GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Chemistry
(Subject Code CHM2)

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CHM2 Foundation Phyiscal and Inorganic Chemistry

Section A

Question 1

(a) ΔH = Σ(bonds broken) – Σ(bonds formed) (or cycle) 1

= +146 – 496/2 *(or 2 × 463 + 146 –(2 × 463 + 496/2)* 1

= – 102 (kJ mol^{-1}) (1) 1
(accept no units, wrong units loses a mark; +102 scores (1) only)

(b) $C(s) + 2H_2(g) \rightarrow CH_4(g)$ equation (1) Correct state symbols (1) 2

(c) (i) Macromolecular 1
(accept giant molecule or carbon has many (4) bonds)

(ii) ΔH = $\Sigma\Delta H_f$(products) – $\Sigma\Delta H_f$(reactants) (or cycle) 1

= 715 + 4 × 218 – (–74.9) 1

=1662 (kJ mol^{-1}) 1
(accept no units, wrong units loses one mark, allow 1660 to 1663, –1662 scores one mark only)

(iii) 1662/4 = 415.5 1
(mark is for divide by four, allow if answer to (c)(ii) is wrong)

Total 10

Question 2

(a)	Graph starts at origin	1
	Graph skewed to left and has decreasing gradient to maximum	1
	Graph after maximum decreases in steepness, never touches *x* axis, levels out less than 5 mm from *x* axis.	1
(b)	Minimum energy	1
	To start a reaction *(or for a reaction to occur)*	1
(c)	Molecules gain energy *(or always some molecules have $E > E_a$)*	1
	Due to collisions	1
(d)	Decreases E_a lowered (1) By alternative route (1) So more molecules have energy > E_a (1)	1 max 2
		Total 10

Question 3

(a)	Same		1
(b)	(i)	Decreases	1
		More moles on left hand side	1
		Equilibrium moves to increase the pressure *(Or to oppose the change or to compensate for low pressure)*	1
	(ii)	Cost of producing high pressure (1) Cost of plant to resist high pressure (1) Correct safety factor with reason (1)	max 2
(c)	No change		1
	Catalyst has no effect on equilibrium position *(Or catalyst affects rate of forward and backwards reactions equally)*		1

(d) Negative 1

Reaction *(or equilibrium)* moves in the exothermic direction *(or to the right)* 1

In order to oppose the change *(or to raise the temperature)* 1

(e) Recycled *(or re-used or 'put back in')* 1

Total 12

Question 4

(a) Gains electrons *(or removes electrons)* 1

(b) (i) +4 1
+6 1

(ii) $Br_2 + 2e^- \rightarrow 2Br^-$ 1

(iii) $SO_2 + 2H_2O \rightarrow 4H^+ + SO_4^{2-} + 2e^-$ 1

(iv) $Br_2 + SO_2 + 2H_2O \rightarrow 2Br^- + 4H^+ + SO_4^{2-}$ 1

(c) $Cl_2 + H_2O \rightarrow H^+ + Cl^- + HOCl$ 1
Chloride: –1 1
Chlorate(I): +1 1

(d) Chloride ions cannot reduce sulphuric acid 1
(Or chloride ions are weak reducing agents
Or sulphuric acid is not a strong enough oxidising agent
Or sulphuric acid is a weaker oxidising agent than chlorine)

(e) $KCl + H_2SO_4 \rightarrow HCl + KHSO_4$ 1
(Allow $2KCl + H_2SO_4 \rightarrow 2HCl + K_2SO_4$*)*

(f) (i) Bromine 1

(ii) Sulphur dioxide 1

Total 13

SECTION B

Question 5

(a)	Limestone (or $CaCO_3$)	1
	Removes SiO_2	1
	$CaCO_3 \rightarrow CaO + CO_2$	1
	$CaO + SiO_2 \rightarrow CaSiO_3$	1
	Removed as slag	1
	Carbon	1
	Removed with oxygen	1
	$2C + O_2 \rightarrow 2CO$ (or $C + O_2 \rightarrow CO_2$)	1
(b)	Dissolve in molten cryolite	1
	Electrolyse	1
	Carbon electrodes	1
	$Al^{3+} + 3e^- \rightarrow Al$	1
	$2O^{2-} \rightarrow O_2 + 4e^-$	1
	Consumes less energy which is expensive	1
	Separation of pure aluminium from scrap (or collection) costs	1

Total 15