WJEC
CBAC

MS4
£4.00

GCE MARKING SCHEME

CHEMISTRY (NEW)
AS/Advanced

SUMMER 2009

CH1

Section A

1. *(a)* (i) Atomic number is the number of protons in the nucleus / in an element (e.g. 19 for potassium) [1]

(ii) Isotopes of elements have the same number of protons but different number of neutrons (e.g. chlorine has two isotopes ^{35}Cl and ^{37}Cl) / same atomic number but different mass number [1]

(b)

1s	2s	2p	3s	3p	3d	4s
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓		↑

[1]

2. *(a)* (i) Measure (the volume of) hydrogen produced (using a gas syringe) / (mass of) hydrogen lost at constant time intervals [1]

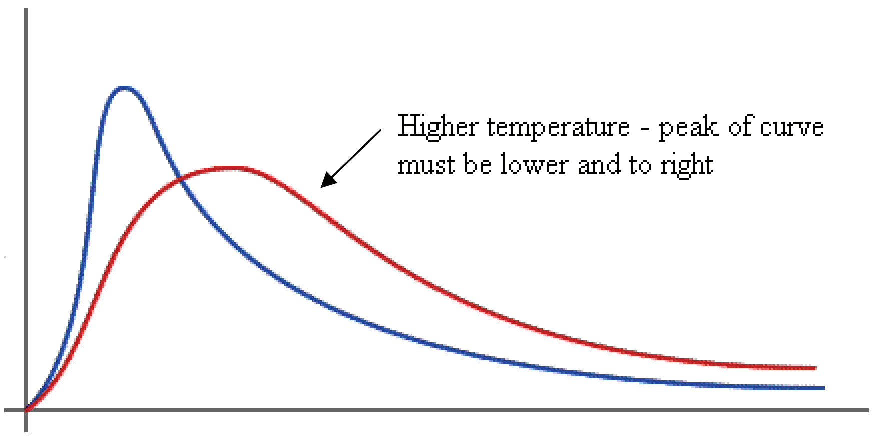
(ii) Crush it into a powder / increase its surface area / heat it / stir it [1]

(b) 2 g [1]

3. 3 g / A [1]

4. *(a)*

fraction of molecules with energy, E



energy E

(b) ΔH = (4 x 412) + 612 + 436 – ((6 x 412) + 348) [1]

= – 124 kJ mol^{-1} [1]

Total [10]

Section B

5. *(a)* (i) Correct plotting of 6 points (Allow ± ½ square) [3]

(ii) In He less shielding of outer electron (1)
outweighs smaller nuclear charge (1) /
He has greater effective nuclear charge (1) /
He outer electron closer to nucleus (1)

(Accept any two points) [2]

(iii) Ne has greater nuclear charge /
greater number of protons (in same orbital) [1]

(iv) N only has unpaired 2p electrons, O has two unpaired and two paired 2p electrons / N $1s^2\ 2s^2\ 2p^3$, O $1s^2\ 2s^2\ 2p^4$ (1), repulsion between the paired electrons makes it easier to remove one of the electrons / takes more energy to remove unpaired electron (1) [2]

(b) (i)

Pb	C	O	
$\frac{77.5}{207}$	$\frac{4.50}{12}$	$\frac{18.0}{16}$	
0.374	0.375	1.125	(1)
1	1	3	

Formula = $PbCO_3$ (1) [2]

(ii) I M_r Pb_3O_4 = (3 x 207) + (4 x 16) = 685 [1]

II Moles PbO = $\frac{134}{223}$ = 0.601 (1)

Moles Pb_3O_4 = 0.200 (1)

Mass Pb_3O_4 = 137 g (1) [3]

or alternative

1338 g PbO gives 1370 g Pb_3O_4 (1)

1 g PbO gives $\frac{1370}{1388}$ g Pb_3O_4 (1)

134 g PbO gives 137(.2) g Pb_3O_4 (1)

Total [14]

6. *(a)* (i) It provides a new route (1)
of lower activation energy (1) [2]

