1092-1st Midterm Exam_04/14/21_(A)

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

1) The vapor pressure of pure ethanol at 333 K is 0.459 atm. Raoult's Law predicts that a solution prepared by dissolving 10.0 mmol naphthalene (nonvolatile) in 90.0 mmol ethanol will have a vapor pressure of __________ atm.

A) 0.367 B) 0.413 C) 0.0918 D) 0.498 E) 0.790

Answer: B

2) At 293 k, a 4.79 M aqueous solution of ammonium chloride has a density of 1.0674 g/mL. What is the molality of ammonium chloride in the solution? The formula weight of NH_4Cl is 53.50 g/mol.

A) 0.0955 B) 4.79 C) 24.00 D) 0.223 E) 5.90

Answer: E

3) The osmotic pressure of a solution formed by dissolving 85.0 mg of aspirin ($C_9H_8O_4$) in 0.250 L of water at 25 °C is __________ atm. (R = 0.0821 L-atm / mol-K)

A) 0.0462 B) 4.68 C) 3.88×10^{-3} D) 46.2 E) 8.32

Answer: A

4) The ratio of the actual value of a colligative property to the value calculated, assuming the substance to be a nonelectrolyte, is referred to as __________.

A) vapor pressure lowering
B) freezing point depression
C) osmotic pressure
D) Henry's law
E) the van't Hoff factor

Answer: E

5) Which one of the following substances is more likely to dissolve in CCl_4?

A) HCl
B) NaCl
C) HBr
D) CH_3CH_2OH
E) CBr_4

Answer: E

6) A solution contains 15 ppm of benzene. The density of the solution is 1.00 g/mL. This means that __________.

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

Answer: D

7) The concentration of sodium chloride in an aqueous solution that is 2.02 M and that has a density of 1.01 g/mL is __________% by mass.

A) 7.83 B) 2.01 C) 118 D) 11.7 E) 18.1

Answer: D

8) A solution containing 15.0 g of an unknown liquid and 90.0 g water has a freezing point of -3.33 °C. Given K_f = 1.86°C/m for water, the molar mass of the unknown liquid is __________ g/mol.

A) 333 B) 69.0 C) 93.0 D) 161 E) 619

Answer: C

9) The concentration of HCl in a solution that is prepared by dissolving 11 g of HCl in 200 g of C_2H_6O is __________ molal.

A) 27.5 B) 3.3×10^{-2} C) 7.5×10^{-4} D) 1.3 E) 1.5

Answer: E

10) A solution is prepared by dissolving 6.50 g of glycerin ($C_3H_8O_3$) in 201 g of ethanol (C_2H_5OH). The freezing point of the solution is __________°C. The freezing point of pure ethanol is -114.6 °C at 1 atm. The molal-freezing-point-depression constant (K_f) for ethanol is 1.99 °C/m. The molar masses of glycerin and of ethanol are 92.1 g/mol and 46.1 g/mol, respectively.

A) 0.699 B) -120.8 C) -108.4 D) -113.9 E) -115.3

Answer: E

11) A solution is prepared by dissolving 13.0 g of NH_3 in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The mole fraction of NH_3 in the solution is __________.

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

Answer: B, E

12) Pressure has an appreciable effect on the solubility of __________ in liquids.

A) solids and liquids
B) gases
C) salts
D) liquids
E) solids

Answer: B

13) Calculate the freezing point of a 0.05500 m aqueous solution of $NaNO_3$. The molal freezing-point-depression constant of water is 1.86 °C/m.

A) -0.0562 B) -0.106 C) 0.0286 D) 0.106 E) -0.205

Answer: E

14) Of the concentration units below, only __________ is temperature dependent.

A) molality B) mass % C) molarity D) ppm E) ppb

Answer: C

15) The rate constant for a reaction is 0.13 $M^{-1}s^{-1}$. If the initial concentration of reactant is 0.26 mol/L, it takes __________ s for the concentration to decrease to 0.11 mol/L.

A) 0.017 B) 9.1 C) 5.2 D) 0.68 E) 40.

Answer: E

16) A reaction was found to be zero order in A. Increasing the concentration of A by a factor of 3 will cause the reaction rate to __________.

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

Answer: B

The peroxydisulfate ion ($S_2O_8^{2-}$) *reacts with the iodide ion in aqueous solution via the reaction:*

$$S_2O_8^{2-}\ (aq) + 3I^- \rightarrow 2SO_4\ (aq) + I_3^-\ (aq)$$

An aqueous solution containing 0.050 M *of* $S_2O_8^{2-}$ *ion and* 0.072 M *of* I^- *is prepared, and the progress of the reaction followed by measuring* [I^-]. *The data obtained is given in the table below.*

Time (s)	0.000	400.0	800.0	1200.0	1600.0
[I^-] (M)	0.072	0.057	0.046	0.037	0.029

17) The concentration of $S_2O_8^{2-}$ remaining at 1600 s is __________ M.

