

Chapter 4

- 10) Measure the electrical conductivity of a solution and compare it to the conductivity of a solution of equal concentration of a strong electrolyte.
- 16) 5.2 M
- 20) 75.0 ml of 0.150 M Na₃PO₄
- 28) Solution A $1.442 \times 10^{-3} M$
 Solution B $5.768 \times 10^{-5} M$
 Solution C $1.154 \times 10^{-6} M$
- 30)
- No precipitate
 - Al(OH)₃(s)
 - CaSO₄(s)
 - NiS(s)
- 32)
- No reaction
 - $$2\text{Al}(\text{NO}_3)_3(\text{aq}) + 3\text{Ba}(\text{OH})_2(\text{aq}) \rightarrow 2\text{Al}(\text{OH})_3(\text{s}) + 3\text{Ba}(\text{NO}_3)_2(\text{aq})$$

$$2\text{Al}^{3+}(\text{aq}) + 6\text{NO}_3^{-}(\text{aq}) + 3\text{Ba}^{2+}(\text{aq}) + 6\text{OH}^{-}(\text{aq})$$

$$\rightarrow 2\text{Al}(\text{OH})_3(\text{s}) + 3\text{Ba}^{2+}(\text{aq}) + 6\text{NO}_3^{-}(\text{aq})$$

$$\text{Al}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Al}(\text{OH})_3(\text{s})$$
 - $$\text{CaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$$

$$\text{Ca}^{2+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) + 2\text{Na}^{+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$$

$$\rightarrow \text{CaSO}_4(\text{s}) + 2\text{Na}^{+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq})$$

$$\text{Ca}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{CaSO}_4(\text{s})$$
 - $$\text{K}_2\text{S}(\text{aq}) + \text{Ni}(\text{NO}_3)_2(\text{aq}) \rightarrow 2\text{KNO}_3(\text{aq}) + \text{NiS}(\text{s})$$

$$2\text{K}^{+}(\text{aq}) + \text{S}^{2-}(\text{aq}) + \text{Ni}^{2+}(\text{aq}) + 2\text{NO}_3^{-}(\text{aq})$$

$$\rightarrow 2\text{K}^{+}(\text{aq}) + 2\text{NO}_3^{-}(\text{aq}) + \text{NiS}(\text{s})$$

$$\text{Ni}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{NiS}(\text{s})$$
- 34) There are many possible reactions the following are examples:
- $\text{Fe}(\text{NO}_3)_3(\text{aq}) + 3\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + 3\text{NaNO}_3(\text{aq})$
 - $\text{Hg}_2(\text{NO}_3)_2(\text{aq}) + 3\text{NaCl}(\text{aq}) \rightarrow \text{Hg}_2\text{Cl}_2(\text{s}) + 2\text{NaNO}_3(\text{aq})$
 - $\text{Pb}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{PbSO}_4(\text{s}) + 2\text{NaNO}_3(\text{aq})$
 - $\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{CrO}_4(\text{aq}) \rightarrow \text{BaCrO}_4(\text{s}) + 2\text{NaNO}_3(\text{aq})$
- 36)
- $\text{Cr}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Cr}(\text{OH})_3(\text{s})$
 - $2\text{Ag}^{+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CO}_3(\text{s})$
 - $\text{Hg}_2^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{Hg}_2\text{SO}_4(\text{s})$
 - No reaction
- 46)
- $$3\text{HNO}_3(\text{aq}) + \text{Al}(\text{OH})_3(\text{s}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Al}(\text{NO}_3)_3(\text{aq})$$

$$3\text{H}^{+}(\text{aq}) + 3\text{NO}_3^{-}(\text{aq}) + \text{Al}(\text{OH})_3(\text{s}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Al}^{3+}(\text{aq}) + 3\text{NO}_3^{-}$$

$$3\text{H}^{+}(\text{aq}) + \text{Al}(\text{OH})_3(\text{s}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Al}^{3+}(\text{aq})$$
 - $$\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{KC}_2\text{H}_3\text{O}_2(\text{aq})$$

$$\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{K}^{+}(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{K}^{+}(\text{aq}) + \text{C}_2\text{H}_3\text{O}_2^{-}(\text{aq})$$

$$\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{C}_2\text{H}_3\text{O}_2^{-}(\text{aq})$$

