A/B I Written Response Key:

1.

4. (3 marks)

Complete the following equilibrium, then predict whether the reactants or products will be favoured and explain why.

$$HSO_4^- + HSO_3^- \rightleftarrows \_\_\_\_\_$$

Solution:

For Example:

$HSO_4^- + HSO_3^- \rightleftarrows H_2SO_3 + SO_4^{2-}$ ← 1 mark

The equilibrium favours the reactants ← 1 mark

since the $K_a\ H_2SO_3 > K_a\ HSO_4^-$ ← 1 mark

2.

6. (3 marks)

The following three solutions are mixed together in a fourth container:

40.0 mL of 1.0 M HCl | 60.0 mL of 1.0 M HBr | 100.0 mL of 0.50 M NaOH

What pH results?

Solution: Mole Method

For Example:

$HCl: 1.0\,M \times 0.040\,L$
$= 0.040\,mol$
$HBr: 1.0\,M \times 0.060\,L$
$= 0.060\,mol$
$Total\ H^+ = 0.100\,mol$

$NaOH = 0.50\,M \times 0.100\,L$
$= 0.050\,mol$

← 1½ marks

$Excess\ H^+ = 0.100\,mol - 0.050\,mol$
$= 0.050\,mol$ ← ½ mark

$[H^+] = \frac{0.050\,mol}{0.200\,L} = 0.25\,M$ ← ½ mark

$pH = 0.60$ ← ½ mark

3.

6. What mass of NaOH(s) is required to just neutralize 50.0 mL of 2.0 M H_2SO_4? Begin by writing the balanced equation for the neutralization reaction. **(3 marks)**

Solution:

For Example:

$$H_2SO_4(aq) + 2NaOH(s) \rightarrow Na_2SO_4(aq) + 2H_2O(\ell)$$ ← **1 mark**

$$\text{Mass of NaOH} = \frac{2.0\,\text{mol}}{\text{L}}\,H_2SO_4 \times 0.0500\,\text{L} \times \frac{2\,\text{mol NaOH}}{1\,\text{mol}\,H_2SO_4} \times \frac{40.0\,\text{g}}{\text{mol NaOH}}$$ ← **2 marks**

$$= 8.0\,\text{g}$$

4.

5. Water, at 60°C, has a $K_w = 9.55 \times 10^{-14}$.

a) Write an equation representing the ionization of water. Include the heat of reaction (57.1kJ) in the equation. **(2 marks)**

Solution:

For Example:

$$2H_2O_{(\ell)} + 57.1\,\text{kJ} \rightleftarrows H_3O^+_{(aq)} + OH^-_{(aq)}$$ ← **2 marks**

Note: Endothermic can be deduced from the data provided.
1 mark for the equation.
1 mark for determining endothermic.

OR

$$H_2O_{(\ell)} + 57.1\,\text{kJ} \rightleftarrows H^+_{(aq)} + OH^-_{(aq)}$$

b) If a small amount of NaOH is added to water, what happens to the value of K_w ? **(1 mark)**

Solution:

For Example:

K_w remains unchanged. ← **1 mark**