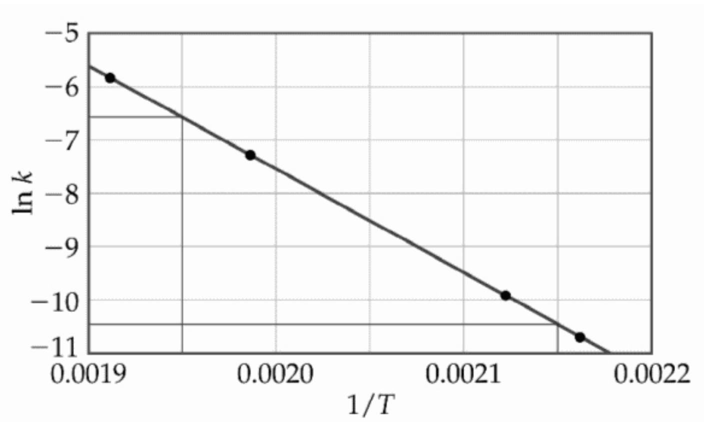
A) 0.029 B) 0.064 C) 0.014 D) 0.043 E) 0.036

Answer: E

18) At elevated temperatures, methylisonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN):

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

The dependence of the rate constant on temperature is studied and the graph below is prepared from the res



The energy of activation of this reaction is __________ kJ/mol.

A) 4.4×10^{-7} B) 4.4×10^{-4} C) 1.9×10^{4} D) 160 E) 1.6×10^{5}

Answer: D

A flask is charged with 0.124 mol of A *and allowed to react to form* B *according to the reaction* A(g) →B(g). *The following data are obtained for* [A] *as the reaction proceeds:*

Time (s)	0.00	10.0	20.0	30.0	40.0
Moles of A	0.124	0.110	0.088	0.073	0.054

19) The average rate of disappearance of A between 20 s and 40 s is __________ mol/s.

A) 1.4×10^{-3} B) 1.7×10^{-3} C) 8.5×10^{-4} D) 7.1×10^{-3} E) 590

Answer: B

20) If the rate law for the reaction

$$2A + 3B \rightarrow \text{products}$$

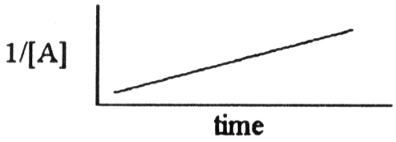
is first order in A and second order in B, then the rate law is rate = __________.

A) k[A][B] B) $k[A]^2[B]^3$ C) $k[A]^2[B]^2$ D) $k[A][B]^2$ E) $k[A]^2[B]$

Answer: D

21) Which one of the following graphs shows the correct relationship between concentration and time for a reaction that is second order in [A]?

A)



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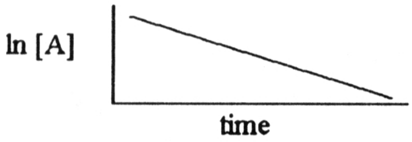

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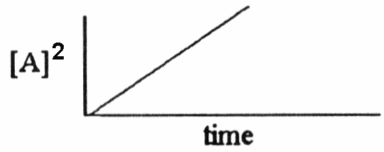

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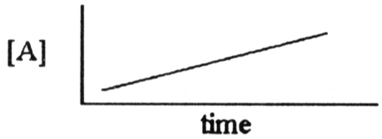
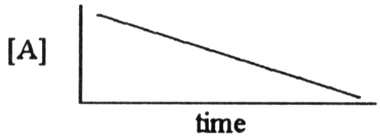


E)



Answer: A

22) The reaction

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

follows second-order kinetics. At 300 °C, $[NO_2]$ drops from 0.0100 M to 0.00650 M in 100.0 s. The rate constant for the reaction is _________ $M^{-1}s^{-1}$.

A) 0.096 B) 0.54 C) 0.65 D) 0.81 E) 1.2

Answer: B

23) At elevated temperatures, dinitrogen pentoxide decomposes to nitrogen dioxide and oxygen:

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

When the rate of formation of NO_2 is 5.5×10^{-4} M/s, the rate of decomposition of N_2O_5 is ________ M/s.

A) 10.1×10^{-4} B) 5.5×10^{-4} C) 2.8×10^{-4} D) 1.4×10^{-4} E) 2.2×10^{-3}

Answer: C

24) A particular first-order reaction has a rate constant of 1.35×10^{2} s^{-1} at 25.0 °C. What is the magnitude of k at 75.0°C if E_a = 75.5 kJ/mol?

A) 3.40×10^{6} B) 1.36×10^{2} C) 1.08×10^{4} D) 3.06×10^{4} E) 591

Answer: C

25) The isomerization of methylisonitrile to acetonitrile

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

is first order in CH_3NC. The rate constant for the reaction is $3.22 \times 10^{-4}\ s^{-1}$ at 493 K. The half-life of the reaction when the initial $[CH_3NC]$ is 0.030 M is __________ s.

