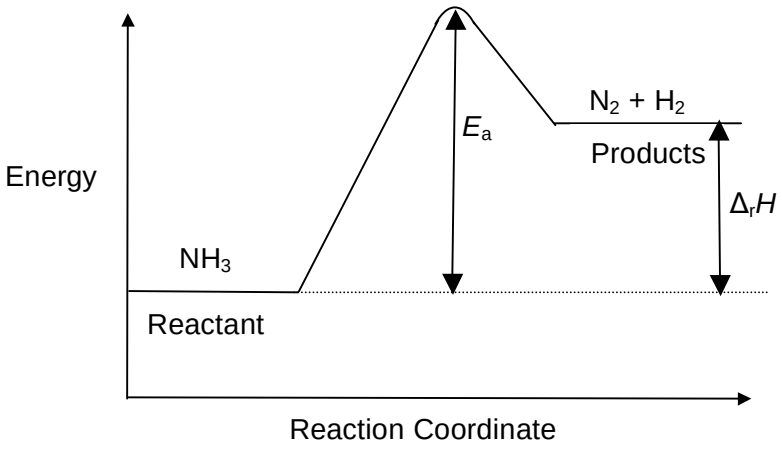
Assessment Schedule – 2007

Chemistry: Describe thermochemical and equilibrium principles (90310)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
One (a)	CO_3^{2-} (+ H_3O^+) H_2CO_3 (+ OH^-)	ONE correct.	BOTH correct.	
(b)	**Reaction B** circled. Formation of OH^- causes solution to be basic, and only reaction B produces this.	**B** correctly identified with reason.		
Two (a)	pH = 0.903	pH correct.		
(b)	$[OH^-] = 1.58 \times 10^{-4}$ mol L^{-1}	ONE correct.	BOTH correct.	
(c)	pH = 13.1			
Three (a)	Solution has been diluted so fewer acid particles in same volume; collision rate decreases so number of effective / successful collisions decreases. Hence, rate decreases.	Lower concentration / dilution of acid **OR** decrease in collision rate of particles.	Fewer particles per unit volume in solution **AND** decrease in collision rate of particles.	
(b)	Carry out two experiments, one with Cu and the other without. Both experiments use same mass of zinc and same conc. and volume of acid. Time how long **each** reaction takes, eg bubbles formed in time period, volume of gas in time period, length of time for reaction to complete. Use a weighed mass of Cu and reweigh at the end to determine whether it has been used in the reaction. An increased reaction rate with Cu not used up will mean it is a catalyst for the reaction.	Recognises need to have a practical which compares two reactions with respect to time in some way.	Recognises amounts of reactants need to be the same, and clearly states what will be measured with respect to time.	**PLUS** Initial and final mass of Cu included. Recognises catalyst will increase reaction rate and not be used up in reaction.

