1052-1st Chem Exam-1060329(A)

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

1) The concentration of CO_2 in a soft drink bottled with a partial pressure of CO_2 of 6.5 atm over the liquid at 29 °C is 2.2×10^{-1} M. The Henry's law constant for CO_2 at this temperature is _________.

A) 5.6×10^{-3} mol/L-atm
B) 3.4×10^{-2} mol/L-atm
C) 7.6×10^{-3} mol/L-atm
D) 2.2×10^{-1} mol/L-atm
E) More information is needed to solve the problem.

Answer: B

2) Calculate the mole fraction of phosphoric acid (H_3PO_4, molar mass = 97.99 g/mol) in a 25.4% (by mass) aqueous solution.

A) 4.14 B) 1.00 C) 0.0589 D) 0.259 E) 0.0626

Answer: C

3) Calculate the molality of a 25.4% (by mass) aqueous solution of phosphoric acid (H_3PO_4, molar mass = 97.99 g/mol).

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

Answer: C

4) A solution is prepared by dissolving 15.0 g of NH_3 (molar mass = 17.03 g/mol) in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The molarity of NH_3 in the solution is _________.

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

Answer: E

5) A solution contains 15 ppm of benzene (C_6H_6, molar mass = 78.11 g/mol). The density of the solution is 1.00 g/mL. This means that _________.

A) 100 g of the solution contains 15 g of benzene
B) there are 15 mg of benzene in 1.0 L of this solution
C) the solution is 15% by mass of benzene
D) the molarity of the solution is 15
E) 100 g of the solution contains 15 mg of benzene

Answer: B

6) A 1.35 m aqueous solution of compound X had a boiling point of 101.4 °C. Which one of the following could be compound X? The boiling point elevation constant for water is 0.52 °C/m.

A) $C_6H_{12}O_6$ B) CH_3CH_2OH C) Na_3PO_4 D) KCl E) $CaCl_2$

Answer: D

7) Of the following, a 0.1 M aqueous solution of _________ will have the lowest freezing point.

A) $Al(NO_3)_3$ B) NaCl C) K_2CrO_4 D) Na_2SO_4 E) sucrose

Answer: A

8) Determine the freezing point of a solution that contains 78.8 g of naphthalene ($C_{10}H_8$, molar mass = 128.16 g/mol) dissolved in 722 mL of benzene (d = 0.877 g/mL). Pure benzene has a melting point of 5.50°C and a freezing point depression constant of 4.90°C/*m*.

A) 1.68°C B) 0.74°C C) 4.17°C D) 4.76°C E) 1.33°C

Answer: B

9) When two nonpolar organic liquids are mixed, a solution forms and the enthalpy of solution is quite small. Label the two organic liquids as *A* (solvent) and *B* (solute). The formation of solution is favored by __________.

A) solvation of the solvent, *A*
B) the highly negative enthalpy of the solution process
C) the equal enthalpy of the solvent and solute
D) an increase in disorder, since A-A, B-B, and A-B interactions are similar
E) hydration of the solute, *B*

Answer: D

10) A saturated solution __________.

A) will rapidly precipitate if a seed crystal is added
B) contains no double bonds
C) contains as much solvent as it can hold
D) cannot be attained
E) contains dissolved solute in equilibrium with undissolved solute

Answer: E

11) Which of the following substances is least likely to dissolve in water?

A) $CHCl_3$
B) $HOCH_2CH_2OH$
C) O
‖
$CH_3(CH_2)_9CH$
D) CCl_4
E) $CH_3(CH_2)_8CH_2OH$

Answer: D

12) Calculate the vapor pressure of a solution made by dissolving 109 grams of glucose (molar mass = 180.2 g/mol) in 920.0 ml of water at 25 °C. The vapor pressure of pure water at 25 °C is 23.76 mm Hg. Assume the density of the solution is 1.00 g/ml.

A) 23.48 mm Hg
B) 0.278 mm Hg
C) 22.98 mm Hg
D) 23.76 mm Hg
E) 0.605 mm Hg

Answer: A

13) 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.

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

Answer: B

14) A reaction is found to have an activation energy of 38.0 kJ/mol. If the rate constant for this reaction is 1.60×10^2 $M^{-1}s^{-1}$ at 249 K, what is the rate constant at 436 K?

