**1.**      (a)     (i)      Different number / amount of neutrons

*Not different neutrons*

*Ignore same protons and/or electrons*

*CE incorrect statement relating to protons / electrons*

**1**

(ii)     Same electron configuration / same number of  
electrons (in the outer shell)

*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 12C

OR

Average/mean mass of atoms of an element  
1/12 mass of one atom of 12C

OR

(Average) mass of one mole of atoms  
1/12 mass of one mole of 12C

OR

(Weighted) average mass of all the isotopes  
1/12 mass of one atom of 12C

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

*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*

**2**

(c)     (i)      

= 65.6

*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 (c)(ii)*

*65.6 = 3 marks*

**3**

(ii)     64Zn+

*M1 for identifying Zn / zinc*

*M2 is for the + sign and the 64*

*M2 is dependent on M1*

**2**

(d)     Size of the charge (on the ion) / different charges / different m/z

*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

*Implication that current depends on the number of ions*

*M2 dependent on M1*

**2**

**[12]**

**2.**      (a)     **4**LiH + AlCl3 → LiAlH4 + **3**LiCl

**1**

(b)     Tetrahedral    or diagram

*(Not distorted tetrahedral)*

**1**

(Equal) repulsion

**1**

between four bonding pairs / bonds

*(Not repulsion between H atoms loses M2 and M3)*

*(Not ‘separate as far as possible’)*

*(‘4’ may be inferred from a correct diagram)*

**1**

(c)     Dative (covalent) or coordinate

**1**

Lone pair **or** non-bonding pair of electron **or** both e–

**1**

**QoL**  Donated from H– to Al **or** shared between H and Al

*(tied to M2)*

*(Not ‘from H atom’) (Not ‘to Al ion’) (Not ‘e–s transferred’)*

**1**

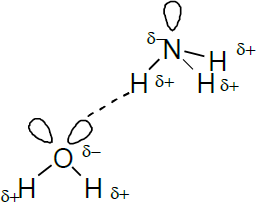
**[7]**

**3.** (a)     Hydrogen bonding / hydrogen bonds / H-bonding / H-Bonds

*Not just hydrogen.*

**1**

(b)

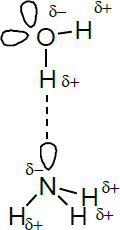


*One mark for minimum of 4 correct partial charges shown on the N-H and O-H*

*One mark for the 3 lone pairs.*

*One mark for H bond from the lone pair on O or N to the Hδ+*

***OR***

******

*The N-H-O should be linear but can accept if the lone pair on O or N hydrogen bonded to the H*

*If wrong molecules or wrong formula, CE = 0/3*

**3**

(c)     (Phosphine) does not form hydrogen bonds (with water)

**1**

**[5]**

**4.** (a)     Lithium / Li

*Penalise obvious capital I (second letter).*

**1**

(b)     (i)     Increase / gets bigger

*Ignore exceptions to trend here even if wrong*

**1**

(ii)     Boron / B

*If not Boron, CE = 0/3*

**1**

Electron removed from (2)p orbital /sub-shell / (2)p electrons removed

*If p orbital specified it must be 2p*

**1**

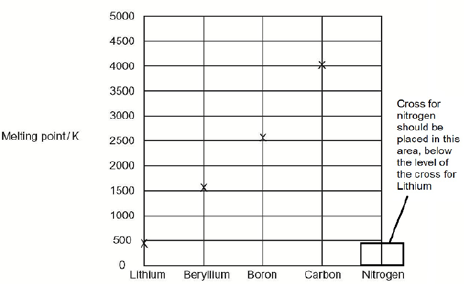
Which is higher in energy (so more easily lost) / more shielded (so more  
easily lost) / further from nucleus

**1**

(c)     C / carbon

**1**

(d)     Below Li



*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.*

**1**

(e)     Macromolecular / giant molecular / giant atomic

*Allow giant covalent (molecule) = 2*

**1**

Covalent bonds in the structure

**1**

Strong (covalent) bonds must be broken or overcome / (covalent) bonds need  
a lot of energy to break

*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*

**1**

**[10]**

**5.**          *Ideal gas equation*: pV = nRT **(1)**

*Calculation*: n = pV/RT =  **(1)**

*mark for volume conversion fully correct*

                                             = 3.79 × 10–3 (mol) **(1)**

*range 3.79 × 10–3 to 3.8 × 10–3*

          Mr = m/n = .304/3.79 × 10–3 = 80.1 **(1)**

*range 80 – 80.3  
min 2 s.f. conseq*

*If ‘V’ wrong lose M2; ‘p’ wrong lose M3; ‘inverted’ lose M3 and M4*

**[5]**

**6.**       X = Mg;

*(accept Be,Ca)*

**1**

          Y = Ba;

