# GCE MARKING SCHEME

## CHEMISTRY
## AS/Advanced

## JANUARY 2014

## Section A

Q.1 **D** [1]

Q.2 **A** [1]

Q.3 (a) An electron formed when a neutron changes into a proton / an electron emitted by the nucleus [1]

(b) $^{32}S$ [1]

(c) Time taken for half of the atoms in a radioisotope to decay (or similar) [1]

(d) 42 days [1]

Q.4 Combustion of C and $H_2$ = (2 × –394) + (3 × –286)
= –1646 kJ $mol^{-1}$ (1)

$\Delta H$ = –1646 – (–1560) = –86 kJ $mol^{-1}$ (1) [2]

Q.5

| | Ag | S |
|---|---|---|
| Mass | 1.08 | 0.16 |
| $A_r$ | 108 | 32 |
| Moles | 0.01 | 0.005 |

(1)

2 1

Formula = $Ag_2S$ (1) [2]

**Total Section A [10]**

**Section B**

Q.6 (a) (i) **B** is $^{37}Cl^{+}$ (1)
**C** is $(^{35}Cl—^{35}Cl)^{+}$ (1) [2]

(ii) **C** = 54, **E** = 6 (1)
Ratio of **C**:**E** is 9:1 (1) [2]

(iii) Ratio of $^{35}Cl$:$^{37}Cl$ is 3:1 (1)
Ratio of $^{35}Cl—^{35}Cl$ : $^{37}Cl—^{37}Cl$ is 3:1 × 3:1 = 9:1 (1)

or

Probability of atom being
$^{35}Cl$ is ¾ and that of $^{37}Cl$ is ¼ (1)

Probability of
$^{35}Cl—^{35}Cl$ is ¾ × ¾ = 9/16
and $^{37}Cl—^{37}Cl$ is ¼ × ¼ = 1/16 (1) [2]

(b) $A_r = \frac{(79 \times 50.69) + (81 \times 49.31)}{100}$ (1)

$A_r$ = 79.99 (1) [2]

**Total [8]**

Q.7 (a) Use weighing scales to weigh the metal oxide (1)
Use measuring cylinder to pour hydrogen peroxide solution and water into a conical flask (1)
Immerse flask in water bath at 35 ˚C (1)
Add oxide to flask and connect flask to gas syringe (1)
Measure volume of oxygen every minute for 10 minutes / at regular time intervals (1)

(any 4 of above, credit possible from labelled diagram) [4]

(b) Oxide **A** because reaction is faster [1]

(c) (i) 18 $cm^3$ [1]

(ii) 10 $cm^3$ [1]

(d) Concentration of hydrogen peroxide has decreased (1)
reaction rate decreases / fewer successful collisions (1) [2]

(e) All the hydrogen peroxide has decomposed / the same quantity of hydrogen peroxide was used [1]

(f) 25 $cm^3$ [1]

(g) Reaction will take less time (1)
Reactants collide with more (kinetic) energy (1)
More molecules have the required activation energy (1) [3]

*QWC Selection of a form and style of writing appropriate to purpose and to complexity of subject matter* [1]

**Total [15]**

Q.8 (a) Electrons within atoms occupy fixed energy levels or shells of increasing energy / nitrogen has electrons in two shells (1)
$1s^2\ 2s^2\ 2p^3$ (1)

Electrons occupy atomic orbitals within these shells /
The first shell in nitrogen has s orbitals and the second shell s and p orbitals (1)

A maximum of two electrons can occupy any orbital /
Each s orbital in nitrogen contains two electrons (1)

Each with opposite spins (1)

Orbitals of the same type are grouped together as a sub-shell /
There are three p orbitals in nitrogen's p sub-shell (1)

Each orbital in a sub-shell will fill with one electron before pairing starts / In nitrogen's p sub-shell each orbital contains one electron (1)

(configuration mark + any 3 of above) [4]

*QWC The information is organised clearly and coherently, using specialist vocabulary where appropriate* [1]

(b) Atomic spectrum of hydrogen is a series of lines (1)
that get closer as their frequency increases (1)
(credit possible from labelled diagram)

Lines arise from atom / electrons being excited by absorbing energy (1)
electron jumping up to a higher energy level (1)
falling back down and emitting energy (in the form of electromagnetic radiation) (1)
to the n = 2 level (1)
(any **three** points for maximum 3 marks)

Since lines are discrete energy levels must have fixed values /
Since energy emitted is equal to the difference between two energy levels, $\Delta E$ is a fixed quantity or quantum (1) [6]

(c) (i) It has greater nuclear charge (1)
but little / no extra shielding (1) [2]

(ii) In Be less shielding of outer electron (1)
outweighs smaller nuclear charge (1)

or

Be outer electron closer to nucleus (1)
Be has greater effective nuclear charge (1) [2]

(iii) I. Too much energy required to form $B^{3+}$ ion [1]

II. $K^{+}(g) \rightarrow K^{2+}(g) + e^{-}$ [1]

III. Value of 1st and 3rd I.E. will be higher (1)
Value of 2nd I.E. will be smaller (1)
(accept large jump in I.E. value would be between 2nd and 3rd electrons for 1 mark) [2]

**Total [19]**

Q.9 (a) Enthalpy change when one mole of a compound is formed from its (constituent) elements (1)
in their standard states / under standard conditions (1) [2]

(b) (i) $H_2 + ½O_2 \rightarrow H_2O$ [1]

(ii) $-242 = 436 + 248 - 2(O—H)$ (1)
$2(O—H) = 926$
$O—H = 463\ kJ\ mol^{-1}$ (1) [2]

(c) (i) I. Burning hydrogen will not produce $CO_2$ (or $SO_2$) as pollutants [1]

II. Hydrogen is very flammable, storing as $MgH_2$ is safer / $MgH_2$ is solid therefore volume occupied by given amount of hydrogen is less [1]

(ii) If the $MgH_2$ is not kept dry, hydrogen will be formed and there could be a potential explosion [1]

(iii) Moles $MgH_2 = \frac{70000}{26.32} = 2659.6$ (2660) (1)

Moles $H_2 = 5319.2$ (5320) (1)

Volume $H_2 = 1.28 \times 10^5\ dm^3$ (1) [3]

(d) (i) An increase in temperature would decrease the yield and an increase in pressure would increase the yield [1]

(ii) Forward reaction is exothermic so equilibrium shifts to the left as temperature is increased (1)

More gaseous moles on the l.h.s. so equilibrium shifts to the right as pressure is increased (1) [2]

(e) Lower temperatures can be used (1)
Energy costs saved (1)
More product can be made in a given time (so more can be sold) (1)
Enable reactions to take place that would be impossible otherwise (1)
Less fossil fuels burned to provide energy (so less $CO_2$ formed) (1)
(any 3 of above) [3]

*QWC Legibility of text; accuracy of spelling, punctuation and grammar, clarity of meaning* [1]

**Total [18]**

Q.10 (a) Moles NaCl = $\frac{900}{58.5}$ = 15.38 (1)

Moles $Na_2CO_3$ = 7.69 (1)

Mass $Na_2CO_3$ = 7.69 × 106 = 815(.4) g (1) [3]

(b) (i) 2.52 g [1]

(ii) Moles $Na_2CO_3$ = 0.02 (1)
Moles $H_2O$ = 0.14 (1) $x$ = 7 (1) [2]

(c) (i) Moles = 0.5 × 0.018 = 0.009 [1]

(ii) 0.0045 [1]

(iii) 0.0045 × 106 = 0.477 [1]

(iv) % = 0.477/0.55 = 86.7 % [1]

**Total [10]**

**Total Section B [70]**