Assessment Schedule – 2006

Chemistry: Describe properties of aqueous systems (90700)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	(i) C (ii) A (iii) D	Two out of three correct		
	Reasons: (i) Strong acid – no acid molecules, HA, are present so acid must have completely dissociated in solution. Dilute – only a small number of solute particles compared to number present in B. (ii) Weak acid – particles in solution are mostly acid molecules with only a few conjugate base and hydronium ions present implying only partial dissociation. Concentrated – a large number of solute particles present in the given volume of water. (iii) Both the acid HA particles and its conjugate base A^- particle are present in similar quantities.	Evidence of understanding of relationship between definitions and particles present in solution. Must mention at least two of: • weak acid • strong acid • concentrated • dilute • define buffer correctly.	Explanations for two are correct but lack some details.	All three explanations correct, including the key points in bold.
1(b)	pH not affected by dilution because $\frac{[\text{acid}]}{[\text{base}]}$ ratio remains the same on dilution. Buffering capacity reduced as not so many acid or base particles are available to react with added acid or base if same volume is taken.	Both factors correct **OR** One correct explanation.	Both explanations correct.	
2(a)(i)	$CaSO_4(s) \rightleftharpoons Ca^{2+}(aq) + SO_4^{2-}(aq)$ Reverse eqn also acceptable. *Subscripts not required but penalise $CaSO_4(aq)$.*	Correct answer.		
(ii)	$K_s\ (CaSO_4) = [Ca^{2+}][SO_4^{2-}] = 2.45 \times 10^{-5}$ $S = \sqrt{(2.45 \times 10^{-5})} = 4.95 \times 10^{-3}$ mol L^{-1}	Correct answer.		
2(b)	The added Cl^- reduces the solubility of the NaCl. For the saturated solution: $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$. The addition of Cl^- causes the equilibrium to favour the reactants and hence a precipitate will begin to form.	Recognition of common ion.	Answer discusses shift in equilibrium.	
2(c)	$[Mg^{2+}][OH^-]^2 > 7.10 \times 10^{-12}$ $0.555 \times [OH^-]^2 > 7.10 \times 10^{-12}$ $[OH^-] > 3.58 \times 10^{-6}$ Minimum pH = 8.55	Correct K_s expression substituted correctly.	Correct method, but may be one error in calculation.	Answer correct.

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
3(a)	$pK_a(NH_4^+) = 9.2$ – *9.3* $K_a(NH_4^+) = 10^{-9.2} = 6.3 \times 10^{-10}$ **OR** 5.01×10^{-10}	pK_a correct **OR** K_a correctly converted from pK_a.	K_a correct.	
3(b)	At equivalence point all the NH_3 has been converted to NH_4^+ which reacts with water to produce H_3O^+ ions and hence acidic solution. $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$	Either, correctly balanced equation or, recognises NH_4^+ responsible for acidity.	Correctly links acidity to NH_4^+ and equation for reaction.	
3(c)	pH of 9.6 occurs after 3 mL – *4mL* 0.200 mol L^{-1} HCl has been added. To 40.00 mL of 0.0500 mol L^{-1} NH_3 add 3.00 mL – *4.00 mL* 0.2 mol L^{-1} HCl solution.	Correct answer.		
3(d)	$NH_4^+ + OH^- \rightarrow NH_3 + H_2O$ Accept molecular equations. $NH_4Cl + NaOH \rightarrow NH_3 + H_2O + NaCl$	Correct answer.		
3(e)	(i) At equivalence point $n(NH_3) = 0.0400 \times 0.0500$ $V = 50$ mL $= 0.050$ L $c(NH_3) = 0.04$ mol L^{-1} At equivalence point all NH_4^+ converted to NH_3 $c(NH_4^+)$ at start $= 0.0500$ mol L^{-1} $c(NH_3)$ at finish $= 0.0500 \times 40/50$ $= 0.0400$ mol L^{-1} (ii) $[H_3O^+]^2 = \frac{1 \times 10^{-14} \times 6.3 \times 10^{-10}}{0.04}$ $[H_3O^+] = 1.26 \times 10^{-11}$ pH = 10.9	Correct method used for either calculation.	Correct method used for both calculations.	Both answers correctly calculated.

Judgement Statement

Chemistry: Describe properties of aqueous systems (90700)

Achievement	Achievement with Merit	Achievement with Excellence
SIX questions answered correctly. Minimum of $6 \times$ A	SEVEN questions answered correctly, including at least THREE at Merit level. Minimum of $3 \times$ M + $4 \times$ A	NINE questions answered correctly, including at least THREE at Merit level and at least TWO at Excellence level. $2 \times$ E + $3 \times$ M + $4 \times$ A