17. Moles of NaOH = 50.0 L H_2 x $\frac{1 \text{ mol } H_2}{22.4 \text{ L } H_2}$ x $\frac{2 \text{ mol NaOH}}{3 \text{ mol } H_2}$ = 1.344 mol

volume of NaOH = $\frac{n}{c} = \frac{1.344 \text{ mol}}{3.00 \text{ mol / L}}$ = 0.496 L NaOH or 496 mL NaOH

18. The neutralization equation is: $HCl + NaOH \longrightarrow NaCl + H_2O$.

moles of NaOH = $0.318 \frac{mol}{L} \times 0.0250\ L = 7.95 \times 10^{-3}$ mol = moles HCl

volume of HCl = $\frac{n}{c} = \frac{0.00795\ mol}{0.250\ mol/L} =$ **0.0318 L** $\cdot \frac{1\ mL}{2 \cdot 10^{-3}\ L} =$ **31.8 mL HCl** (or)

19. (a) moles of Cl^- = $0.0148 \frac{mol}{L} \times 0.0154\ L = 2.279 \times 10^{-4}$ mol

moles of Hg^{2+} = 2.279×10^{-4} mol $Cl^- \times \frac{1\ mol\ Hg^{2+}}{2\ mol\ Cl^-} = 1.140 \times 10^{-4}$ mol

= moles $HgCl_2$ (for second part of problem)

$[Hg^{2+}] = \frac{n}{V} = \frac{1.140 \times 10^{-4}\ mol}{0.0250\ L} =$ **4.56×10^{-3} M Hg^{2+}**

(b) mass of $HgCl_2$ = 1.140×10^{-4} mol $\times \frac{271.6\ g}{1\ mol} =$ **0.0310 g $HgCl_2$**

20. (a) The neutralization reaction is: $Ca(OH)_2 + 2\ HCl \longrightarrow CaCl_2 + 2\ H_2O$.

moles of HCl = $0.0156 \frac{mol}{L} \times 0.0235\ L = 3.666 \times 10^{-4}$ mol

moles of $Ca(OH)_2$ = 3.666×10^{-4} mol HCl $\times \frac{1\ mol\ Ca(OH)_2}{2\ mol\ HCl} = 1.833 \times 10^{-4}$ mol

$[Ca(OH)_2] = \frac{n}{V} = \frac{1.833 \times 10^{-4}\ mol}{0.0100\ L} =$ **0.0183 M $Ca(OH)_2$**

(b) mass of $Ca(OH)_2$ = $0.01833 \frac{mol}{L} \times 0.2500\ L \times \frac{74.1\ g}{1\ mol} =$ **0.340 g $Ca(OH)_2$**

21. (a) moles of H_2O_2 = $1.24 \frac{mol}{L} \times 0.00200\ L = 2.48 \times 10^{-3}$ mol

moles of MnO_4^- = 2.48×10^{-3} $H_2O_2 \times \frac{2\ mol\ MnO_4^-}{5\ mol\ H_2O_2} = 9.92 \times 10^{-4}$ mol

volume of MnO_4^- = $\frac{n}{c} = \frac{9.92 \times 10^{-4}\ mol}{0.0496\ mol/L} =$ **0.0200 L MnO_4^-** $\cdot \frac{1\ mL}{1 \cdot 10^{-3}\ L} =$ **20.0 mL MnO_4^-** (or)

(b) volume of O_2 = 9.92×10^{-4} mol $MnO_4^- \times \frac{5\ mol\ O_2}{2\ mol\ MnO_4^-} \times \frac{22.4\ L\ O_2}{1\ mol\ O_2} \cdot \frac{1\ mL}{1 \cdot 10^{-3}\ L} =$ **55.6 mL O_2**

22. (a) moles of NaOH = $0.853 \frac{mol}{L} \times 0.0438\ L = 0.03736$ mol

moles of H_3PO_4 = 0.03736 mol NaOH $\times \frac{1\ mol\ H_3PO_4}{2\ mol\ NaOH} = 0.01868$ mol

$[H_3PO_4] = \frac{n}{V} = \frac{0.01868\ mol}{0.00100\ L} =$ **18.7 M H_3PO_4**

(b) density = $18.68 \frac{mol}{L} \times \frac{98.0\ g}{1\ mol} =$ **$1.83 \times 10^3 \frac{g}{L}$ H_3PO_4**

23. (a) moles of $Cr_2O_7^{2-} = 0.125 \frac{mol}{L} \times 0.0176\ L = 2.20 \times 10^{-3}$ mol

moles of $Fe^{2+} = 2.20 \times 10^{-3}$ mol $Cr_2O_7^{2-} \times \frac{6\ mol\ Fe^{2+}}{1\ mol\ Cr_2O_7^{2-}} = 0.0132$ mol

$[Fe^{2+}] = \frac{n}{V} = \frac{0.0132\ mol}{0.0250\ L} =$ **0.528 M Fe^{2+}**

(b) mass of Fe = mass of $Fe^{2+} = 0.01320$ mol $\times \frac{55.8\ g}{1\ mol} =$ **0.737 g**

24. (a) $[NH_4NO_3] = \frac{15.5\ g}{0.5000\ L} \times \frac{1\ mol}{80.0\ g} = 0.3875$ M

moles of $NH_4NO_3 = 0.3875 \frac{mol}{L} \times 0.0100\ L = 3.875 \times 10^{-3}$ mol = moles NaOH

$[NaOH] = \frac{n}{V} = \frac{3.875 \times 10^{-3}\ mol}{0.0250\ L} =$ **0.155 M NaOH**

(b) volume of $NH_3 = 3.875 \times 10^{-3}$ mol NaOH $\times \frac{1\ mol\ NH_3}{1\ mol\ NaOH} \times \frac{24.8\ L\ NH_3}{1\ mol\ NH_3} =$ **0.0961 L**