[1]

electronic configuration of ion of **A**: $1s^2 2s^2 2p^6 3s^2 3p^6$ ✓

[1]

(b) (i) different number of neutrons ✓

[1]

(ii) Ni ✓

[1]

(c) (i) average **atomic** mass/weighted mean/average mass ✓

compared with carbon-12 ✓
1/12th of mass of carbon-12/on a scale where carbon-12 is 12 ✓

OR
The mass of 1 mole of **atoms** of an element ✓
compared with 12 g ✓
of carbon-12 ✓

[3]

(ii) 58.0x68.2/100 + 60.0x27.3/100 + 62.0x4.5/100 / 58.726 ✓

= 58.7 ✓ *(to 3 sig figs: allow full marks for answer.* 58.726 *(calc) gets 1 mark only)*

[2]

[Total: 11 marks]

2. **(a)** correct dot and cross ✓

[1]

(b) number of electrons increases down group ✓

$\longrightarrow$ greater van der Waals' forces/intermolecular forces ✓

more energy/higher temperature needed to break these intermolecular forces ✓

[3]

(c) **(i)** brown/orange/yellow colour ✓

[1]

(ii) $2NaBr + Cl_2 \longrightarrow Br_2 + 2NaCl$ *balanced equation* ✓

or ionic equation: $2Br^- + Cl_2 \longrightarrow Br_2 + 2Cl^-$

[1]

(iii) Cl/Cl_2 gains electron(s) ✓ Br^- loses an electron ✓

[2]

(iv) Cl is more reactive/more powerful oxidising agent than Br ✓

[1]

(v) add $AgNO_3$ / Ag^+ ✓

yellow precipitate ✓

OR

add Cl_2 / Br_2 ✓

purple in hexane / blue-black in starch ✓

[2]

[Total: 11 marks]

3. **(a)** correct dot and cross ✓ correct charges ✓

[2]

(b) **(i)** Ca: (+)2 ✓

[1]

(ii) C: (+)4 ✓

[1]

(c) moles $CaCO_3$ = 20 x 10^6/100 = 200 000 mol ✓

mass CaO = 200 000 x 56 = 11 200 000 g / 1.12 x 10^7 g / 11.2 tonnes ✓

use of 56 x 20/100 OR 56/5 is worth 1 mark
decimal point in wrong place i.e. 1.12 x 10^x is worth 1 mark.
units needed for 2nd mark.

[2]

(d) $CaO + H_2O \longrightarrow Ca(OH)_2$ ✓

[1]

(e) **(i)** molar mass = 40.1 + (16 + 1) x 2 = 74.1 (g mol^{-1}) ✓

[1]

(ii) moles HCl = 0.200 x 25.0/1000 = 0.005 mol ✓

[1]

(iii) moles $Ca(OH)_2$ = 0.5 x 0.005 = 0.0025 mol ✓

mass $Ca(OH)_2$ = 0.0025 x 74.1 = 0.185 g ✓ accept from 0.19 g to 0.18525 g

i.e. 0.0025 x answer to (i)

candidate who does not use 0.5 will get 0.37 g – worth 1 mark

[2]

(iv) 1 mol NaOH reacts with 1 mol HCl

/ $Ca(OH)_2$ Has more OHs / OHs needed to neutralise ✓

Therefore twice the number of moles of NaOH are needed

/ twice number of OHs in $Ca(OH)_2$ ✓

[2]

(f) solution reacted with CO_2 ✓ forming $CaCO_3$ ✓

[2]

[Total: 15 marks]

4. **(a)** 4 valid examples ✓✓✓✓

Can be names or formulae. If a formula is used, it must be correct for the structure: i.e. for simple molecular, H_2, P_4, S_8, etc is feuqired.

[4]

(b) **(i)** positive ions/metal ions/cations ✓

surrounded by free/delocalised/sea of electrons ✓

[2]

(ii) electrons move ✓

[1]

(c) solid lattice, ions are in fixed positions ✓

molten, ions are free to move and conduct ✓

[2]

(d) giant has stronger forces/simple has weaker forces ✓ *(i.e. comparison of forces)*

giant: covalent bonds break ✓
simple: molecules/intermolecular forces break / van der Waals break ✓

[3]

[Total: 12 marks]

5. electron pairs repel ✓

as far apart as possible ✓

lone pair repulsion > bonded pair repulsion / lone pair reduces bond angle ✓

[3]

4 examples, for each: shape ✓✓✓✓

either

a named molecule that matches a correct shape

or

correct number and type of electron pairs to match shape

3 correct bond angles ✓ ✓✓

[7]

[Sub-total: 10]

qowc: technical words of **three** shapes:

i.e. linear

non-linear / V-shaped / angular / bent

trigonal planar / planar triangle

tetrahedral / tetrahedron

pyramid(al) / trigonal pyramid(al)

[Sub-total: 1]

[Total: 11 marks]

Further notes on Question 5

1. Three marks that explain the theory:

electron pairs repel ✓

- This could simply be within 'electron pair repulsion theory' or 'lone pairs repel'

lone pairs repel **more** ✓

repelled as far apart as possible ✓

2. Seven marks for shapes and bond angles

Bond angles

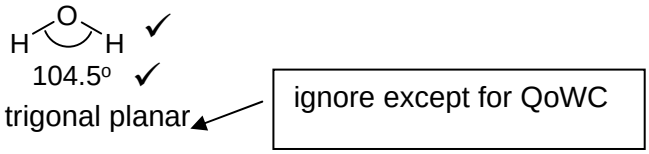
- Credit up to three correct bond angles for chosen examples. i.e. 3 max

Shapes

(a) If a candidate has drawn shapes of molecules,

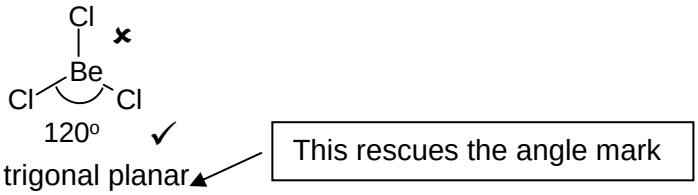
- mark the shapes irrespective of any words that describe them.
- only look at the words (pyramidal, etc) for the QoWC mark (see below)
- do **not** use an incorrect name as a 'con' or we will be looking for both the shape **and** the name for the mark.

e.g.



(b) If a candidate has drawn a 'correct' shape but for a molecule that does **not** exist, then the shape mark cannot be awarded. e.g. $BeCl_3$ shown as a trigonal planar molecule would not score the shape (but could score an angle mark of 120 ° if 'trigonal planar' is used as a fall back). The example below is certainly worth something!

e.g.



(c) If a candidate has not drawn a diagram,

- the shape mark is still possible if the correct technical word is used. If this tactic has been used then you can still award the technical words as part of the QoWC mark (see below).

e.g. CH_4 has a tetrahedral shape ✓ with a bond angle of 109.5 ° ✓

QoWC One mark

Use of any three of the 'shape technical words' with correct shapes.

i.e. testing 'correct usage' of technical words.