- c) $\text{Ca(OH)}_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{CaCl}_2(\text{aq})$
 $\text{Ca}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{Cl}^-(\text{aq})$
 $\rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Ca}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq})$
 $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- 48)
- a) $\text{Ag(OH)}(\text{s}) + \text{HBr}(\text{aq}) \rightarrow \text{AgBr}(\text{s}) + \text{H}_2\text{O}(\text{l})$
 $\text{Ag(OH)}(\text{s}) + \text{H}^+(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{AgBr}(\text{s}) + \text{H}_2\text{O}(\text{l})$
 $\text{Ag(OH)}(\text{s}) + \text{H}^+(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{AgBr}(\text{s}) + \text{H}_2\text{O}(\text{l})$
- b) $\text{Sr(OH)}_2(\text{aq}) + 2\text{HI}(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{SrI}_2(\text{aq})$
 $\text{Sr}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) + 2\text{H}^+ + 2\text{I}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Sr}^{2+} + 2\text{I}^-(\text{aq})$
 $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- c) $\text{Cr(OH)}_3(\text{s}) + 3\text{HNO}_3(\text{aq}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Cr(NO}_3)_3(\text{aq})$
 $\text{Cr(OH)}_3(\text{s}) + 3\text{H}^+(\text{aq}) + 3\text{NO}_3^-(\text{aq}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Cr}^{3+}(\text{aq}) + 3\text{NO}_3^-(\text{aq})$
 $\text{Cr(OH)}_3(\text{s}) + 3\text{H}^+(\text{aq}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Cr}^{3+}(\text{aq})$
- 52) $2.0 \times 10^{-2} \text{ M OH}^-$
- 56) $1.528 \times 10^{-4} \text{ M NaOH}$
- 58)
- | | | | |
|----|--------------------------|----|-------------------------|
| a) | O (-2); U (+6) | e) | H (+1); O (-2); As (+3) |
| b) | O (-2); As (+3) | f) | Mg (+2); O (-2); P (+5) |
| c) | Na (+1); O (-2); Bi (+5) | g) | Na (+1); O (-2); S (+2) |
| d) | As (0) | h) | Hg (+1); Cl (-1) |
- 62)
- | | Redox? | Oxidizing Agent | Reducing Agent | Substance Oxidized | Substance Reduced |
|----|--------|-----------------|----------------|--------------------|----------------------|
| a) | Yes | Ag^+ | Cu | Cu | Ag^+ |
| b) | No | | | | |
| c) | No | | | | |
| d) | Yes | SiCl_4 | Mg | Mg | SiCl_4 (Si) |
| e) | No | | | | |
- 64)
- a) $3\text{Cu}(\text{s}) + 8\text{H}^+(\text{aq}) + 2\text{NO}_3^-(\text{aq}) \rightarrow 3\text{Cu}^+(\text{aq}) + 2\text{NO}(\text{g}) + 4\text{H}_2\text{O}(\text{l})$
- b) $14\text{H}^+(\text{aq}) + \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 6\text{Cl}^-(\text{aq}) \rightarrow 3\text{Cl}_2(\text{g}) + 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$
- c) $\text{Pb}(\text{s}) + 2\text{H}_2\text{SO}_4(\text{aq}) + \text{PbO}_2(\text{s}) \rightarrow 2\text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$
- d) $14\text{H}^+(\text{aq}) + 2\text{Mn}^{2+}(\text{aq}) + 5\text{NiBiO}_3$
 $\rightarrow 2\text{MnO}_4^-(\text{aq}) + 5\text{Bi}^{3+}(\text{aq}) + 5\text{Na}^+ + 7\text{H}_2\text{O}(\text{l})$
- e) $8\text{H}^+(\text{aq}) + \text{H}_3\text{AsO}_4(\text{aq}) + 4\text{Zn}(\text{s}) \rightarrow 4\text{Zn}^{2+}(\text{aq}) + \text{AsH}_3(\text{g}) + 4\text{H}_2\text{O}(\text{l})$
- 66)
- a) $4\text{H}_2\text{O}(\text{l}) + \text{Cr}(\text{s}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow 2\text{Cr(OH)}_3(\text{s}) + 2\text{OH}^-(\text{aq})$
- b) $8\text{H}_2\text{O}(\text{l}) + 7\text{S}^{2-}(\text{aq}) + 2\text{MnO}_4^- \rightarrow 5\text{S}(\text{s}) + 2\text{MnS}(\text{s}) + 16\text{OH}^-(\text{aq})$
- c) $\text{H}_2\text{O}(\text{l}) + 3\text{CN}^-(\text{aq}) + 2\text{MnO}_4^-(\text{aq})$
 $\rightarrow 3\text{CNO}^-(\text{aq}) + 2\text{MnO}_2(\text{s}) + 2\text{OH}^-(\text{aq})$
- 72)
- a) 14.2 % MgCl_2
- b) 8.95 mL AgNO_3
- 74) atomic mass M = 23 amu, M = Na (sodium)

76)

a) 0.0559 g Fe

b) 0.242 g $\text{Fe}(\text{NO}_3)_3$

c) 53.1 % $\text{Fe}(\text{NO}_3)_3$

88) 77.1 % KCl

22.9 % KBr

94) $\text{C}_{22}\text{H}_{20}\text{O}_{13}$