

Name key Print Name _____

Please show work on all questions for partial credit even on questions which do not specify. (20 total pts)
 (M = moles solute / L solution) (m = moles solute / kg solvent) (K = °C + 273.15)

[mass % = (mass of solute / mass solution) * 100] [X = moles solute or solvent / moles solution]

$\Delta T_b = i K_b m$ $\Delta T_f = i K_f m$ $P_{\text{solution}} = i P_{\text{solvent}} X_{\text{solvent}}$ $\Pi = i M R T$ [R = 0.08206 L atm / (mol K)]

1 In general as the temperature increases, the solubility of gases in water decreases and the solubility of most solids in water increases (1 pt)

A) decreases, decreases B) increases, increase C) increases, decrease D) decreases, increases

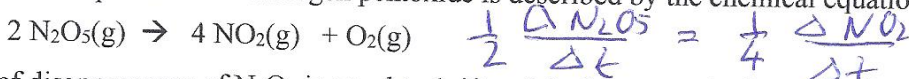
2 Which of the following will have the lowest freezing point? (1 pt)

A) 0.0120 m Li₂SO₄ B) 0.0100 m NaCl C) 0.0150 m MgCl₂ D) 0.0400 m CH₃CH₂CH₂OH

3 When ethylene glycol (HOCH₂CH₂OH) is added to the water in an automobile radiator, the effect is to (BP = boiling point, FP = freezing point) (1 pt) BP elevates FP depresses

A) Lower BP & lower FP B) raise BP & lower FP C) raise BP & raise FP D) lower BP & raise FP

4 The decomposition of dinitrogen pentoxide is described by the chemical equation (1 pt)



If the rate of disappearance of N₂O₅ is equal to 1.40 mol / min at a particular moment, what is the rate of appearance of NO₂ at that moment?

A) 0.700 mol/min B) 5.60 mol/min C) 1.40 mol / min D) 2.80 mol/min

$$\frac{1}{2} \frac{\Delta \text{N}_2\text{O}_5}{\Delta t} = \frac{1}{4} \frac{\Delta \text{NO}_2}{\Delta t}$$

$$(1.4/2) = \frac{1}{4} \frac{\Delta \text{NO}_2}{\Delta t}$$

$$\frac{\Delta \text{NO}_2}{\Delta t} = 4 \left(\frac{1.4}{2} \right)$$

5 What is the Boiling Point for the following solution. Assume complete dissociation of the solute in the water. You dissolve 0.278 grams of Na₃PO₄ (FM = 163.97 g/mol) in 807.9 grams of water. [BP water = 100.0 °C, K_b = 0.51 (°C kg) / mol] (6 pts)

$$\frac{278 \text{ g}}{163.97 \text{ g/mol}} = 1.70 \text{ mol}$$

$$\frac{807.9 \text{ g}}{1000} = 0.8079 \text{ kg}$$

$$i = 4 \quad \Delta T_b = (0.51)(4)(2.10) = 4.28$$

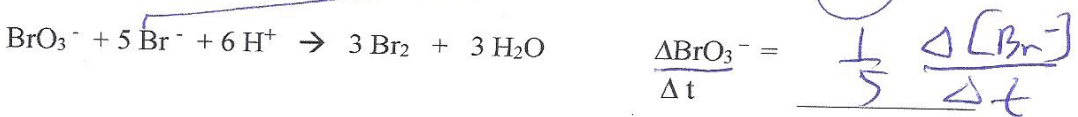
$$\text{BP} = 100.0^\circ\text{C} + 4.28 = 104.3$$

6 What is the vapor pressure for a solution made by dissolving 35.2 grams of ethylene glycol (HOCH₂CH₂OH, FM = 62.08 g/mol) in 125.2 grams of water (FM = 18.02 g/mol). P_{solvent} = 23.9 mm Hg (6 pts)

$$X_{\text{solvent}} = \frac{125.2 \text{ g} / 18.02 \text{ g/mol}}{125.2 \text{ g} / 18.02 \text{ g/mol} + 35.2 \text{ g} / 62.08 \text{ g/mol}} = \frac{6.95}{6.95 + 0.567} = 0.925$$

$$P_{\text{soln}} = (1)(0.925)(23.9 \text{ mmHg}) = 22.1 \text{ mmHg}$$

7 Given the following reaction, what is the expression for the rate of Br⁻ equivalent to (4 pts)



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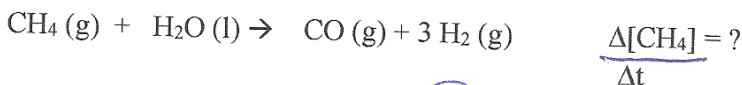
1 In general as the temperature increases, the solubility of gases in water decrease and the solubility of most solids in water increase (1 pt)

