1082–1st Chem Exam(A)–1090408

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

1) For the reaction: $C_2H_4Br_2 + 3\ KI \rightarrow C_2H_4 + 2\ KBr + KI_3$

At the time when $C_2H_4Br_2$ is being consumed at a rate of 2.0×10^{-5} M/s, what is the rate at which KBr is being formed?

A) 1.0×10^{-5} B) 4.0×10^{-5} C) 2.0×10^{-5} D) 0.67×10^{-5} E) 5.0×10^{-6}

Answer: B

Information of following two questions:
The data of following two questions in the table below were obtained for the reaction:

$A + B \rightarrow C$

Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.451	0.885	1.13
2	0.451	1.77	1.13
3	1.35	0.885	10.17

2) The rate law for this reaction is rate = _____.

A) k[B] B) $k[A]^2$ C) k[A][B] D) $k[A]^2[B]^2$ E) $k[A]^2[B]$

Answer: B

3) The magnitude of the rate constant ($M^{-1}s^{-1}$) is _____.

A) 13.2 B) 42.0 C) 5.56 D) 2.21 E) 0.278

Answer: C

4) On which factor the rate constant of a reaction does **not** depend upon?

A) the presence or absence of a catalyst
B) the nature of reactant and product
C) the temperature
D) the concentration of reactant and product
E) the activation energy

Answer: D

5) Which of the following represents the integrated rate law for a zeroth–order reaction (reaction type: A → product) ?

A) $\frac{1}{[A]_t} = kt + \frac{1}{[A]_o}$

B) $[A]_t = -kt + [A]_o$

C) $\ln[A]_t = -kt + \ln[A]_o$

D) $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

E) $k = Ae^{(-Ea/RT)}$

Answer: B

6) If the reaction $2HI \rightarrow H_2 + I_2$ is second order, which of the following will yield a linear plot?

A) 1/[HI] vs time
B) log [HI] vs time
C) ln [HI] vs time
D) [HI] vs time
E) $[HI]^2$ vs time

Answer: A

7) The rate constant of a first–order process that has a half–life of 3.50 min is _____s^{-1}.

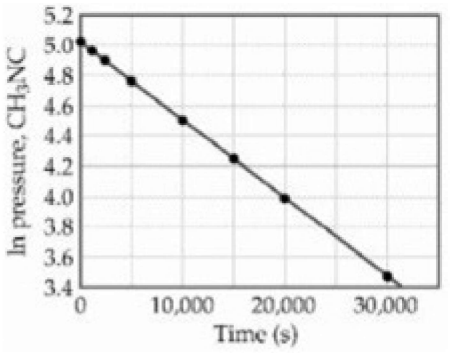
A) 0.198 B) 1.65×10^{-2} C) 0.693 D) 3.30×10^{-3} E) 1.98

Answer: D

8) At elevated temperatures, methyl isonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN):

$$CH_3NC\ (g) \rightarrow CH_3CN\ (g)$$

The reaction is first order in methylisonitrile. The attached graph shows data for the reaction obtained at 198.9 °C.



What is the rate constant (s^{-1}) for the reaction at 198.9 °C?

A) +6.2 B) $+5.2 \times 10^{-5}$ C) -1.9×10^{4} D) $+1.9 \times 10^{4}$ E) -5.2×10^{-5}

Answer: B

9) The second–order decomposition of HI has a rate constant of $1.80 \times 10^{-3}\ M^{-1}s^{-1}$. How much HI remains after 27.3 s if the initial concentration of HI is 4.78 M?

A) 4.55 M B) 3.87 M C) 0.258 M D) 2.20 M E) 2.39 M

Answer: B

10) A reaction is found to have an activation energy of 38.0 kJ/mol. If the rate constant for this reaction is $1.60 \times 10^{2}\ M^{-1}s^{-1}$ at 249 K, what is the rate constant at 349 K? (R = 8.3145 J/K–mol)

