



Question 1

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Question 2

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Knowing that a human eye has an osmotic pressure of 7.97 atm at 37.0 C, an eye-drop solution with the same osmotic pressure and temperature is prepared by adding 0.242 g of NaCl in 25.0 mL water. Calculate the van't Hoff factor for NaCl in this solution. Assume the density of the solution to be 1.00 g/mL.

Question 4

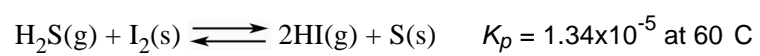
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Question 6

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Consider the following reaction



| 2.00 g solid iodine ( $\text{I}_2$ )

A 5.00 L reactor contains the following initial mixture at 60 C

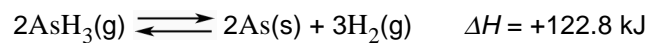
Question 7

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a. Indicate whether the following statements are true or false

- |   | True                     | False                    |
|---|--------------------------|--------------------------|
| i. The solubility of a gas in water decreases with increasing temperature   | <input type="checkbox"/> | <input type="checkbox"/> |
| ii. The presence of a non-volatile solute in a solvent lowers the vapor pressure of the solution  | <input type="checkbox"/> | <input type="checkbox"/> |
| iii. Henry's law states that the amount of a gas dissolved in a solution is directly proportional to the pressure of the gas above the solution | <input type="checkbox"/> | <input type="checkbox"/> |
| iv. A liquid-liquid solution that obeys Raoult's law is called an "ideal solution"  | <input type="checkbox"/> | <input type="checkbox"/> |
| v. Colligative properties are based on the number of particles in solution, whatever the "size" of the particle.                                | <input type="checkbox"/> | <input type="checkbox"/> |
| vi. The addition of an ionic compound to any solvent will cause a boiling point depression.   | <input type="checkbox"/> | <input type="checkbox"/> |

b. The gas Arsine, AsH<sub>3</sub> decomposes as follows:







Question 9

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a. Order the following from the strongest to the weakest base

- i.  $\text{H}_2\text{O}$
- ii.  $\text{CH}_3\text{NH}_2$
- iii.  $\text{ClO}_4^-$

\_\_\_\_\_

*strongest base*

\_\_\_\_\_

\_\_\_\_\_

*weakest base*

b. Arrange the following aqueous solutions in order from most acidic to most basic.

- i. 0.1M KF
- ii. 0.1M  $\text{KNO}_3$
- iii. 0.1M  $\text{NH}_4\text{Cl}$

\_\_\_\_\_

*most acidic*

\_\_\_\_\_

\_\_\_\_\_

*most basic*

Question 10

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Calculate the mass of KNO

Question 11

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A 20.0 mL sample of 0.10 M formic acid (HCOOH) was titrated with  $5.0 \times 10^{-2}$  M Ba(OH)<sub>2</sub>.  
 $K_a$  for HCOOH is  $1.8 \times 10^{-4}$ .

- a. Calculate the pH of the solution upon the addition of 15.0 mL of Ba(OH)<sub>2</sub> to the sample.

Question 11 (cont.)

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b. What volume of  $\text{Ba}(\text{OH})_2$  is needed to reach the equivalence point?

2 marks

c. Calculate the pH of the solution at the equivalence point.

3 marks

*Answers*

*b. volume at equivalence point :*

*c. pH at equivalence point :*

Question 12

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Solid NaI is slowly added to a solution that contains both  $\text{Pb}(\text{NO}_3)_2$

## Question 13

a. Predict the sign of  $\Delta S$  of the system for each of the following processes

	$\Delta S < 0$	$\Delta S > 0$
i. A liquid that boils	<input type="checkbox"/>	<input type="checkbox"/>
ii. Sugar that crystallized out from a supersaturated sugar solution	<input type="checkbox"/>	<input type="checkbox"/>
iii. Iron rusts (formation of $\text{Fe}_2\text{O}_3$ from pure Fe and $\text{O}_2$ )	<input type="checkbox"/>	<input type="checkbox"/>
iv. $\text{A-B(g)} + \text{C-D(s)} \longrightarrow \text{A-B-C(g)} + \text{D(s)}$	<input type="checkbox"/>	<input type="checkbox"/>
v. $\text{N}_2\text{O}_4(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$	<input type="checkbox"/>	<input type="checkbox"/>
vi. $\text{NaCl(s)} \longrightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \quad H_{\text{sol}} = +4.0 \text{ kJ/mol}$	<input type="checkbox"/>	<input type="checkbox"/>

b. For mercury (Hg), the enthalpy of vaporization is 58.51 kJ/mol and the entropy of vaporization is 92.92 J/K.mol. What is the normal boiling point of mercury?

*Answer*

*b.  $T_b$  :*

Question 14

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Consider the following reaction



Will the reaction be spontaneous at each of the following temperatures? Show your work.  
(assume that  $\Delta H^\circ$  and  $\Delta S^\circ$  do not change very much within the given temperature range)

- a. 25.0 C
- b. 60.0 C

*Answers*

Question 15

Complete the "experiment 2" laboratory data sheet and find the molar mass of the unknown no 3.

6 marks

The solid unknown added is a non-ionic compound, completely soluble in cyclohexane.

**COLLIGATIVE PROPERTIES**

**DATA SHEET**

cyclohexane = 20.2 C.kg.mol<sup>-1</sup>

cyclohexane = 6.55 C

**Data for the Unknown Solute/Cyclohexane Solution**

Unknown Number: \_\_\_\_\_

Mass of empty test tube, stopper, beaker

g 1 1.223 1

Mass of test tube, stopper, beaker, & cyclohexane

g 204. 3

Mass of test tube, stopper, beaker, & unknown solute/cyclohexane solution

g 204. 4

Mass of cyclohexane

g \_\_\_\_\_

Mass of unknown solute

g \_\_\_\_\_

Freezing Temperature of unknown solute/cyclohexane solution

C 4.2

Molar mass of unknown solute

g.mol<sup>-1</sup> \_\_\_\_\_

Sample calculation.