Four (a)(i) (ii) (iii) (iv)	Exothermic Endothermic Endothermic Exothermic	All FOUR correct.		
(b)(i)	$50.0\ g \times 2.70^{o}C \times 4.18\ J\ g^{-1}\ {}^{o}C^{-1} = 564.3\ J$ $n(NH_4NO_3) = 1.80\ g \div 80\ g\ mol^{-1} = 2.25 \times 10^{-2}\ mol$ Energy absorbed when 1 mol dissolves $= 564.3\ J \div 2.25 \times 10^{-2}\ mol = 25\ 080\ J$ $\Delta_r H = +\ 25.1\ kJ\ mol^{-1}$	ONE step correct.	TWO steps correct.	Energy value, and units correct.
(ii)	$\frac{1.25\ kJ}{25.1\ kJ\ mol^{-1}} = 0.0498\ mol$ $0.0498\ mol \times 80.0\ g\ mol^{-1} = 3.98\ g$ (or 3.99 g) (or other correct method)	One step correct.	Mass correct.	
Five (a)(i) (ii)	Colour of solution goes orange / becomes a lighter orange / lighter red / colourless Decreased temperature causes an equilibrium shift to favour reaction that releases energy / heat, ie shift in the exothermic direction. As forward reaction is endothermic having a positive $\Delta_r H$, the reverse reaction is exothermic. Equilibrium shifts in exothermic / reverse direction and the concentration of $FeSCN^{2+}$ will be decreased, so colour of solution is lighter.	Observation / equilibrium shift correct.	Observation / equilibrium shift correct and partial explanation.	Observation correct **and** fully explained.
(b)(i) (ii)	Colour of solution goes orange / becomes a lighter orange /lighter red / colourless As the concentration of Fe^{3+} ions is decreased (because of reaction with fluoride ions) equilibrium will move to increase the concentration of Fe^{3+} ions (a reactant). So reverse reaction is favoured, the concentration of $FeSCN^{2+}$ will be decreased so that colour of solution is lighter.	BOTH observations / equilibrium shifts correct. **OR** One observation / equilibrium shift with correct explanation.	BOTH observations / equilibrium shifts correct. **AND** effect of concentration change partly explained for **either** decrease **or** increase in Fe^{3+} concentration.	BOTH observations correct **AND** BOTH fully explained.
(c)(i) (ii)	Colour of solution goes dark red / becomes a darker red. As the concentration of Fe^{3+} ions is increased (due to $FeCl_3$ dissolving), equilibrium will move to decrease the concentration of Fe^{3+} ions (a reactant). So forward reaction is favoured, the concentration of $FeSCN^{2+}$ will be increased so that colour of solution is darker.			

<table>
<tr><td>Six
(a)</td><td>$K_c = \dfrac{[N_2][H_2]^3}{[NH_3]^2}$</td><td>$K_c$ correct</td><td></td><td></td></tr>
<tr><td>(b)</td><td>$\Delta_r H$ = +92 kJ mol^{-1}
E_a = (143 + 92) = 235 kJ mol^{-1}</td><td rowspan="2">Both values correct
OR
One value correct with graph drawn as endothermic reaction.
OR
Graph drawn with correct $\Delta_r H$.</td><td rowspan="2">ONE value correct
AND
graph drawn with correct $\Delta_r H$.</td><td rowspan="2">BOTH values correct
AND
graph drawn with all labels correct.</td></tr>
<tr><td>(c)</td><td> 
</td></tr>
<tr><td>Seven
(a)</td><td>0.1 mol L^{-1} HCl pH = 1 methyl orange is pink.
0.01 mol L^{-1} HCl pH = 2 methyl orange is pink.
distilled water pH = 7 methyl orange is yellow.
0.1 mol L^{-1} NaOH pH = 13 methyl orange is yellow.</td><td rowspan="2">Recognises methyl orange:
– yellow in water and NaOH
– pink in both HCl solutions.
3 of 4 colours correct</td><td rowspan="2">Distinguishes between the two HCl solutions
OR
between the water / NaOH.</td><td rowspan="2">Each solution identified correctly.</td></tr>
<tr><td>(b)</td><td>Both HCl solutions – add indicator and slowly add the same volume of water to each solution. The solution that turns the indicator from pink to yellow first is the more dilute acid, ie 0.01 mol L^{-1} HCl.
Water / NaOH solution – take 1 mL samples of the 0.1 mol L^{-1} HCl solution and add indicator. Add the same volume of water and NaOH, eg 100 mL. The indicator will remain pink for the water sample, and the NaOH will cause the indicator to turn from pink to yellow.</td></tr>
</table>

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
EIGHT opportunities answered at Achievement level (or higher). Minimum of $8 \times A$	EIGHT opportunities answered including at least FIVE at Merit level (or higher) and THREE at Achievement level (or higher). Minimum $5 \times M + 3 \times A$	EIGHT opportunities answered including at least THREE at Excellence level plus THREE at Merit level (or higher) and TWO at Achievement level (or higher). Minimum $3 \times E + 3 \times M + 2 \times A$