17.6a) ii b) iii c) i d) iv

17.41a) $NaOH + HNO_3 \Rightarrow NaNO_3 + H_2O$

40.0mL	1 L HNO_3	0.0900 mol HNO_3	1 mol NaOH	1 L NaOH
	1000 mL	1 L HNO_3	1 mol HNO_3	0.0850 mol NaOH

0.0424 L or 42.4 mL NaOH

17.41c) $NaOH + HCl \Rightarrow NaCl + H_2O$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{1.85\text{g}/36.5\text{gmol}^{-1}}{1\text{ liter}} = 0.0507\ M\ \text{HCl}$$

50.0mL	1 L HCl	0.0507 mol HCl	1 mol NaOH	1 L NaOH
	1000 mL	1 L HCl	1 mol HCl	0.0850 mol NaOH

0.0298 L or 29.8 mL NaOH

17.42a) $NaOH + HCl \Rightarrow NaCl + H_2O$

45.0mL	1 L NaOH	0.0950 mol NaOH	1 mol HCl	1 L HCl
	1000 mL	1 L NaOH	1 mol NaOH	0.105 mol HCl

0.0407 L or 40.7 mL HCl

17.42c) $NaOH + HCl \Rightarrow NaCl + H_2O$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{1.35\text{g}/40.0\text{gmol}^{-1}}{1\text{ liter}} = 0.0338\ M\ \text{NaOH}$$

125.0mL	1 L NaOH	0.0338 mol NaOH	1 mol HCl	1 L HCl
	1000 mL	1 L NaOH	1 mol NaOH	0.105 mol HCl

0.0402 L or 40.2 mL HCl

17.43a) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L HBr}}{1000\text{ mL}} \right| \frac{0.200\text{ mol HBr}}{1\text{ L HBr}} = 0.00400\text{ mol HBr}$

$\frac{15.0\text{mL}}{} \left| \frac{1\text{ L NaOH}}{1000\text{ mL}} \right| \frac{0.200\text{ mol NaOH}}{1\text{ L NaOH}} = \frac{0.00300\text{ mol NaOH}}{} = 0.00100\text{ mol HBr}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00100\text{ mol HBr}}{0.0350\text{ L}} = 0.02857\ M\ \text{HCl}$$

$$\text{pH} = -\log[H_3O^+] = -\log[0.02857M] = 1.54$$

17.43b) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L HBr}}{1000\text{ mL}} \right| \frac{0.200\text{ mol HBr}}{1\text{ L HBr}} = 0.00400\text{ mol HBr}$

$\frac{19.9\text{mL}}{} \left| \frac{1\text{ L NaOH}}{1000\text{ mL}} \right| \frac{0.200\text{ mol NaOH}}{1\text{ L NaOH}} = \frac{0.00398\text{ mol NaOH}}{} = 0.00002\text{ mol HBr}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00002\text{ mol HBr}}{0.0399\text{ L}} = 0.000501\ M\ \text{HCl}$$

$$\text{pH} = -\log[H_3O^+] = -\log[0.000501\ M] = 3.30$$

17.43c) Given that the concentrations of the acid and base are equal, when equal volumes of each are mixed equivalence will be reached, leaving a solution of a neutral salt and water. This solution's pH is 7.

17.43d) $$\frac{20.0\text{mL}}{} \left| \frac{1\text{ L HBr}}{1000\text{ mL}} \right| \frac{0.200\text{ mol HBr}}{1\text{ L HBr}} = 0.00400\text{ mol HBr}$$

$$\frac{20.1\text{mL}}{} \left| \frac{1\text{ L NaOH}}{1000\text{ mL}} \right| \frac{0.200\text{ mol NaOH}}{1\text{ L NaOH}} = 0.00402\text{ mol NaOH}$$

$$= 0.00002\text{ mol NaOH}$$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00002\text{ mol NaOH}}{0.0401\text{ L}} = 0.000499\ M\ \text{NaOH}$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log[0.000499M] = 3.30$$

$$\text{pH} = 14 - \text{pOH} = 14 - 3.30 = 10.7$$

17.43e) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L HBr}}{1000\text{ mL}} \right| \frac{0.200\text{ mol HBr}}{1\text{ L HBr}} = 0.00400\text{ mol HBr}$

