Ch. 12 #17

$M = 9.168\,M$

$\rho = 1.4987\ g/mL$ @ 20°

mass = 50.0 g of solution

mass of H_2SO_4

$$\frac{\text{moles solute}}{\text{L solution}} = \frac{\text{moles } H_2SO_4}{\text{L solution}}$$

$$50.0\text{ g of solution} \times \frac{1\text{ mL}}{1.4987\text{ g}} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.0334\text{ L solution}$$

$$\frac{0.0334\text{ L solution}}{1} \times \frac{9.168\text{ moles } H_2SO_4}{1\text{ L solution}} \times \frac{98.09\text{ g } H_2SO_4}{1\text{ moles } H_2SO_4} = 30.0\text{ g}$$

#18)

a) $\frac{1.85\text{ moles}}{2.50\text{ L}} = 0.740\text{ M}$

$Na_2B_4O_7 = 201.22\text{ g/mole}$

b) $\frac{6.78\text{ kg}}{45.0\text{ L}} \cdot \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ moles}}{201.22\text{ g}} = \boxed{0.749\text{ M}}$

c) $\frac{600.0\text{ mL}}{1} \times \frac{1\text{ L}}{1000\text{ mL}} \times \frac{1.57\text{ moles}}{1\text{ L}} = \boxed{0.942\text{ moles}}$

d) $\frac{50.8\text{ g}}{1} \times \frac{1\text{ moles}}{201.22\text{ g}} \times \frac{1\text{ L}}{1.87\text{ moles}} \times \frac{1000\text{ mL}}{1\text{ L}} = \boxed{135\text{ mL}}$

#19 a) $\frac{0.100 \text{ Moles sucrose}}{1 \text{ L solution}}$ $C_{12}H_{22}O_{11}$ = **0.102 m** $\frac{\text{moles solute}}{\text{kg solvent}}$

$\rho = 1.0119 \text{ g/mL}$

$$\frac{0.100 \text{ moles sucrose}}{1 \text{ L solution}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1 \text{ mL}}{1.0119 \text{ g}} = \frac{9.88\times10^{-5} \text{ moles sucrose}}{1 \text{ g solution}}$$

$$\frac{9.88\times10^{-5} \text{ moles sucrose}}{1 \text{ g solution}} \times \frac{342.22 \text{ g}}{1 \text{ mole}} = \frac{0.0338 \text{ g sucrose}}{1 \text{ g solution}}$$

$$m = \frac{\text{moles solute}}{\text{kg solvent}} = \frac{9.88\times10^{-5} \text{ moles}}{1 \text{ g} - 0.0338 \text{ g}} = \frac{9.88\times10^{-5} \text{ moles}}{9.662\times10^{-4} \text{ kg } H_2O} =$$

#19b $T_{boiling} = 100.100°C$

$m = ?$ $C_{12}H_{22}O_{11}$

$\Delta T_b = K_b \cdot m \cdot i$

$$\frac{\Delta T_b}{K_b \cdot i} = m = \frac{0.100°C}{(0.512\ °C/m) \cdot 1} = \boxed{0.195m}$$

$\Delta T_f = (T_{final} - T_{inial})$

19c) $\Delta T_f = -K_f \cdot m \cdot i$

$$\frac{\Delta T_f}{-K_f \cdot i} = m = \frac{-0.100°C}{-(1.86\ °C/m) \cdot 1} = \boxed{0.0538m}$$

#20

a) 1.85 kg of H_2O & 1.00 mol of solute

$$m = \frac{\text{moles solute}}{\text{kg solvent}} = \frac{1.00\ \text{mole}}{1.85\ \text{kg}} = \boxed{0.541\ m}$$

b)

$$\frac{0.356\ \text{g}\ Na_2PO_3F}{125.0\ \text{g}\ H_2O} \times \frac{1000\ \text{g}\ H_2O}{1\ \text{kg}\ H_2O} \times \frac{1\ \text{moles}\ Na_2PO_3F}{144.0\ \text{g}\ Na_2PO_3F} = \boxed{0.0198\ m}$$

c)

$$\frac{12.0\ \text{g}\ Na_2PO_3F}{500.0\ \text{g solution}} \times \frac{1000\ \text{g solvent}}{1\ \text{kg solvent}} \times \frac{1\ \text{mole}\ Na_2PO_3F}{144.0\ \text{g}\ Na_2PO_3F} = \boxed{0.171\ m}$$