A) $4.20 \times 10^{5}\ M^{-1}s^{-1}$

B) $7.94 \times 10^{4}\ M^{-1}s^{-1}$

C) $1.26 \times 10^{3}\ M^{-1}s^{-1}$

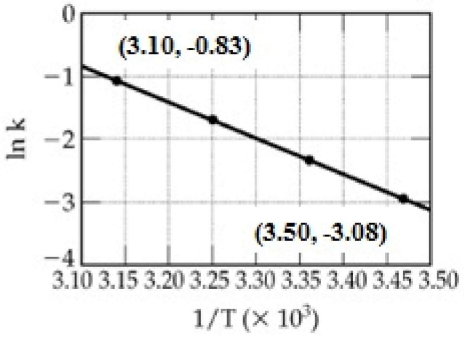
D) $2.38 \times 10^{5}\ M^{-1}s^{-1}$

E) $3.08 \times 10^{4}\ M^{-1}s^{-1}$

Answer: E

11) The rate of the reaction $CH_3COOC_2H_{5(aq)} + OH^-_{(aq)} \rightarrow CH_3COO^-_{(aq)} + C_2H_5OH(aq)$ was measured at several temperatures, and the experimental data and pretreated data are as follows:

Temperature (K)	k ($M^{-1}s^{-1}$)
288	0.0521
298	0.101
308	0.184
318	0.332



What is the energy of activation (kJ/mol) for this reaction? (R = 8.3145 J/K–mol)

A) 8.4×12^3 B) 46.8 C) 4.3×10^3 D) 5.63 E) 0.178

Answer: B

12) Which of the following is **not** an example of a dynamic equilibrium? (assume that the situation doesn't change with time)

A) a supersaturated solution
B) solid solute in saturated solution
C) solute gas and liquid solvent in a closed container
D) liquid and vapor at the normal boiling point
E) liquid and vapor in a closed container

Answer: A

Information of following three questions:

The following mechanism has been proposed for $(CH_3)_3AuPH_3$ decomposes into C_2H6 and $(CH_3)AuPH_3$:

Step 1 : $(CH_3)_3\ AuPH_3 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} (CH_3)_3\ Au + PH_3$ (fast)

Step 2 : $(CH_3)_3\ Au \xrightarrow{k_2} C_2H_6 + (CH_3)Au$ (slow)

Step 3 : $(CH_3)Au + PH_3 \xrightarrow{k_3} (CH_3)\ Au\ PH_3$ (fast)

13) What is the overall reaction?

A) $CH_3)Au \rightarrow C_2H_6 + (CH_3)AuPH_3$
B) $(CH_3)_3AuPH_3 \rightarrow (CH_3)_3Au + PH_3$
C) $(CH_3)_3AuPH_3 \rightarrow C_2H_6 + (CH_3)AuPH_3$
D) $(CH_3)_3Au \rightarrow C_2H_6 + (CH_3)Au$
E) $(CH_3)_2AuPH_3 \rightarrow C_2H_6 + AuPH_3$

Answer: C

14) How many intermediates were presented in the mechanisms?

A) 5 B) 2 C) 3 D) 4 E) 1

Answer: C

15) What is the rate law predicted by this mechanism?

A) rate = $k[C_2H_6][AuPH_3]$

B) rate = $\dfrac{k[(CH_3)AuPH_3]}{[C_2H_6]}$

C) rate = $\dfrac{k[AuPH_3]}{[C_2H_6]}$

D) rate = $\dfrac{k[(CH_3)_3AuPH_3]}{[PH_3]}$

E) rate = $k[(CH_3)_3AuPH_3][PH_3]$

Answer: D

16) Assume both the forward and reverse are elementary step in the reaction:

$$N_2O_{4(g)} \underset{k_r}{\overset{k_f}{\rightleftharpoons}} 2\,NO_{2(g)}$$

Which of the following variables are equal when the reaction reaches equilibrium?

A) k_f and k_r

B) $[N_2O_4]$ and $[NO_2]^2$

C) the forward reaction rate and reverse reaction rate

D) $[N_2O_4]$ and $[NO_2]$

E) k_f^2 and k_r

Answer: C

17) The dissolution of water in octane (C_8H_{18}) is principally **prevented** by_____.

A) dipole–dipole attraction between octane molecules

B) hydrogen bonding between water molecules

C) London dispersion forces between octane molecules

D) ion–dipole attraction between water and octane molecules

E) repulsion between like–charged water and octane molecules

Answer: B

18) Which one of the following is **the least soluble** in water?