A) 3.80×10^4 $M^{-1}s^{-1}$
B) 1.26×10^3 $M^{-1}s^{-1}$
C) 7.94×10^4 $M^{-1}s^{-1}$
D) 2.38×10^5 $M^{-1}s^{-1}$
E) 4.20×10^5 $M^{-1}s^{-1}$

Answer: E

15) Nitrogen dioxide decomposes to nitric oxide and oxygen via the reaction:

$$2NO_2 \rightarrow 2NO + O_2$$

In a particular experiment at 300 °C, $[NO_2]$ drops from 0.0100 to 0.00650 M in 100 s. The rate of production of NO for this period is __________ M/s.

A) 0.35
B) 1.8×10^{-3}
C) 7.0×10^{-3}
D) 3.5×10^{-3}
E) 3.5×10^{-5}

Answer: E

16) Consider the following reaction:

$$3A \rightarrow 2B$$

The average rate of appearance of B is given by $\Delta[B]/\Delta t$. Comparing the rate of appearance of B and the rate of disappearance of A, we get $\Delta[B]/\Delta t$ = __________ $\times$ $(-\Delta[A]/\Delta t)$.

A) +2/3
B) +3/2
C) -3/2
D) +1
E) -2/3

Answer: A

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

$$A + B \rightarrow P$$

Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.273	0.763	2.83
2	0.273	1.526	2.83
3	0.819	0.763	25.47

17) The magnitude of the rate constant is __________.

A) 13.2
B) 0.278
C) 38.0
D) 42.0
E) 2.21

Answer: C

18) The mechanism for formation of the product X is:

$$A + B \rightarrow C + D \quad \text{(slow)}$$
$$B + D \rightarrow X \quad \text{(fast)}$$

The intermediate reactant in the reaction is __________.

A) A
B) B
C) C
D) D
E) X

Answer: D

19) The decomposition of N_2O_5 in solution in carbon tetrachloride proceeds via the reaction

$$2N_2O_5\ (soln) \rightarrow 4NO_2\ (soln) + O_2\ (soln)$$

The reaction is first order and has a rate constant of $4.82 \times 10^{-3}\ s^{-1}$ at 64 °C. The rate law for the reaction is rate = __________.

A) $2k[N_2O_5]$
B) $k[N_2O_5]$
C) $k\dfrac{[N_2O_5]^2}{[NO_2]^4\ [O_2]}$
D) $k\dfrac{[NO_2]^4\ [O_2]}{[N_2O_5]^2}$
E) $k[N_2O_5]^2$

Answer: B

20) For a first-order reaction, a plot of __________ versus __________ is linear.

A) $\dfrac{1}{[A]_t}$, t B) ln $[A]_t$, t C) ln $[A]_t$, $\dfrac{1}{t}$ D) $[A]_t$, t E) t, $\dfrac{1}{[A]_t}$

Answer: B

21) A compound decomposes by a first-order process. If 25.0% of the compound decomposes in 60.0 minutes, the half-life of the compound is __________.

A) 145 minutes B) 180 minutes C) 198 minutes D) 120 minutes E) 65 minutes

Answer: A

22) Consider the following reaction:

$$NO(g) + SO_3(g) \rightleftharpoons NO_2(g) + SO_2(g)$$

A reaction mixture initially contains 0.86 atm NO and 0.86 atm SO_3. Determine the equilibrium pressure of NO_2 if K_p for the reaction at this temperature is 0.0118.

A) 0.084 atm B) 0.012 atm C) 0.85 atm D) 0.78 atm E) 0.048 atm

Answer: A

23) A possible mechanism for the overall reaction

$$Br_2 (g) + 2NO (g) \rightarrow 2NOBr (g)$$

is

$$NO (g) + Br_2 (g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} NOBr_2 (g) \qquad \text{(fast)}$$

$$NOBr_2 (g) + NO (g) \xrightarrow{k_2} 2NOBr \qquad \text{(slow)}$$

The rate law for formation of NOBr based on this mechanism is rate = __________.

