WJEC
CBAC

GCE MARKING SCHEME

CHEMISTRY
AS/Advanced

JANUARY 2012

GCE Chemistry – CH1

SECTION A

Q.1

1s	2s	2p			3s	3p		
↓↑	↓↑	↓↑	↓↑	↓↑	↓↑	↓↑	↑	↑

[1]

Q.2 B / 13 [1]

Q.3 Acid: Proton donor (1)

Dynamic equilibrium: Reversible reaction where the **rate** of forward and reverse reactions is equal (1) [2]

Q.4 (a)

	1	2	3	4
Volume used / cm^3	20.75	20.20	20.10	20.30

[1]

(b) 20.20 cm^3 [1]

Q.5 A [1]

Q.6 (a) Ratio of C:H is 1:1.33 (1)
Emp. Formula = C_3H_4 (1) [2]

(b) Molecular formula = C_9H_{12} [1]

SECTION A TOTAL [10]

SECTION B

Q.7 (a) (i) Temperature: 298K / 25°C (1) Pressure: 1 atm / 101.325 kPa or 100 kPa (1) [2]

(ii) Hydrogen gas is an element in its standard state [1]

(iii) $\Delta H = \Delta H_f\ (C_5H_{12}) + 5\ \Delta H_f\ (H_2O) - 5\ \Delta H_f\ (CO) - 11\Delta H_f\ (H_2)$ (1)

$\Delta H_f\ (C_5H_{12}) = -1049 - 5\ (-286) + 5\ (-111)$ (1)

$\Delta H_f\ (C_5H_{12}) = -174\ kJ\ mol^{-1}$ (1) [3]

(b) (i) Catalyst in different state to reactants [1]

(ii) Catalysts provide an alternative route (1) with a lower activation energy (1) [2]

(iii) Lower temperature or less time so less energy needed / Can make alternative production method possible with sustainable starting materials or less waste products [1]

(iv) At higher temperatures particles have more energy (1)

More collisions have energy above activation energy (1)

(Can obtain these two marks from correctly labelled Boltzmann energy distribution plot with two temperature lines (1) and Activation energy (1))

Successful collisions occur more frequently (1) – 3 max [3]

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

(c) (i) No effect (1)

Same number of (gas) molecules on both sides of reaction (1) [2]

(ii) Lower yield of hydrogen (1)

Reaction shifts in endothermic direction to (try to counteract increase in temperature) (1) [2]

(iii) No effect [1]

Total [19]

Q.8 (a) Be: 800 - 1000 kJ mol^{-1} (1)

Ne: 1700 – 2300 cm^{-1} (1) [2]

(b) Be (g) → Be^{+} (g) + e [1]

(c) (i) Greater nuclear charge on He (1)

No increase in shielding / Outer electrons same distance from nucleus / Outer electrons in same shell (1) [2]

(ii) Outer electron in O is paired in orbital / Outer electron for N is unpaired (1)

Repulsion between paired electrons makes it easier to remove outer electron of oxygen (1) [2]

(d) (i) Electrons excited to a higher energy level (1)

Energy levels are quantised (1)

Electrons drop from higher to lower energy levels (1)

Energy is emitted as light (1) – 3 max [3]

Lines represent the energy emitted (1) when an excited electron drops back (1) from one energy level to another (1)

QWC: legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning [1]

(ii) Find frequency of convergence limit (1) for Lyman series (1)

Ionisation energy is given by E=hf / Energy $\propto$ frequency (1) [3]

Total [14]

Q.9 (a) M_r (PbS) = 239.1 M_r (PbO) = 223 (1)

Moles of PbS = 20,000 ÷ 239.1 = 83.65 moles (1)

Mass of PbO = 83.65 x 223 ÷1000 = 18.7 kg (1) [3]

(b) (i) Sulfur dioxide: Acid rain (1)

Carbon dioxide: Climate change / global warming / acidification of oceans (1) [2]

(ii) I. Sum of M_r of reactants = 223 + 28 = 251 (1)