A) $CH_3CH_2CH_2CH_2CH_2OH$

B) CH_3OH

C) CH_3CH_2OH

D) $CH_3CH_2CH_2OH$

E) $CH_3CH_2CH_2CH_2OH$

Answer: A

19) Which one of the following substances is **more likely** to dissolve in benzene (C_6H_6)?

A) HBr

B) NaCl

C) CH_3CH_2OH

D) NH_3

E) CCl_4

Answer: E

20) When solutions of strong electrolytes in water are formed, the ions are surrounded by water molecules. These interactions are described as a case of _____.
A) dehydration
B) saturation
C) crystallization
D) hydration
E) supersaturation

Answer: D

21) A solution is formed at room temperature by vigorously dissolving enough of the solid solute so that some solid remains at the bottom of the solution. Which statement below is **true**?
A) The solution is considered unsaturated.
B) The solution is considered saturated.
C) The solution is considered supersaturated.

Answer: B

22) The greatest gas solubility in water is predicted under what conditions?
A) low temperature, low partial pressure
B) low temperature, high partial pressure
C) high temperature, high partial pressure
D) high temperature, low partial pressure
E) Solubility of gases cannot be predicted.

Answer: B

23) Which of the following concentration unit is temperature **dependent**?
A) mass percent
B) molarity
C) mole fraction
D) molality
E) none of the above.

Answer: B

24) A solution contains 11% **by mass** of sodium chloride. This means that _____.
A) the density of the solution is 11 g/mL
B) 100 mL of the solution contains 11 g of sodium chloride
C) there are 11 g of sodium chloride in 1.0 mL of this solution
D) the molality of the solution is 11
E) 100 g of the solution contains 11 g of sodium chloride

Answer: E

25) A 4.55 L sample of water contains 0.115 g of sodium ions. Determine the concentration of sodium ions in ppm if the density of the solution is 1.00 g/mL.
A) 25.3 ppm B) 13.2 ppm C) 36.5 ppm D) 52.3 ppm E) 12.7 ppm

Answer: A

26) Commercial grade HCl solutions are typically 39.0% (by mass) HCl in water. Determine the **molarity** of the HCl, if the solution has a density of 1.20 g/mL. (HCl = 36.46 g/mol)
A) 12.8 M B) 7.79 M C) 13.9 M D) 10.7 M E) 9.35 M

Answer: A

27) A 0.200 m solution of which one of the following solutes will have the **low**est vapor pressure?
A) glucose B) $AlCl_3$ C) KCl D) LiCl E) $CaCl_2$

Answer: B

28) A 0.100 L solution is made by dissolving 0.441 g of $CaCl_2$ in water and the measured osmotic pressure of this solution is 2.56 atm at 27 °C. What is the **actual van't Hoff factor, i**, for the solute in this solution? (R = 0.0821 L–atm/mol–K; $CaCl_2$ = 110 g/mol)

A) 2.62 B) 3 C) 1.98 D) 1 E) 0.38

Answer: A

29) An unknown compound is composed of 65.46% C, 5.47% H, and 29.07% O. A sample weighing 5.34 g dissolved in 60.00 g H_2O, lowers the freezing point to –0.600°C. What is the molecular formula of the compound? (K_f for water = 1.86°C/m; C = 12.0, O = 16.0, H = 1.0 g/mol).

A) C_3H_3O B) $C_{15}H_{15}O_5$ C) $C_5H_{10}O$ D) $C_9H_9O_3$ E) $C_{10}H_{20}O_2$

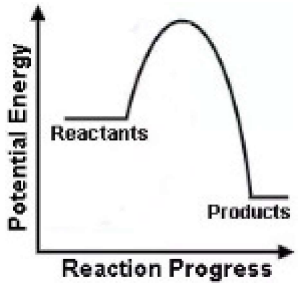
Answer: B

30) Soap has an ionic and a polar end. It works well to remove oil by

A) surrounding the oil with the polar end, and the water interacts with the nonpolar end.
B) surrounding the oil with the nonpolar end, and the water interacts with the polar end.
C) surrounding the oil and water with the polar end.
D) surrounding the oil and water with the nonpolar end.

Answer: B

31) Based on the following energy profile, predict which of following statement is correct? (k_f: forward reaction rate constant, k_r: reverse reaction rate constant, K_c: equilibrium constant.)



