Version 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Chemistry 5421

CHM2 Foundation Physical and Inorganic Chemistry

Mark Scheme

2005 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Question 1

(a) enthalpy (or energy) to break (or dissociate) a bond; 1
averaged over different molecules (environments); 1

enthalpy (or heat energy) change when one mole of a compound; 1
is formed from its elements; 1
in their standard states; 1

(b) enthalpy change = Σ(bonds broken) -Σ(bonds formed) or cycle; 1
= 4×388 +163 + 2×146 +4×463 –(944 + 8×463); 1
(or similar)
= -789 ; 1
(+789 scores 1 only)

(c) (i) zero; 1
1

(ii) ΔH = Σ (enthalpies of formation of products) -Σ(enthalpies of formation of reactants)
= 4×-242 – (75 + 2×-133); 1
= -777; 1
(+777 scores one only)

(d) mean bond enthalpies are not exact 1
(or indication that actual values are different from real values)

Total 13

Question 2

(a) mark labelled **X** on curve **A** where curve **C** joins **A;** 1

(b) equilibrium opposes a change; 1

(c) 1
B
more ammonia is produced (or yield increases); 1
fewer moles (of gas) on right (or 4 mol goes to 2 mol); 1
equilibrium moves to oppose increase in pressure (or oppose change); 1

(d) 1
C
amount of ammonia (or yield or equilibrium) unchanged; 1
reaction is faster; 1

Total 9

Question 3

(a) decreases; 1
increase in shielding ; 1
(or atomic radius)
less attraction for bonding *(or shared)* electrons; 1

(b) brown solution; 1
(or black solid)
$Cl_2 + 2KI \rightarrow 2KCl + I_2$; 1
(or ionic equation)

(c) SO_2; 1
$SO_4^{2-} + 4H^+ + 2e^- \rightarrow SO_2 + 2H_2O$; 1
S (also H_2S); 1
$SO_4^{2-} + 8H^+ + 6e^- \rightarrow S + 4H_2O$ (or $SO_4^{2-} + 10H^+ + 6e^- \rightarrow H_2S + 4H_2O$; 1

(d) $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$; 1
sodium chloride; 1
-1; 1
sodium chlorate(I) (or bleach etc); 1
+1; 1

Total 14

Question 4

(a) Electron donor; 1

(b) CO (or C); 1
$3CO + Fe_2O_3 \rightarrow 3CO_2 + 2Fe$ (or correct equations with carbon); 1

(c) Na (or Mg); 1
Argon; 1
Na (or Mg or $TiCl_4$) reacts with air (or oxygen or water) (or impurities of O or N in Ti); 1

(d) (i) cryolite; 1
Molten (or liquid or solution); 1
1

(ii) $Al^{3+} + 3e^- \rightarrow Al$;

Total 9

Question 5

(a) the <u>minimum energy;</u> 1
<u>Energy</u> required for a reaction to occur; 1
(or to start a reaction or for successful collisions)

(b) axes labelled:- y: number *(or fraction or %)* of molecules (*or particles)* x: energy *(or KE);* 1
curve starts at origin; 1
skewed to right; 1
approaches x axis as an asymptote; 1
(penalise a curve that levels off >10% of max peak height or a curve that crosses the energy axis)
second curve displaced to the left *(and does not cross T_1 curve for a second time)* 1
and peak higher; 1

<u>many</u> fewer molecules; 1
fewer molecules have $E > E_a$; 1
(can score this mark from suitably marked curves)

(b) molecules *(or particles or collisions)* do not have enough energy; 1
(or orientation may be wrong)

increase the pressure; 1
(or increase the concentration or reduce the volume)
increases the collision frequency; 1
(or more collisions)
(do not allow if stated to be due to increase in energy implied by temperature increase)

add a catalyst; 1
lowers <u>activation energy</u> (or E_a) (QoL mark); 1

Total 15