A) $k_1[Br_2]^{1/2}$

B) $(k_2k_1/k_{-1})[NO]^2[Br_2]$

C) $(k_1/k_{-1})^2[NO]^2$

D) $k_1[NO]^{1/2}$

E) $(k_2k_1/k_{-1})[NO][Br_2]^2$

Answer: B

24) The following reaction is second order in [A] and the rate constant is 0.039 $M^{-1}s^{-1}$:

$$A \rightarrow B$$

The concentration of A was 0.30 M at 23 s. The initial concentration of A was __________ M.

A) 2.4 B) 0.27 C) 0.41 D) 3.7 E) 1.2×10^{-2}

Answer: C

25) The elementary reaction

$$2NO_2 (g) \rightarrow 2NO (g) + O_2 (g)$$

is second order in NO_2 and the rate constant at 501 K is 7.93×10^{-3} $M^{-1}s^{-1}$. The reaction half-life at this temperature when $[NO_2]_0$ = 0.45 M is __________ s.

A) 126 B) 0.011 C) 280 D) 3.6×10^{-3} E) 87

Answer: C

26) In general, as temperature goes up, reaction rate __________.

A) goes up if the reaction is exothermic

B) goes up if the reaction is endothermic

C) stays the same regardless of whether the reaction is exothermic or endothermic

D) stays the same if the reaction is first order

E) goes up regardless of whether the reaction is exothermic or endothermic

Answer: E

27) SO_2Cl_2 decomposes in the gas phase by the reaction

$$SO_2Cl_2\ (g) \rightarrow SO_2\ (g) + Cl_2\ (g)$$

The reaction is first order in SO_2Cl_2 and the rate constant is $3.0 \times 10^{-6}\ s^{-1}$ at 600 K. A vessel is charged with 2.4 atm of SO_2Cl_2 at 600 K. The partial pressure of SO_2Cl_2 at 3.0×10^{5} s is _________ atm.

A) 0.98 B) 1.4×10^{5} C) 0.29 D) 2.2 E) 0.76

Answer: A

28) A catalyst can increase the rate of a reaction _________.

A) by lowering the activation energy of the reverse reaction
B) by increasing the overall activation energy (E_a) of the reaction
C) by changing the value of the frequency factor (A)
D) by providing an alternative pathway with a lower activation energy
E) All of these are ways that a catalyst might act to increase the rate of reaction.

Answer: D

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

$$HF\ (aq) + H_2O\ (l) \rightleftharpoons H_3O^+\ (aq) + F^-\ (aq)$$

A) $[H_3O^+][F^-] / [HF][H_2O]$
B) $[HF][H_2O] / [H_3O^+][F^-]$
C) $[F^-] / [HF]$
D) $[H_3O^+][F^-] / [HF]$
E) $1 / [HF]$

Answer: D

30) Given the following reaction:

$$CO\ (g) + 2\ H_2(g) \rightleftharpoons CH_3OH\ (g)$$

In an experiment, 0.42 mol of CO and 0.42 mol of H_2 were placed in a 1.00-L reaction vessel. At equilibrium, there were 0.29 mol of CO remaining. K_{eq} at the temperature of the experiment is _________.

A) 0.357
B) 17.5
C) 2.80
D) 14.5
E) none of the above

Answer: B

31) Dinitrogentetraoxide partially decomposes according to the following equilibrium:

$N_2O_4\ (g) \rightleftharpoons 2NO_2\ (g)$

A 1.00-L flask is charged with 0.0400 mol of N_2O_4. At equilibrium at 373 K, 0.0055 mol of N_2O_4 remains. K_{eq} for this reaction is __________.

A) 2.2×10^{-4} B) 0.87 C) 0.022 D) 13 E) 0.22

Answer: B

32) At 400 K, the equilibrium constant for the reaction

$Br_2\ (g) + Cl_2\ (g) \rightleftharpoons 2BrCl\ (g)$

is $K_p = 7.0$. A closed vessel at 400 K is charged with 1.00 atm of Br_2 (g), 1.00 atm of Cl_2 (g), and 2.00 atm of BrCl (g). Use Q to determine which of the statements below is true.