$\frac{35.0\text{mL}}{} \left| \frac{1\text{ L NaOH}}{1000\text{ mL}} \right| \frac{0.200\text{ mol NaOH}}{1\text{ L NaOH}} = 0.00700\text{ mol NaOH}$

$- 0.00400\text{ mol HBr}$

$= 0.00300\text{ mol NaOH}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00300\text{ mol NaOH}}{0.0550\text{ L}} = 0.0545\ M\ \text{NaOH}$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log[0.0545\ M] = 1.26$$

$$\text{pH} = 14 - \text{pOH} = 14 - 1.26 = 12.74$$

17.44a) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L KOH}}{1000\text{ mL}} \right| \frac{0.150\text{ mol KOH}}{1\text{ L HBr}} = 0.00300\text{ mol KOH}$

$\frac{20.0\text{mL}}{} \left| \frac{1\text{ L HClO}_4}{1000\text{ mL}} \right| \frac{0.125\text{ mol HClO}_4}{1\text{ L HClO}_4} = \frac{0.00250\text{ mol HClO}_4}{} = 0.00050\text{ mol KOH}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00050\text{ mol KOH}}{0.0400\text{ L}} = 0.0125\ M\text{ KOH}$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log[0.0125\ M] = 1.90$$

$$\text{pH} = 14 - \text{pOH} = 14 - 1.90 = 12.10$$

17.44b) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L KOH}}{1000\text{ mL}} \right| \frac{0.150\text{ mol KOH}}{1\text{ L HBr}} = 0.00300\text{ mol KOH}$

$\frac{23.0\text{mL}}{} \left| \frac{1\text{ L HClO}_4}{1000\text{ mL}} \right| \frac{0.125\text{ mol HClO}_4}{1\text{ L HClO}_4} = \frac{0.00288\text{ mol HClO}_4}{} = 0.00012\text{ mol KOH}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00012\text{ mol KOH}}{0.0430\text{ L}} = 0.00279\ M\ \text{KOH}$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log[0.00279\ M] = 2.55$$

$$\text{pH} = 14 - \text{pOH} = 14 - 2.58 = 11.46$$

17.44c) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L KOH}}{1000\text{ mL}} \right| \frac{0.150\text{ mol KOH}}{1\text{ L HBr}} = 0.00300\text{ mol KOH}$

$\frac{24.0\text{mL}}{} \left| \frac{1\text{ L HClO}_4}{1000\text{ mL}} \right| \frac{0.125\text{ mol HClO}_4}{1\text{ L HClO}_4} = 0.00300\text{ mol HClO}_4$

When these volumes are mixed, equivalence will be reached, leaving a solution of a neutral salt and water. This solution's pH is 7.

17.44d) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L KOH}}{1000\text{ mL}} \right| \frac{0.150\text{ mol KOH}}{1\text{ L HBr}} = 0.00300\text{ mol KOH}$

$\frac{25.0\text{mL}}{} \left| \frac{1\text{ L HClO}_4}{1000\text{ mL}} \right| \frac{0.125\text{ mol HClO}_4}{1\text{ L HClO}_4} = \frac{0.00313\text{ mol HClO}_4}{} = 0.00013\text{ mol HClO}_4$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00013\text{ mol HClO}_4}{0.045\text{ L}} = 0.00289\ M\ \text{HClO}_4$$

$$\text{pH} = -\log[H_3O^+] = -\log[0.00289\ M] = 2.54$$

17.44e) $\frac{20.0\text{mL}}{} \left| \frac{1\text{ L KOH}}{1000\text{ mL}} \right| \frac{0.150\text{ mol KOH}}{1\text{ L HBr}} = 0.00300\text{ mol KOH}$

$\frac{30.0\text{mL}}{} \left| \frac{1\text{ L HClO}_4}{1000\text{ mL}} \right| \frac{0.125\text{ mol HClO}_4}{1\text{ L HClO}_4} = \frac{0.00375\text{ mol HClO}_4}{} = 0.00075\text{ mol HClO}_4$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.00075\text{ mol HClO}_4}{0.0500\text{ L}} = 0.0150\ M\ \text{HClO}_4$$

$$\text{pH} = -\log[H_3O^+] = -\log[0.0150\ M] = 1.82$$