GCE MARKING SCHEME

CHEMISTRY
AS/Advanced

SUMMER 2011

CHEMISTRY - CH1

SECTION A

Q.1

Atom/ion	No. of protons	No. of neutrons	No.of electrons
^{24}Mg	12	12	12
^{26}Mg	12	14	12
$^{24}Mg^{2+}$	12	12	10

One mark for each correct line [3]

Q.2 An iron atom, Fe

3s	3p			3d					4s
↑↓	↑↓	↑↓	↑↓	↑↓	↑	↑	↑	↑	↑↓

[1]

Q.3 58.5 - working must be shown [1]

Q.4 **C** [1]

Q.5 ΔH (1), **both** activation energies (1) [2]

Q.6 (a) NO_2

(b) N_2O_4 [2]

Total [10]

SECTION B

Q.7 (a) The electrons absorb energy from the radiation (1) and are excited up to a higher energy level (1)leaving dark lines or bands in the spectrum (1)
- 2 max. [2]

(b) A **series** (four) of sharp (bright) **lines** (on a dark background) (converging towards the violet end). (1)
The atom's electron energy levels have fixed values/ are quantized (1), the lines arise when electrons fall between these levels (1) and thus have fixed energies and wavelengths. (1)
Any two in this sentence for two marks. [3]

QWC: Information organized clearly and coherently, using specialist vocabulary where appropriate. [1]

(c) (i) IEs increase (1) due to increasing nuclear charge / more protons and same orbitals being filled. (1)

(ii) IEs decrease (1) since increase in nuclear charge is outweighed by increased shielding by electrons in inner orbitals (or similar sense). (1)
[4]

(d)

Radiation	Effect on atomic number	Effect on mass number
alpha particle	-2	-4
beta particle	+1	0
gamma radiation	0	0

One mark per correct line. [3]

(e) (i) The time taken for one half of a (radioactive) isotope to decay. (1)
By measuring how much of the isotope has decayed the period of time over which it has been decaying can be calculated and the age of the rock or organic material found. (1)
[2]

(ii) Accept any two realistic examples - not x-ray / MRI. [2]

Total [17]

Q.8 (a) (i) 96.8 g (1) for 1.5 mol if answer incorrect [2]

(ii) 81.7 % (1) for 1.22 mol if answer incorrect [2]

(b) (i) The amount or % by mass of all the reactants that ends up in the desired product. [1]

(ii) **A** 100 % (1); **B** 31.9 % (1) [2]

(iii) **A** is preferred giving complete use of materials and no waste or co-products to be removed. [1]

(c) General statement of meaning of the term (1) and examples of individual aims such as to maximise yield, prevent waste, avoid materials toxic to health and damaging to the environment, minimise energy use, work at lower temperatures and pressures, increase safety, avoid the use of organic solvents, etc., etc.,
Any three of above or similar points. Mark flexibly! [3]

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

Total [12]

Q.9 (a) If the temperature, pressure or concentration of a system in equilibrium is changed the position of equilibrium shifts in the direction to oppose the change (or similar). [1]

(b) This is a measure of the acidity or alkalinity of an (aqueous) solution (and relates to the hydrogen ion concentration.) pH 7 is neutral, lower values are acidic and higher values alkaline and the further the values are from 7 the more acidic or alkaline the solution is. [1]
Accept pH = $-\log_{10}[H^+]$

(c) (i) I Acidity will increase since, from Le Chatelier, increased CO_2 pushes the equilibrium to the right. [1]
II pH will fall since $[H^+]$ increases [1]

(ii) This will decrease since the increase in H^+ moves the equil. to the left, (reducing carbonate and increasing hydrogencarbonate). [1]

(iii) It will be more difficult to make shells since the reduction in carbonate will displace the equil. to the left and the solid shell will tend to dissolve rather than form. [1]
Accept error carried forward from (ii).

(d) 7.6 ± 0.1 [1]

(e) moles H^+ = 0.095 x 19.6/1000 = 0.00186 (1)

concn HCO_3^- = 0.00186 x 1000/25 = 0.0744 (1) (mol dm^{-3}) [2]

Total [9]

Q.10 (a) Temperature, pressure/concentration, catalyst, light, particle size.
- any three for 1 mark each [3]

(b) (i) Results correctly plotted (2), one error (1), more than one (0).
Good curve (and tangent) (1).
Correct rate 0.1 (1), cm^3/s (1) [5]

(ii) The rate is lower at 250 s (1) since the concentration of peroxide has fallen through decomposition (1) (and there are fewer collisions/the rate depends on concentration) [2]

(iii) A gas syringe or gas volume-measuring device is attached to the reaction flask, a stopwatch/timer is started and the volume of gas in the syringe measured at (50 s) time intervals. [2]

(c) Rate increases with increasing pressure and temperature (1).
Increasing pressure increases concentration (1).
Increasing temperature increases number of molecules with E_a. (1)
Rate increases with rate of successful collisions. (1) [4]

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

Total [17]

Q.11 (a) (i) A known mass / volume of water is placed into an insulated vessel (calorimeter)(1) and the temperature measured every 30s. When the temperature is constant (1) a known mass of $NaNO_3$ is rapidly added (and stirred to dissolve) (1). The temperature continues to be measured every 30 s for some minutes (1), a temperature/time plot is made from the results, ΔT (max) is found from the graph(1) – extrapolation (1)- and ΔH calculated from the equation below.
- 4 max. [4]

(ii) Extrapolate (1)
$\Delta T = -10.0 \pm 0.4^o$ (1)

$\Delta H = +21\ kJ\ mol^{-1}$ (2); -1 if wrong sign, consequential [4]
[21 000 $kJ\ mol^{-1}$ (1)]

(b) (i) The overall enthalpy change for a reaction is independent of the reaction route taken (or equivalent). [1]

(ii) $\Delta H = \Delta H^o_f(H_2SO_4) - [\Delta H^o_f(SO_3) + \Delta H^o_f(H_2O)$ (1)

$= (-811)-[(-395) + (-286)] = -130\ kJ\ mol^{-1}$ (1) [2]
- 1 max. for $+130\ kJ\ mol^{-1}$

(c) The (average) energy needed to break the O-H bond. (1)
O-H bonds in different molecules will have slightly different bond energies and so a mean or average value is useful. (1) [2]

(d) These are fossil fuels, that are non-renewable and finite in amount so will eventually run out. (1)
Turn to renewable sources of energy (such as solar, wind, biofuels and nuclear.) (1)
OR
Combustion of carbon compounds gives CO_2 in the atmosphere that is causing global warming. (1)
Reduce the use of these fuels / capture / store the CO_2. (1)
OR
Sulfur in fuels producing sulfuric acid in atmosphere –acid rain-(1).
Remove sulfur dioxide from flues (FGD), use low sulfur fuels, etc. (1) [2]

Total [15]

Section B Total [70]