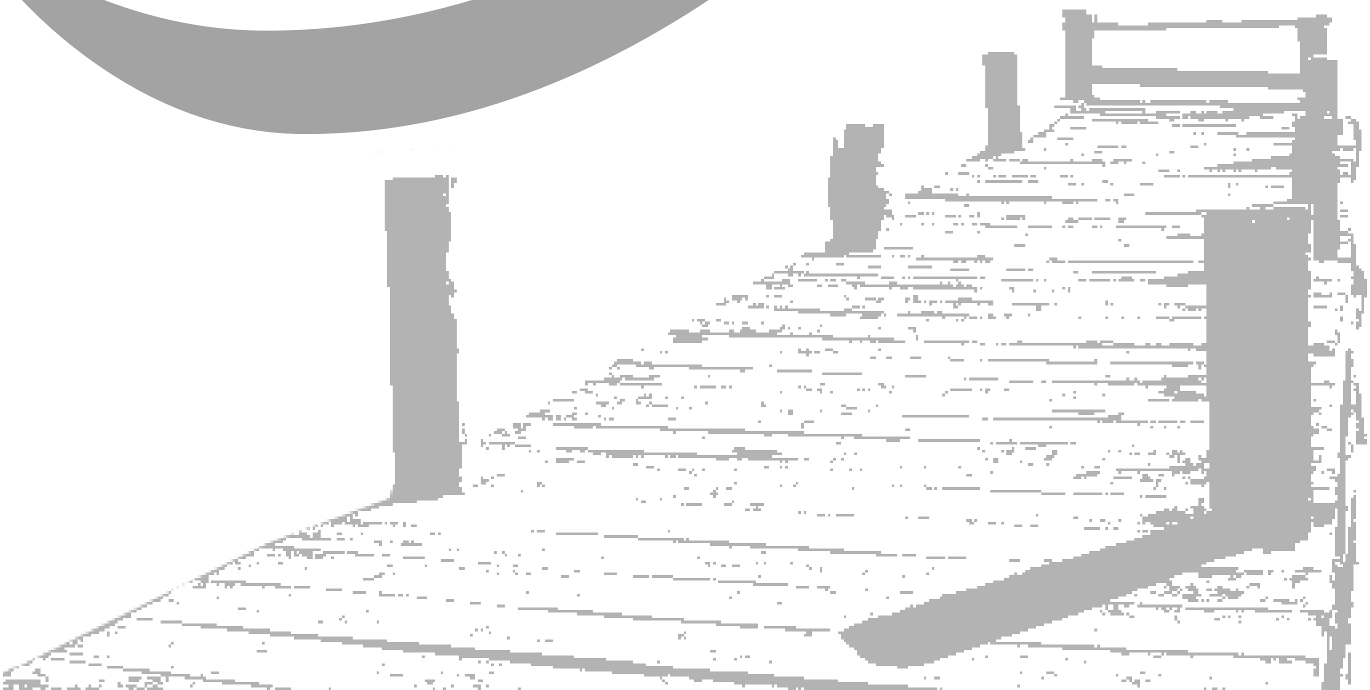
# GCE
## AS and A Level

# Chemistry

**AS exams 2009 onwards**
**A2 exams 2010 onwards**

## Unit 1:
## Specimen mark scheme

**Version 1.2**



Version 1.2 02/09

# General Certificate of Education

# Chemistry 2420

## CHEM1 Foundation Chemistry

## Mark Scheme

*Specimen Paper*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers.  The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of the planned question papers and mark schemes in advance of the first operational exams.

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.



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## *Question 1*

| | | | |
|---|---|---|---|
| (a) | | Number of protons in the nucleus | (1) |
| (b) | | They may have different numbers of neutrons | (1) |
| (c) | (i) | Mass spectrometer | (1) |
| | (ii) | $\frac{\text{Mean mass of an atom}}{\text{Mass of 1 atom of } ^{12}\text{C}} \times 12$ | (2) |
| | (iii) | $A_r = \frac{\text{sum of relative m/z} \times \text{rel. abundance}}{\text{Total abundance}}$ | (1) |
| | | $= (82\times12 + 83\times12 + 84\times50 + 86\times26)/100 = 84.16$ | (1) |
| (d) | | $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$ | (1) |
| (e) | | Krypton was thought to be an inert gas (or has 8 electrons in outer shell) | (1) |
| (f) | (i) | Krypton has more protons than bromine | (1) |
| | | But its outer electrons are in the same shell (or have similar shielding) | (1) |
| | (ii) | Al electron is in a 3p orbital, magnesium in 3s | (1) |
| | | Energy of 3p is greater than 3s | (1) |