*(accept Sr)*

**1**

          MgCl2(aq) *+* 2NaOH(aq) → Mg(OH)2(s) + 2NaCl(aq)

Species;

**1**

State symbols & balance;

**1**

          BaCl2(aq) + Na2SO4(aq) → BaSO4(s) + 2NaCl(aq);

Species;

**1**

State symbols & balance;

*(accept ionic equations)*

**1**

**[6]**

**7. M1 and M2 (either order)**

**Any two from**

•        purple vapour / gas

•        (white solid goes to) black or black / grey or black / purple   
solid

•        bad egg smell or words to this effect

*Ignore misty white fumes  
Ignore yellow solid  
Ignore purple solid  
Ignore “goes (dark) brown”*

M3

*Or multiples for possible equation in* ***M3***

The iodide ion(s) / they lose (an) electron(s)

***OR***

2I− I2 + 2e−

M4

*Accept “changes by − 8”*

Oxidation state of S changes from **+6 to −2** or **changes by 8**

M5

H2SO4 + **8**H+ + **8**e− H2S + **4**H2O

***OR***

SO42− + **10**H+ + **8**e− H2S + **4**H2O

**[5]**

**8.** (a)    Cl2 0.4

**1**

NOCl 1.7

**1**

(b)    (i)      *K*c= 

*Penalise expression containing V  
Allow ( ) here, but must have all brackets.  
If Kc expression wrong, max 2 in (b)(ii) for  
M1 for correct rearrangement of their Kc and  
M4 for multiplying by 15*

**1**

(ii)     M1  

*Mark is for rearrangement of correct Kc expression.  
If Kc rearrangement wrong, can only score max 2 for:  
M3 and M4*

**1**

M2



*Rounding 1.90 / 15 wrongly to 0.126 is AE*

**1**

M3  [Cl2] = 0.0361 to 0.0365 (min 2 sfs)

*Mark for correct calculation of [Cl2]*

**1**

M4  mol Cl2 = 0.54 to 0.55

***Correct answer scores 4 ignore working***

*Mark is for answer of (M3 × 15)*

**1**

(iii)    ((7.4 × 10−3) = ) 0.086

Allow 0.085 to 0.086)

*Mark for answer* ***OR*** *conseq on their Cl2*

**

*Or     *

**1**

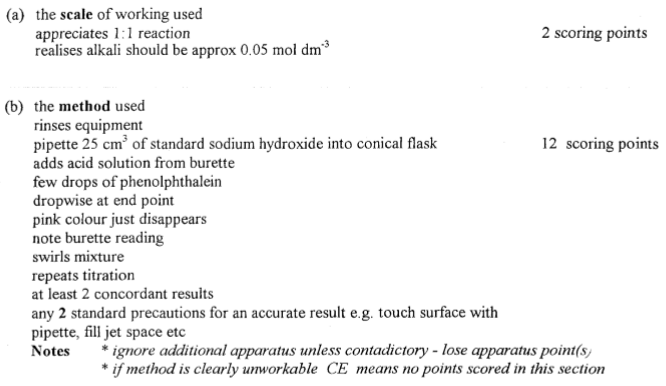
mol ½ dm−3/2 ***OR*** mol 0.5 dm −1.5

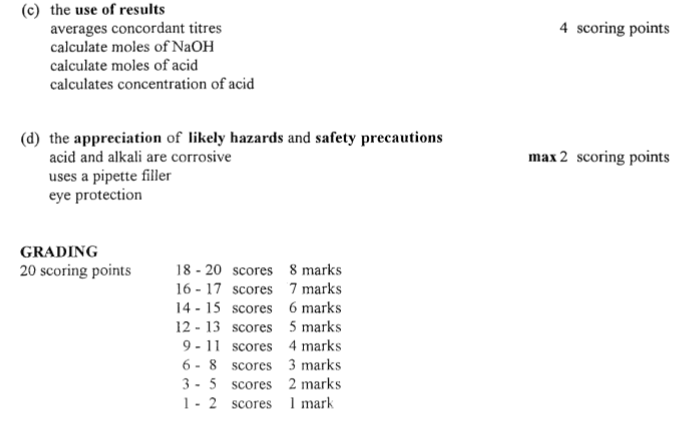
*NOT *

**1**

**[9]**

**9.**



**[8]**

**10. C**

**11. B**

**12. D**

**13. B**

**14. D**

**15. C**

**16. D**

**17. C**

**18. B**

**19. D**

**20. B**

**21. B**

**22. A**