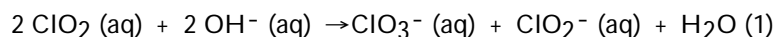


# 1102-1st Midterm Exam\_03/30/22\_(A)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The data in the table below were obtained for the reaction:



Experiment Number	[ClO <sub>2</sub> ] (M)	[OH <sup>-</sup> ] (M)	Initial Rate (M/s)
1	0.060	0.030	0.0248
2	0.020	0.030	0.00276
3	0.020	0.090	0.00828

1) What is the order of the reaction with respect to ClO<sub>2</sub>?

- A) 4                      B) 1                      C) 3                      D) 2                      E) 0

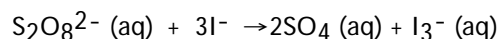
Answer: D

2) A reaction was found to be third order in A. Increasing the concentration of A by a factor of 3 will cause the reaction rate to \_\_\_\_\_.

- A) remain constant  
 B) triple  
 C) increase by a factor of 9  
 D) increase by a factor of 27  
 E) decrease by a factor of the cube root of 3

Answer: D

The peroxydisulfate ion (S<sub>2</sub>O<sub>8</sub><sup>2-</sup>) reacts with the iodide ion in aqueous solution via the reaction:



An aqueous solution containing 0.050 M of S<sub>2</sub>O<sub>8</sub><sup>2-</sup> ion and 0.072 M of I<sup>-</sup> is prepared, and the progress of the reaction followed by measuring [I<sup>-</sup>]. The data obtained is given in the table below.

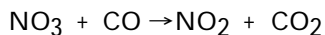
Time (s)	0.000	400.0	800.0	1200.0	1600.0
[I <sup>-</sup> ] (M)	0.072	0.057	0.046	0.037	0.029

3) The average rate of disappearance of I<sup>-</sup> between 400.0 s and 800.0 s is \_\_\_\_\_ M/s.

- A)  $3.6 \times 10^4$                       B)  $1.4 \times 10^{-5}$                       C)  $2.6 \times 10^{-4}$                       D)  $2.8 \times 10^{-5}$                       E)  $5.8 \times 10^{-5}$

Answer: D

4) For the elementary reaction



the molecularity of the reaction is \_\_\_\_\_, and the rate law is rate = \_\_\_\_\_.

- A) 4,  $k[\text{NO}_3][\text{CO}][\text{NO}_2][\text{CO}_2]$
- B) 4,  $k[\text{NO}_2][\text{CO}_2]/[\text{NO}_3][\text{CO}]$
- C) 2,  $k[\text{NO}_3][\text{CO}]/[\text{NO}_2][\text{CO}_2]$
- D) 2,  $k[\text{NO}_3][\text{CO}]$
- E) 2,  $k[\text{NO}_2][\text{CO}_2]$

Answer: D

5) A second-order reaction has a half-life of 18 s when the initial concentration of reactant is 0.71 M. The rate constant for this reaction is \_\_\_\_\_  $\text{M}^{-1}\text{s}^{-1}$ .

- A) 18
- B) 1.3
- C)  $2.0 \times 10^{-2}$
- D)  $3.8 \times 10^{-2}$
- E)  $7.8 \times 10^{-2}$

Answer: E

6) The half-life of a first-order reaction is 13 min. If the initial concentration of reactant is 0.085 M, it takes \_\_\_\_\_ min for it to decrease to 0.055 M.

- A) 3.6
- B) 8.2
- C) 8.4
- D) 11
- E) 0.048

Answer: B

7) A particular first-order reaction has a rate constant of  $1.35 \times 10^2 \text{ s}^{-1}$  at 25.0 °C. What is the magnitude of k at 75.0 °C if  $E_a = 60.2 \text{ kJ/mol}$ ?  $R = 8.314 \text{ J/mol} \cdot \text{K}$

- A)  $2.71 \times 10^6$
- B) 471
- C)  $2.44 \times 10^4$
- D)  $4.43 \times 10^3$
- E)  $1.35 \times 10^2$

Answer: D

8) Which one of the following substances would be the most soluble in  $\text{CCl}_4$ ?