(ii) Heterogenous [1]

(iii) I Lower temperatures could be used (1)
(which would mean) increased yield (1) /
less energy consumption (1) / lower pressure used (1) /
equilibrium could be reached faster (1)
(Accept any two points) [2]

II More ammonia formed / equilibrium moves to right (1)
since more (gas) molecules on l.h.s. (1)
(Increases rate of reaction 1 mark) [2]

III Equilibrium moves to right / more ammonia formed (1)
since removing ammonia decreases its concentration in the mixture (1)
(Stops ammonia from returning to nitrogen and hydrogen 1 mark) [2]

(iv) Near a port / on the coast for exporting products (1),
good transport links for product (1), nearby workforce (1)

(Two valid reasons without one qualification 1 mark only) [2]

(b) (i) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$ [1]

(ii) Ammonia accepts a proton (from the acid) / ammonia has a lone pair of electrons / ammonia neutralises the acid
[1]

(iii) % N = 28/132 × 100 (1)
= 21.2% (1) [2]

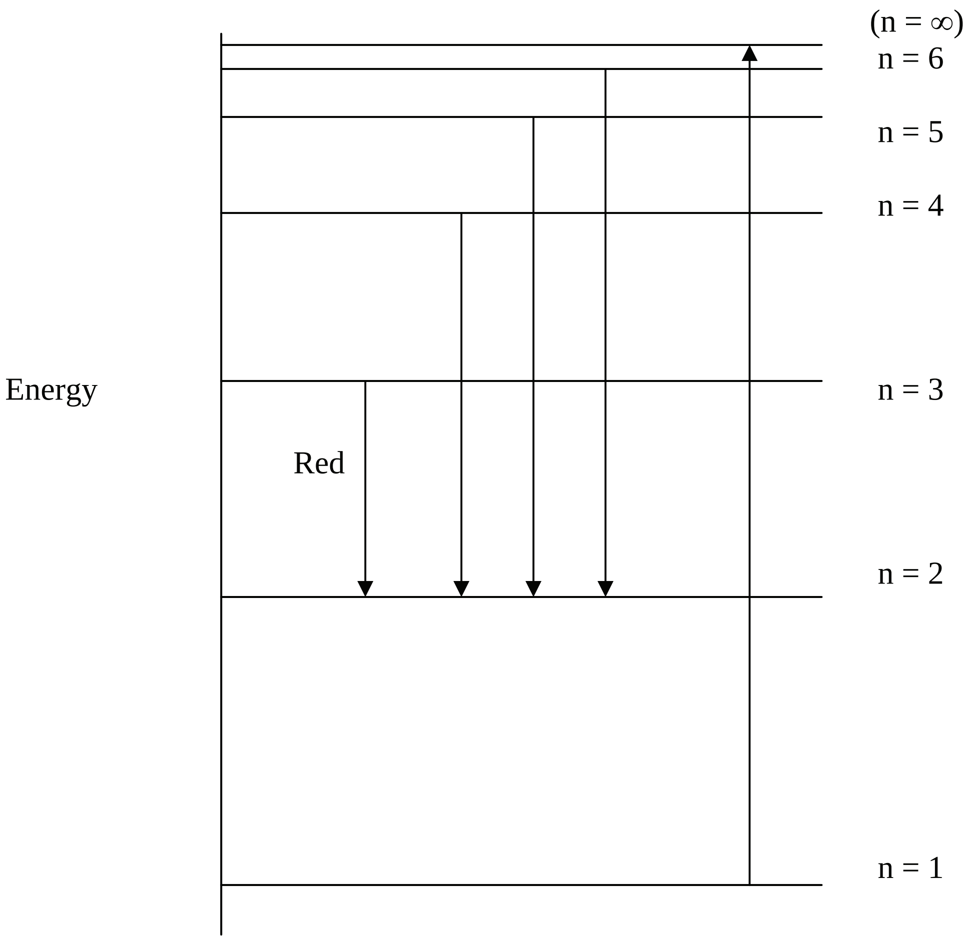
Total [15]