A) The reaction will go to completion since there are equal amounts of Br_2 and Cl_2.
B) The equilibrium partial pressures of Br_2, Cl_2, and BrCl will be the same as the initial values.
C) The equilibrium partial pressure of Br_2 will be greater than 1.00 atm.
D) The equilibrium partial pressure of BrCl (g) will be greater than 2.00 atm.
E) At equilibrium, the total pressure in the vessel will be less than the initial total pressure.

Answer: D

33) At 27°C, $K_p = 0.095$ for the equilibrium:

$NH_4HS\ (s) \rightleftharpoons NH_3\ (g) + H_2S\ (g)$

A sample of solid NH_4HS is placed in a closed vessel and allowed to equilibrate. Calculate the equilibrium partial pressure (atm) of ammonia, assuming that some solid NH_4HS remains.

A) 0.095 B) 0.0049 C) 3.8 D) 0.31 E) 0.052

Answer: D

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

$CO_2\ (g) + 2H_2\ (g) \rightleftharpoons CH_3OH\ (g)$

A) $\frac{[CH_3OH]}{[CO_2][H_2]}$ B) $\frac{[CO_2][H_2]^2}{[CH_3OH}$ C) $\frac{[CH_3OH]}{[CO_2]}$ D) $\frac{[CH_3OH]}{[CO_2][H_2]^2}$ E) $\frac{[CO_2][H_2]}{[CH_3OH}$

Answer: D

35) Given the following reaction at equilibrium, if $K_c = 6.34 \times 10^5$ at 230.0 °C, K_p = __________.

$2NO\ (g) + O_2\ (g) \rightleftharpoons 2NO_2\ (g)$

A) 6.44×10^5 B) 2.62×10^7 C) 1.53×10^4 D) 3.67×10^{-2} E) 2.61×10^6

Answer: C

36) The value of K_{eq} for the equilibrium

$$H_2 (g) + I_2 (g) \rightleftharpoons 2 HI (g)$$

is 54.0 at 427 °C. What is the value of K_{eq} for the equilibrium below?

$$HI (g) \rightleftharpoons 1/2 H_2 (g) + 1/2 I_2 (g)$$

A) 0.136 B) 7.35 C) 3.43×10^{-4} D) 2.92×10^{3} E) 27

Answer: A

37) At 200 °C, the equilibrium constant (K_p) for the reaction below is 2.40×10^{3}.

$$2NO (g) \rightleftharpoons N_2 (g) + O_2 (g)$$

A closed vessel is charged with 36.1 atm of NO. At equilibrium, the partial pressure of O_2 is __________ atm.

A) 17.9 B) 35.7 C) 1.50×10^{-2} D) 6.00 E) 294

Answer: A

38) Consider the following reaction at equilibrium:

$$2NH_3 (g) \rightleftharpoons N_2 (g) + 3H_2 (g)$$

Le Châtelier's principle predicts that the moles of H_2 in the reaction container will increase with __________.

A) some removal of NH_3 from the reaction vessel (V and T constant)
B) a decrease in the total pressure (T constant)
C) addition of some N_2 to the reaction vessel (V and T constant)
D) an increase in total pressure by the addition of helium gas (V and T constant)
E) a decrease in the total volume of the reaction vessel (T constant)

Answer: B

39) Of the following equilibria, only __________ will shift to the right in response to a decrease in volume.

A) $2 Fe_2O_3 (s) \rightleftharpoons 4 Fe (s) + 3 O_2 (g)$
B) $H_2 (g) + Cl_2 (g) \rightleftharpoons 2 HCl (g)$
C) $2 SO_3 (g) \rightleftharpoons 2 SO_2 (g) + O_2 (g)$
D) $N_2 (g) + 3 H_2 (g) \rightleftharpoons 2 NH_3 (g)$
E) $2HI (g) \rightleftharpoons H_2 (g) + I_2 (g)$

Answer: D

40) Consider the following reaction at equilibrium:

$$2CO_2\ (g) \rightleftharpoons 2CO\ (g) + O_2\ (g) \qquad \Delta H° = -514\ kJ$$

Le Châtelier's principle predicts that an increase in temperature will __________.

A) increase the partial pressure of O_2 (g)
B) increase the partial pressure of CO
C) decrease the value of the equilibrium constant
D) decrease the partial pressure of CO_2 (g)
E) increase the value of the equilibrium constant

Answer: C