- A)  $\text{C}_{10}\text{H}_{22}$
- B) NaCl
- C)  $\text{CH}_3\text{CH}_2\text{OH}$
- D)  $\text{H}_2\text{O}$
- E)  $\text{NH}_3$

Answer: A

9) A solution is prepared by dissolving 13.0 g of  $\text{NH}_3$  in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The mole fraction of  $\text{NH}_3$  in the solution is \_\_\_\_\_.

- A) 0.0520
- B) 0.940
- C) 0.922
- D) 0.0522
- E) 16.8

Answer: D

10) Which of the following liquids will have the lowest freezing point?

- A) pure  $\text{H}_2\text{O}$
- B) aqueous  $\text{FeI}_3$  (0.030 m)
- C) aqueous glucose (0.050 m)
- D) aqueous NaI (0.030 m)
- E) aqueous  $\text{CO}_2$  (0.030 m)

Answer: B

11) Calculate the molality of a 25.4% (by mass) aqueous solution of phosphoric acid (H<sub>3</sub>PO<sub>4</sub>).

- A) 4.45 m
- B) 25.4 m
- C) 3.47 m
- D) 2.59 m
- E) The density of the solution is needed to solve the problem.

Answer: C

12) A solution is prepared by dissolving calcium chloride in water and diluting to 500.0 mL. If this solution contains 44 ppm chloride ions, the concentration of calcium ions is \_\_\_\_\_ ppm.

- A) 88
- B) 11
- C) 500
- D) 44
- E) 22

Answer: E

13) The vapor pressure of pure water at 25 °C is 23.8 torr. What is the vapor pressure (torr) of water above a solution prepared by dissolving 18.0 g of glucose (a nonelectrolyte, MW = 180.0 g/mol) in 95.0 g of water?

- A) 23.4
- B) 23.8
- C) 0.451
- D) 0.443
- E) 24.3

Answer: A

14) A solution is prepared by dissolving 15.0 g of NH<sub>3</sub> in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The molarity of NH<sub>3</sub> in the solution is \_\_\_\_\_.

- A) 3.24
- B) 0.882
- C) 60.0
- D) 3.53
- E) 0.00353

Answer: A

15) Which one of the following solutes has a limiting van't Hoff factor (i) of 3 when dissolved in water?

- A) KNO<sub>3</sub>
- B) CH<sub>3</sub>OH
- C) sucrose
- D) CCl<sub>4</sub>
- E) Na<sub>2</sub>SO<sub>4</sub>

Answer: E

16) A solution is prepared by dissolving 0.60 g of nicotine (a nonelectrolyte) in water to make 12 mL of solution. The osmotic pressure of the solution is 7.55 atm at 25 °C. The molecular weight of nicotine is \_\_\_\_\_ g/mol.  
R=0.0821 atm•L/mol•K

- A) 160
- B) 43
- C) 50
- D) 0.60
- E) 28

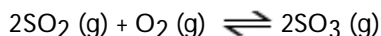
Answer: A

17) The solubility of Ar in water at 25 °C is  $1.6 \times 10^{-3}$  M when the pressure of the Ar above the solution is 1.0 atm. The solubility of Ar at a pressure of 2.5 atm is \_\_\_\_\_ M.

- A)  $1.6 \times 10^3$
- B)  $4.0 \times 10^{-3}$
- C)  $1.6 \times 10^{-3}$
- D)  $6.4 \times 10^{-4}$
- E)  $7.5 \times 10^{-2}$

Answer: B

18) Which of the following expressions is the correct equilibrium-constant expression for the reaction below?



- A)  $[\text{SO}_2] / [\text{SO}_3]$
- B)  $[\text{SO}_3] / [\text{SO}_2][\text{O}_2]$
- C)  $[\text{SO}_3]^2 / [\text{SO}_2]^2[\text{O}_2]^2$
- D)  $[\text{SO}_3]^2 / [\text{SO}_2]^2[\text{O}_2]$
- E)  $[\text{SO}_3] / [\text{SO}_2][\text{O}_2]^2$

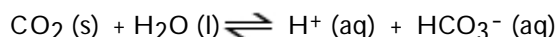
Answer: D

19) In which of the following reactions would increasing pressure at constant temperature change the concentrations of reactants and products, based on Le Châtelier's principle?