7. *(a)* (i) Only changes between energy levels allowed /

electron falls from higher energy levels to lower energy levels (1)

Energy emitted related to frequency / E = hf / the difference between any two energy levels are fixed / energy levels are quantised (1) [2]

(ii)



Labelling of any 3 horizontal lines (1)

Transitions going to n = 2 (1)

Red line from n = 3 to n = 2 (1)

(If all lines go to n = 1, accept red line from n = 2 to n = 1) [3]

(iii) Transition from n = 1 to n = ∞ [1]

(b) (i) A_r H = $\frac{(1 \times 99.2) + (2 \times 0.8)}{100}$ (1)

= 1.008 (1) [2]

(ii) Some of the hydrogen molecules are split into atoms [1]

(c) (i) Electron gun / source of electrons / heated filament [1]

(ii) Electric field / charged plates / accelerator / collimator [1]

(iii) To ensure a vacuum /
prevents collisions between sample and air molecules [1]

(d)

Type	*Nature*	*Effect on atomic number*
α particle	**Cluster of 2 protons and 2 neutrons** (1) / **$^{4}_{2}$He <u>nucleus</u>**	**Decrease by 2** (1)
β particle	**Electron (1)**	**Increase by 1 (1)**
γ radiation	Electromagnetic radiation of high energy	No effect

(Accept '*decrease*' and '*increase*' in 'atomic number' for 1 mark only)
[4]

Total [16]

8. *(a)* (i) Increases CO_2 levels / causes global warming (1)

Gas is a non renewable energy source / will run out (1) [2]

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

(ii) Wind / hydro / biomass / solar / geothermal (1)

Rotation of blades turns turbine / falling water turns turbine / combustion steam turns turbine / sunlight on photovoltaic cell produces electricity (1)

(Accept answers in terms of energy changes) [2]

(b) (i) $C_2H_5OH + \mathbf{3}O_2 \longrightarrow \mathbf{2}CO_2 + \mathbf{3}H_2O$ [1]

(ii) $\Delta H = (2 \times -394) + (3 \times -286) - (-278)$ (1)

$\Delta H = -1368 \text{ kJ mol}^{-1}$ (1) [2]

(iii) Energy for ethanol $= \frac{1368}{46} = 29.7 \text{ kJ g}^{-1}$ (1)

Energy for octane $= \frac{5512}{11\ 4} = 48.4 \text{ kJ g}^{-1}$ (1) [2]

(iv) Ethanol is a renewable fuel (if obtained by fermentation) / ethanol is cheaper in countries with plentiful sugar cane growth / ethanol is more carbon neutral / ethanol burns more cleanly [1]

Total [11]

9. *(a)* Volumetric / graduated / standard flask [1]

(b) 23.10 23.95 23.20 23.15 [1]

(c) Anomalous result = 23.95 cm^3

Mean = 23.15 cm^3 [1]

(d) (i) Moles HCl $= \frac{0.1 \times 23.15}{1000} = 2.315 \times 10^{-3}$ [1]

(ii) Moles $Na_2CO_3 = 1.158 \times 10^{-3}$ [1]

(iii) Moles in original solution = 1.158×10^{-2} [1]

(iv) Mass Na_2CO_3 = 1.227 g [1]

(v) % Na_2CO_3 = 59.9 % [1]

(Consequential marking applies)

(e) e.g. funnel left in burette (1) / air in pipette (1) /

not reading meniscus (1) / solution in flask not mixed thoroughly (1) /all of solid not used to make solution (1)

(Maximum 2 marks for sources of error)

If end-point overshot, too much acid would have been added (1),

so moles (mass) carbonate calculated would have been more than actual moles (mass) present (1)

[4]

(QWC) *Legibility of text; accuracy of spelling, punctuation and grammar, clarity of meaning* *(1)*
Selection of a form and style of writing appropriate to purpose and to complexity of subject matter *(1)* [2]

Total [14]

Section B Total [70]