A) increases, decrease B) decreases, decreases C) decreases, increases D) increases, increase

2 A 0.50 m solution of which solute has the largest van't Hoff factor (assume complete dissociation) (1 pt)

A) $i=4$ Li_3PO_4 B) $i=2$ CaF_2 C) $i=3$ K_2CO_3 D) $i=2$ NaNO_3

3 Molecular hydrogen can be made from methane gas by the reaction below. How is the rate of disappearance of CH_4 related to the rate of appearance of H_2 ? (1 pt)

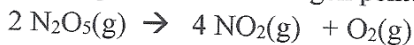


$\frac{1}{1} \frac{\Delta[\text{CH}_4]}{\Delta t} = \frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t}$

A) $\frac{+3\Delta[\text{H}_2]}{\Delta t}$ B) $\frac{+\Delta[\text{H}_2]}{\Delta t}$ C) $\frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t}$ D) none of these

$\frac{1}{2} \frac{\Delta[\text{N}_2\text{O}_5]}{\Delta t} = \frac{1}{4} \frac{\Delta[\text{NO}_2]}{\Delta t}$

4 The decomposition of dinitrogen pentoxide is described by the chemical equation (1 pt)



If the rate of disappearance of N_2O_5 is equal to 1.40 mol / min at a particular moment, what is the rate of appearance of NO_2 at that moment?

$(1.4) / 2 = \frac{1}{2} \frac{\Delta[\text{N}_2\text{O}_5]}{\Delta t} = 0.7$

A) 2.80 mol/min B) 1.40 mol/min C) 5.60 mol/min D) 0.700 mol/min

$0.7 \times 4 = \frac{\Delta[\text{NO}_2]}{\Delta t} = 2.8$

5 What is the Freezing Point for the following solution. You dissolve 278 grams of ethylene glycol (FM = 62.08 g/mol) in 1.92 kilograms of water. [FP water = 0.0 °C, $K_f = 1.86$ (°C kg) / mol] (6 pts)

$\Delta T_f = i K_f m$

$m = \frac{278 \text{ g}}{62.08 \text{ g/mol}} = 4.48 \text{ mol}$ (2 pt)

278 not 0.278

$i=1$ $\Delta T_f = (1.86 \frac{^\circ\text{C}}{\text{m}}) (4.48 \text{ m}) = 8.37 \text{ }^\circ\text{C}$ (2 pt)

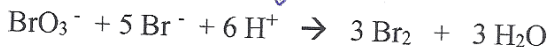
$0.0 - 8.37 = -8.37 \text{ }^\circ\text{C}$

6 What is the osmotic pressure for a saline solution in an intravenous fluid made by dissolving 13.7 grams of NaCl (FM = 58.44 g/mol) in 250.2 mL of the solution at T = 273.5 K. Assume complete dissociation. (6 pts)

$m = \frac{13.7 \text{ g NaCl}}{58.44 \text{ g/mol}} = 0.234 \text{ mol}$ (2 pt)

$\Pi = (0.234 \text{ mol} / 0.2502 \text{ L}) (2) (0.08206 \text{ L atm} / \text{mol K}) (273.5 \text{ K}) = 41.9 \text{ atm}$ (2 pt)

7 Given the reaction, what is the expression for the rate of the H^+ equivalent to (4 pts)



$\frac{\Delta[\text{BrO}_3^-]}{\Delta t} = \frac{1}{6} \frac{\Delta[\text{H}^+]}{\Delta t}$ (2 pt)