- A)  $\text{N}_2\text{O}_4 (\text{g}) \rightleftharpoons 2\text{NO}_2 (\text{g})$
- B)  $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightleftharpoons 2\text{NH}_3 (\text{g})$
- C)  $2\text{N}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightleftharpoons 2\text{N}_2\text{O} (\text{g})$
- D)  $\text{N}_2 (\text{g}) + 2\text{O}_2 (\text{g}) \rightleftharpoons 2\text{NO}_2 (\text{g})$
- E) all of the above

Answer: E

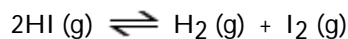
20) Which of the following expressions is the correct equilibrium-constant expression for the reaction below?



- A)  $[\text{H}^+][\text{HCO}_3^-]$
- B)  $[\text{H}^+][\text{HCO}_3^-] / [\text{CO}_2][\text{H}_2\text{O}]$
- C)  $[\text{H}^+][\text{HCO}_3^-] / [\text{CO}_2]$
- D)  $[\text{CO}_2] / [\text{H}^+][\text{HCO}_3^-]$
- E)  $[\text{CO}_2][\text{H}_2\text{O}] / [\text{H}^+][\text{HCO}_3^-]$

Answer: A

21)  $K_p = 0.0198$  at 721 K for the reaction

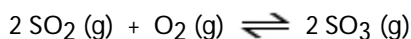


In a particular experiment, the partial pressures of  $\text{H}_2$  and  $\text{I}_2$  at equilibrium are 0.763 and 0.863 atm, respectively. The partial pressure of HI is \_\_\_\_\_ atm.

- A) 5.77
- B) 0.0130
- C) 33.3
- D) 0.114
- E) 7.87

Answer: A

22) Consider the following equilibrium.

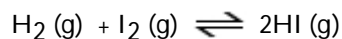


The equilibrium cannot be established when \_\_\_\_\_ is/are placed in a 1.0-L container.

- A) 0.75 mol  $\text{SO}_2 (\text{g})$
- B) 1.0 mol  $\text{SO}_3 (\text{g})$
- C) 0.25 mol  $\text{SO}_2 (\text{g})$  and 0.25 mol  $\text{O}_2 (\text{g})$
- D) 0.50 mol  $\text{O}_2 (\text{g})$  and 0.50 mol  $\text{SO}_3 (\text{g})$
- E) 0.25 mol of  $\text{SO}_2 (\text{g})$  and 0.25 mol of  $\text{SO}_3 (\text{g})$

Answer: A

23) Consider the following chemical reaction:

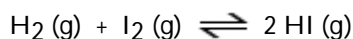


At equilibrium in a particular experiment, the concentrations of  $\text{H}_2$ ,  $\text{I}_2$ , and  $\text{HI}$  were 0.15 M, 0.033 M, and 0.55 M, respectively. The value of  $K_{\text{eq}}$  for this reaction is \_\_\_\_\_.

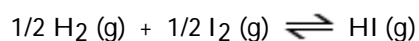
- A) 0.0090                      B) 5.1                      C) 23                      D) 111                      E) 61

Answer: E

24) The value of  $K_{\text{eq}}$  for the equilibrium



is 794 at 25 °C. What is the value of  $K_{\text{eq}}$  for the equilibrium below?

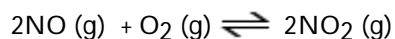


- A) 397                      B) 0.0013                      C) 0.035                      D) 1588                      E) 28

Answer: E

25) Given the following reaction at equilibrium, if  $K_{\text{c}} = 5.54 \times 10^5$  at 230.0 °C,  $K_{\text{p}} =$  \_\_\_\_\_.

$R = 0.0821 \text{ atm}\cdot\text{L/mol}\cdot\text{K}$



- A)  $2.28 \times 10^6$                       B)  $3.67 \times 10^{-2}$                       C)  $6.44 \times 10^5$                       D)  $1.34 \times 10^4$                       E)  $2.99 \times 10^7$

Answer: D