A) $k_f = k_r$ and $K_c = 1$
B) $k_f > k_r$ and $K_c > 1$
C) $k_f > k_r$ and $K_c < 1$
D) $k_f < k_r$ and $K_c < 1$
E) $k_f < k_r$ and $K_c > 1$

Answer: B

32) For which of the following values of K_c will the equilibrium mixture consist almost entirely of reactants?

A) 1.00 B) 1×10^{-10} C) 0.030 D) 30 E) 4×10^{8}

Answer: B

33) Which one of the following will change the value of an equilibrium constant?

A) varying the initial concentrations of products
B) changing temperature
C) varying the initial concentrations of reactants
D) changing the volume of the reaction vessel
E) adding other substances that do not react with any of the species involved in the equilibrium

Answer: B

34) For which of the following reactions does $K_p = K_c$?

A) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

B) $3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$

C) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

D) $2\ Cl_2(g) + 2\ H_2O(g) \rightleftharpoons 4\ HCl(g) + O_2(g)$

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

Answer: B

35) Given the following:

I) $N_2O(g) + 1/2\ O_2(g) \rightleftharpoons 2NO(g)$ $\quad K_c = 1.7 \times 10^{-13}$

II) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ $\quad K_c = 4.1 \times 10^{-31}$

Find the value of equilibrium constant (K_c) for the following equilibrium reaction:

$$N_2(g) + 1/2\ O_2(g) \rightleftharpoons N_2O(g)$$

A) 7.0×10^{-44} B) 2.6×10^{-22} C) 1.6×10^{-9} D) 4.2×10^{17} E) 2.4×10^{-18}

Answer: E

36) Write the equilibrium constant (K_c) expression for the reaction:

$$3\ Sn(s) + 4\ HNO_3(aq) + H_2O(l) \rightleftharpoons 3\ H_2SnO_3(s) + 4\ NO(g)$$

A) $K_c = \dfrac{[H_2SnO_3]^3[NO]^4}{[Sn]^3[HNO_3]^4[H_2O]}$

B) $K_c = \dfrac{[NO]^4}{[HNO_3]^4}$

C) $K_c = \dfrac{[H_2SnO_3]^3[NO]^4}{[Sn]^3[HNO_3]^4}$

D) $K_c = \dfrac{[H_2SnO_3][NO]}{[Sn][H_2O][HNO_3]}$

E) $K_c = \dfrac{[H_2SnO_3]^3[NO]^4}{[HNO_3]^4}$

Answer: B

37) A mixture is prepared with [CO] = 0.035, $[Cl_2]$ = 0.015, and $[COCl_2]$ = 0.95. It is known that K_c for the equilibrium $CO\ (g) + Cl_2\ (g) \rightleftharpoons COCl_2\ (g)$ is 1.2×10^3 at 400°C. Predict what will happen.

A) The reaction occurs in the reverse direction.

B) The reaction occurs in the forward direction.

C) The reaction is at equilibrium so no net reaction occurs.

Answer: A

38) A chemical equilibrium has been established for the following system:

$$\underset{\text{(pink)}}{Co(H_2O)_6^{2+}(aq)} + 4\ Cl^-(aq) \rightleftharpoons \underset{\text{(blue)}}{CoCl_4^{2-}(aq)} + 6H_2O(l)$$

What the system will undergo if hydrochloric acid is added?

A) The equilibrium will shift to the left.

B) The equilibrium constant will be increased.

C) It should become more blue.

D) More $Co(H_2O)_6^{2+}$ will be produced.

E) It should become more pink.

Answer: C

39) The process of dissolving $CaSO_4$ in water is known to be exothermic:

$$CaSO_{4(s)} \rightleftharpoons Ca^{2+}_{(aq)} + SO_4^{2-}(aq)$$

If the temperature of the solution is decreased, $CaSO_4$ becomes:

A) Less soluble
B) More soluble
C) No change in solubility occurs

Answer: B

40) A mixture of 1.374 g of H_2 and 70.31 g of Br_2 is heated in a 2.00 L vessel at 700 K. These substances react according to $H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr_{(g)}$. At equilibrium, the vessel is found to contain 0.566 g of H_2. What is the equilibrium constant (K_c) for this reaction? (MW: H_2 = 2.0159; Br_2 = 159.81)

A) 146 B) 3.32×10^{-3} C) 0.261 D) 58.5 E) 6.67

Answer: D