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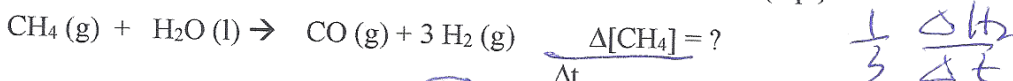
1 In general as the temperature increases, the solubility of gases in water de and the solubility of most solids in water in (1 pt)

A) decreases, decreases B) increases, decrease **C) decreases, increases** D) increases, increase

2 A 0.50 m solution of which solute has the largest van't Hoff factor (assume complete dissociation) (1 pt)

A) NaNO₃ B) CaF₂ C) K₂CO₃ **D) Li₃PO₄**

3 Molecular hydrogen can be made from methane gas by the reaction below. How is the rate of disappearance of CH₄ related to the rate of appearance of H₂? (1 pt)



A) $\frac{+3\Delta[\text{H}_2]}{\Delta t}$ B) $\frac{+\Delta[\text{H}_2]}{\Delta t}$ **C) $\frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t}$** D) none of these

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If the rate of disappearance of N₂O₅ is equal to 1.40 mol / min at a particular moment, what is the rate of appearance of NO₂ at that moment?

A) 0.700 mol/min B) 1.40 mol / min **C) 2.80 mol/min** D) 5.60 mol/min $(1.4/2) = \frac{1}{4} \frac{\Delta[\text{NO}_2]}{\Delta t}$ $(\frac{1.4}{2}) \cdot 4 = 2.8$

5. What is the Freezing Point for the following solution. Assume complete dissociation of the solute in the water. You dissolve 278 grams of NaCl (FM = 58.44 g/mol) in 689.2 grams of water. Assume complete dissociation of the solute in solution. [FP water = 0.0 °C, K_f = 1.86 (°C kg) / mol] (6 pts)

$\frac{278 \text{ g}}{58.44} = 4.758 \text{ mol}$ $i = 2$ $0.0 - \frac{25.7}{0.026} = -25.7^\circ\text{C}$

$\frac{278}{689.2/1000} = 6.90 \text{ m}$

$\Delta T_f = (2)(6.90)(1.86) = 25.7^\circ\text{C}$ $0.0 - 0.026^\circ\text{C} = -0.026^\circ\text{C}$

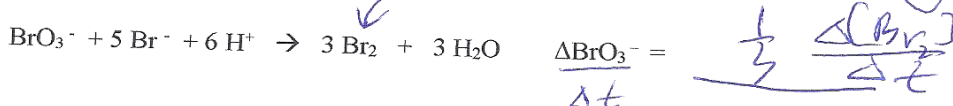
6 What is the osmotic pressure for a solution made by dissolving 13.7 grams of CaF₂ (FM = 78.08 g/mol) in 250.2 grams of the solution at T = 289 K. Assume complete dissociation. (density = 1.00 g/mL). (6 pts)

$\frac{13.7 \text{ g CaF}_2}{78.08} = 0.175 \text{ mol}$ $i = 3$ **2pt**

$\frac{0.175}{250.2 \text{ g} / 1000} = 0.699 \text{ m}$ **2pt**

$\Pi = (3)(0.699 \text{ m})(0.08206 \text{ L atm}) (289 \text{ K}) = 49.7 \text{ atm}$

7. Given the following reaction, what is the expression for the rate of the Br₂ equivalent to (4 pts) $\frac{\Delta[\text{BrO}_3^-]}{\Delta t}$



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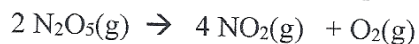
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$$\frac{\Delta \text{BrO}_3^-}{\Delta t} =$$

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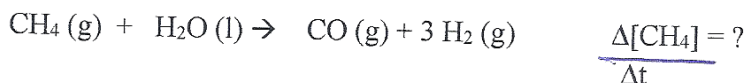
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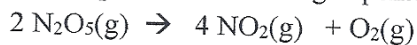
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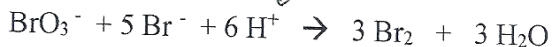
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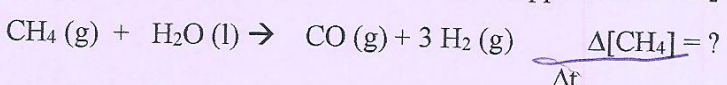
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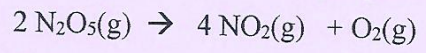
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