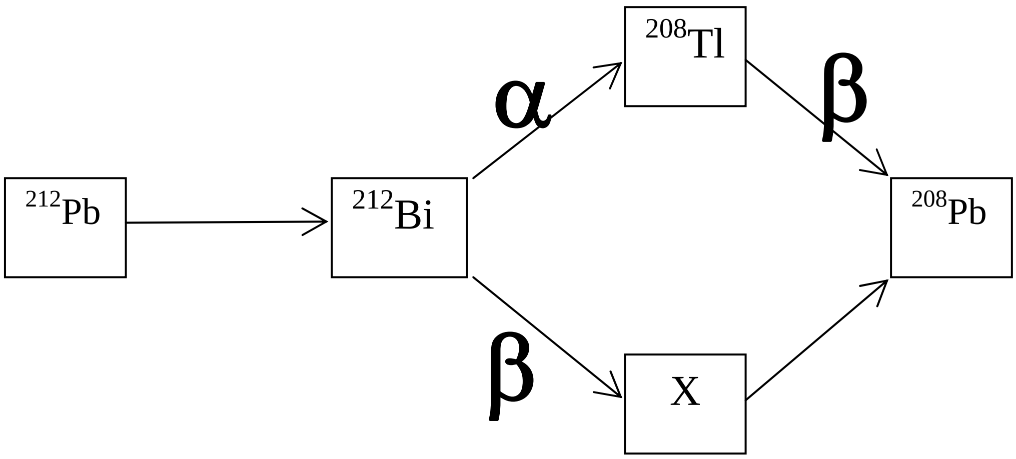
Atom economy = (207 ÷ 251) x 100 = 82.5% (1) [2]

(ii) II. Method 1 as higher atom economy means less waste / more useful product [1]

(c) (i) Symbol = Po (1) Mass number = 212 (1) [2]

(ii) All three arrows labelled correctly, as shows below, gives two marks

Any two arrows labelled correctly gives one mark [2]



(iii) γ-radiation is high energy / frequency electromagnetic waves (1)

It affects neither atomic number nor mass number / it changes neither the number of protons nor neutrons (1) [2]

(iv) 31.8 hours = 3 half lives (1)

Mass remaining after 3 half lives = 3mg (1) [2]

(d) A_r = [(206.0 x 25.48) + (207.0 x 22.12) + (208.0 x 52.40)] ÷ 100 (1)

A_r = 207.3 (1)

1 mark for correct significant figures (answer must be reasonable) [3]

Total [19]

Q.10 (a) (i) M_r ($CuSO_4.5H_2O$) = 249.7 [1]

(ii) I. Moles of copper(II) sulfate

= 0.250 x 250/1000 = 6.25 x 10^{-2} moles (1)

Mass = 6.25 x 10^{-2} x 249.7 = 15.6 g (1) [2]

II. 1 mark each for:

- Weighing method
- Dissolve copper sulfate in a smaller volume of distilled water
- Transfer to 250.0 cm^3 volumetric / standard flask
- Use of funnel
- Wash funnel / glass rod / beaker with distilled water into volumetric flask
- Add distilled water up to mark
- Shake solution / mix thoroughly 5 max [5]

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate [1]

(b) (i) Powder has a greater surface area (1) so gives a higher rate of reaction (1) [2]

(ii) Extrapolate lines from start (level at 21.3°C) and end (through points at 180-270 seconds) (1)

Temperature rise = 6.0°C (Range 5.8-6.2°C) (1) [2]

(iii) I. Moles = 0.250 x 0.05 = 1.25 x 10^{-2} moles [1]

II. Zinc is the limiting reagent / Copper(II) sulfate is in excess [1]

III. ΔH = -(50)x 4.18 x 6.0 ÷ (6.12 x 10^{-3}) (1)

ΔH = -204902 J mol^{-1}

ΔH = -205 kJ mol^{-1} (1) [2]

IV. Enthalpy measures chemical energy, and as heat energy increases, chemical energy must decrease [1]

Total [18]

SECTION B TOTAL [70]