## *Question 2*

| | | | | |
|---|---|---|---|---|
| (a) | (i) | Moles of gas produced = 3 | | (1) |
| | | $PV=nRT$ | | (1) |
| | | $V=nRT/P = 3\times8.31\times298/100000$ | | (1) |
| | | $= 7.43\times10^{-2}\ m^3$ | | (1) |
| | (ii) | $7.43\times10^{-2} \times 1000/298 = 0.249\ m^3$ | | (1) |
| (b) | (i) | any two from:<br>exhaust gases hot so would boil the solution away<br>solution would splash<br>reaction might be too slow<br>would need continuous supply of solution and/or replacement of products | | (2) |
| | (ii) | *Commercial advantage* | could sell chlorine and/or hydrogen | (1) |
| | | *environmental disadvantage* | generation of electricity likely to lead to release of $CO_2$ (or chlorine toxic) | (1) |

| | | | |
|---|---|---|---|
| (c) | | % O = 74% | (1) |
| | | N:O = 26/14:74/16 | (1) |
| | | = 1.86: 4.63 = 1:2.5 therefore formula is $N_2O_5$ | (1) |
| (d) | | $2N_2O \rightarrow 2N_2 + O_2$ | (1) |
| (e) | | Proportion of $O_2$ increased leading to higher T (or more complete combustion) | (1) |

### *Question 3*

| | | | |
|---|---|---|---|
| (a) | | Outer electrons are in p orbitals | (1) |
| (b) | | decreases | (1) |
| | | Number of protons increases | (1) |
| | | Attracting outer electrons in the same shell (or similar shielding) | (1) |
| (c) | | Sulfur molecules ($S_8$) are larger than phosphorus ($P_4$) | (1) |
| | | Therefore van der Waals' forces between molecules are stronger | (1) |
| | | Therefore more energy needed to loosen forces between molecules | (1) |
| (d) | | Argon particles are single atoms with electrons closer to nucleus | (1) |
| | | Cannot easily be polarised (or electron cloud not easily distorted) | (1) |

### *Question 4*

| | | | |
|---|---|---|---|
| (a) | (i) | Prevents release of toxic CO | (1) |
| | | More energy efficient (releases more energy on combustion) | |
| | (ii) | $C_6H_{14} + 6.5O_2 \rightarrow 6CO + 7H_2O$ | (1) |
| | | Suitable product eg CO or C | |
| | | Balanced equation | |
| | (iii) | Detect CO gas or C (soot or particles) in exhaust gases | (1) |
| (b) | | $CH_3CH_2CH_2CH(CH_3)_2$ | (1) |
| | | 2-methylpentane | (1) |
| | | $CH_3CH_2CH(CH_3)CH_2CH_3$ etc | (1) |
| (c) | (i) | $CH_3CH_2CH_2CH{=}CH_2$ | (1) |
| | (ii) | Alumino silicate etc | (1) |
| | (iii) | Can be made into polymers (or alcohols etc) | (1) |

(d) (i) % atom economy = mass $CH_2Cl_2$/total mass reactants = 85×100/158 (1)
= 53.8% (1)

(ii) Because expensive chlorine is not incorperated into desired product (1)
Raise money by selling HCl

(a) NaCl is ionic (1)
cubic lattice (1)
ions placed correctly (1)
electrostatic attraction between ions (1)

Covalent bonds between atoms in water (1)
Hydrogen bonding between water molecules (1)
Tetrahedral representation showing two covalent and two hydrogen bonds (1)
2 hydrogen bonds per molecule (1)

Attraction between ions in sodium chloride is very strong (1)
Covalent bonds in ice are very strong (1)
Hydrogen bonds between water molecules in ice are much weaker (1)
Consequently, less energy is required to break the hydrogen bonds in ice to form separate water molecules than to break the ionic bonds in sodium chloride and make separate ions (1)

(b)

| Mark Range | The marking scheme for this part of the question includes an overall assessment for the Quality of Written Communication (QWC). There are no discrete marks for the assessment of QWC but the candidates' QWC in this answer will be one of the criteria used to assign a level and award the marks for this part of the question<br>**Descriptor**<br>an answer will be expected to meet most of the criteria in the level descriptor |
|---|---|
| 3 | - claims supported by an appropriate range of evidence<br>- good use of information or ideas about chemistry, going beyond those given in the question<br>- argument well structured with minimal repetition or irrelevant points<br>- accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling |
| 2 | - claims partially supported by evidence<br>- good use of information or ideas about chemistry given in the question but limited beyond this<br>- the argument shows some attempt at structure<br>- the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling |
| 0-1 | - valid points but not clearly linked to an argument structure<br>- limited use of information or ideas about chemistry<br>- unstructured<br>- errors in spelling, punctuation and grammar or lack of fluency |

| | | |
|---|---|---|
| 4 bonding electron pairs | | (1) |
| and one lone pair | | (1) |
| repel as far apart as possible | QWC | (1) |
| lone pair - bond pair repulsion > bp—bp | QWC | (1) |
| pushes S-F bonds closer together | | (1) |
| shape is trigonal bipyramidal with lone pair either axial or equatorial | QWC | (1) |
| angles <90 | | (1) |
| and < 120 | | (1) |