500.0 g
− 12.0 g
488.0 g solvent

#21

a)

1.8m CH_3OH

0.7m CH_3OH

2.4m CH_3OH — most particles

0.2m CH_3OH

$i=1$

b)

0.5m Na_3PO_4 $i=4$

0.5m $MgCl_2$ $i=3$

0.5m $NaCl$ $i=2$

0.5m $Al_2(SO_4)_3$ $i=5$ — most particles

#22 101.00°C new boiling point (760 torr)

a) $\Delta T = K_b \cdot m \cdot i$

$$m = \frac{\Delta T}{K_b \cdot i} = \frac{T_f - T_i}{(0.512\ \frac{°C}{m}) \cdot 1} = \frac{101.00°C - 100.00°C}{0.512\ °C/m}$$

$$= \frac{1.00°C}{0.512\ °C/m} = \boxed{1.95\,m}$$

b) $\Delta T = -K_f \cdot m \cdot i$

$$= -(1.86\ \tfrac{°C}{m})(1.95\,m)\,1 = \boxed{-3.63°C}$$

#22 c

$$\frac{7.80\text{ g solute}}{100.0\text{ g solvent}} \begin{matrix}\rightarrow \text{moles} \\ \rightarrow \text{kg}\end{matrix}$$

$$m = \frac{\text{moles solute}}{\text{kg solvent}} = \frac{7.80\text{ g solute}}{0.1000\text{ kg solvent}} \neq \frac{1.95\text{ moles}}{1\text{ kg solvent}}$$

$$\frac{7.80\text{ g solute}}{0.1000\text{ kg solvent}} \cdot \frac{1\text{ kg solvent}}{1.95\text{ moles solute}} = \boxed{40.0\text{ g/mole}}$$

#23 b) $1.00\ L\ H_2O$

$10.0\ g\ NaCl$

$$\Delta T = K_b \cdot m \cdot i = (0.512\ ^\circ C/m)(0.171\ m) \cdot 2$$

$$m = \frac{10.0\ g\ NaCl}{1.00\ L\ H_2O} \times \frac{1\ moles\ NaCl}{58.44\ g\ NaCl} \times \frac{1\ L\ H_2O}{1000\ mL\ H_2O} \times \frac{1.00\ mL\ H_2O}{1.00\ g\ H_2O} \times \frac{1000\ g\ H_2O}{1\ kg\ H_2O} = \frac{0.171\ moles\ NaCl}{kg\ H_2O}$$

$$\Delta T = 0.175\ ^\circ C + 100.0\ ^\circ C = \boxed{100.175\ ^\circ C}$$

#23c new boiling point = 105.00°C

? g of NaCl?

$$\Delta T = K_b \cdot m \cdot i = (0.512\,°C/m)\, m \cdot 2 = 5.00\,°C$$

$$m = \frac{5.00\,°C}{2(0.512\,°C/m)} = \frac{4.88\text{ moles NaCl}}{1\text{ L } H_2O} \times \frac{58.44\text{ g NaCl}}{1\text{ moles NaCl}}$$

$$= \boxed{285\text{ g}}$$

#24) $\Delta T = -K_f \cdot m \cdot i$ $\qquad C_2H_6O_2$

a) $m = \dfrac{\Delta T}{-K_f \cdot i} = \dfrac{T_f - T_i}{-(1.86\ ^\circ C/m) \cdot 1} = \dfrac{-26.0^\circ C - 0.00^\circ C}{-1.86\ ^\circ C/m}$

$= \boxed{14.0\,m}$

b) 4.00 L of H_2O

? g of $C_2H_6O_2$

$m = 14.0\,m = \dfrac{14.0 \text{ moles}}{1 \text{ L solvent}} \cdot 4.00 \text{ L} = 56.0 \text{ moles } C_2H_6O_2$

$\dfrac{56.0 \text{ moles } C_2H_6O_2}{1} \times \dfrac{62.06 \text{ g } C_2H_6O_2}{1 \text{ moles } C_2H_6O_2} = \boxed{3.48 \times 10^3 \text{ g}}$

#24c

$$3.48 \times 10^3 \text{ g antifreeze} \times \frac{1 \text{ mL}}{1.11 \text{ g}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1.06 \text{ qt}}{1 \text{ L}} = 3.32 \text{ qt}$$