A) 1.04×10^5 B) 2.15×10^3 C) 1.55×10^3 D) 4.64×10^{-4} E) 3.11×10^3

Answer: B

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

26) The magnitude of the rate constant is __________.

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

Answer: D

27) 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 0.00750 M in 100 s. The rate of appearance of O_2 for this period is __________ M/s.

A) 2.5×10^{-5} B) 5.0×10^{-3} C) 2.5×10^{-3} D) 1.3×10^{-5} E) 5.0×10^{-5}

Answer: D

28) The combustion of ethylene proceeds by the reaction

$C_2H_4\ (g) + 3O_2\ (g) \rightarrow 2CO_2\ (g) + 2H_2O\ (g)$

When the rate of disappearance of O_2 is 0.33 M s^{-1}, the rate of appearance of CO_2 is __________ M s^{-1}.

A) 0.50 B) 0.99 C) 0.66 D) 0.11 E) 0.22

Answer: E

29) Given the following reaction at equilibrium at 300.0 K:

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

If $pNH_3 = pH_2S = 0.111$ atm, K_p = __________.

A) 5.66×10^{-3} B) .0123 C) 4.99×10^{-4} D) .0821 E) .111

Answer: B

30) Given the following reaction at equilibrium, if $K_c = 5.84 \times 10^5$ at 230.0 °C, K_p = __________.

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

A) 2.40×10^6 B) 1.41×10^4 C) 2.41×10^7 D) 3.67×10^{-2} E) 6.44×10^5

Answer: B

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

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

is 4.2×10^{-31} at 27 °C. What is the value of K_{eq} for the equilibrium below?

$$4\ NO\ (g) \rightleftharpoons 2\ N_2\ (g) + 2\ O_2\ (g)$$

A) 8.4×10^{-31}
B) 4.2×10^{31}
C) 8.4×10^{31}
D) 5.7×10^{60}
E) none of the above

Answer: D

32) 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

33) Given the following reaction at equilibrium at 450.0 °C:

$$CaCO_3\ (s) \rightleftharpoons CaO\ (s) + CO_2\ (g)$$

If pCO_2 = 0.0170 atm, K_c = __________.

A) 0.0821 B) 10.1 C) 1.01 D) 170 E) 2.86×10^{-4}

Answer: E

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

Answer: E

35) 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 100 °C, 0.0055 mol of N_2O_4 remains. K_{eq} for this reaction is __________.

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

Answer: B

36) In the coal-gasification process, carbon monoxide is converted to carbon dioxide via the following reaction:

$$CO\,(g) + H_2O\,(g) \rightleftharpoons CO_2\,(g) + H_2\,(g)$$

In an experiment, 0.35 mol of CO and 0.40 mol of H_2O were placed in a 1.00-L reaction vessel. At equilibrium, there were 0.17 mol of CO remaining. K_{eq} at the temperature of the experiment is ________

A) 0.75 B) 5.5 C) 1.2 D) 1.0 E) 0.87

Answer: E

37) Consider the following chemical reaction:

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

At equilibrium in a particular experiment, the concentrations of H_2, I_2, and HI were 0.15 M, 0.033 M, and 0.55 M, respectively. The value of K_{eq} for this reaction is __________.

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

Answer: C

38) The expression for K_p for the reaction below is __________.

$$4CuO\ (s) + CH_4\ (g) \rightleftharpoons CO_2\ (g) + 4Cu\ (s) + 2H_2O\ (g)$$

A) $\dfrac{[Cu]\ P_{CO_2}\ P_{H_2O}{}^2}{[CuO]^4\ P_{CH_4}}$

B) $\dfrac{P_{CO_2}\ P_{H_2O}{}^2}{P_{CH_4}}$

C) $\dfrac{P_{CH_4}}{P_{H_2O}{}^2\ P_{CO_2}}$

D) $\dfrac{P_{CH_4}}{P_{CO_2}\ P_{H_2}{}^2}$

E) $\dfrac{P_{CO_2}\ P_{H_2O}{}^2}{P_{CuO}}$

Answer: B

39) The equilibrium expression for K_p for the reaction below is __________.

$$2O_3\ (g) \rightleftharpoons 3O_2\ (g)$$

A) $\dfrac{2P_{O_3}}{3P_{O_2}}$ B) $\dfrac{3P_{O_3}}{2P_{O_2}}$ C) $\dfrac{P_{O_3}{}^2}{P_{O_2}{}^2}$ D) $\dfrac{3P_{O_2}}{2P_{O_3}}$ E) $\dfrac{P_{O_2}{}^3}{P_{O_3}{}^2}$

Answer: E

40) The equilibrium expression for K_p for the reaction below is __________.

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

A) $\dfrac{(P_{O_2})\,(P_{N_2})}{P_{NO}}$

B) $\dfrac{(2P_{NO})}{(2P_{N_2})(2P_{O_2})}$

C) $\dfrac{(P_{O_2})\,(P_{N_2})}{2P_{NO}}$

D) $\dfrac{(2P_{O_2})\,(2P_{N_2})}{2P_{NO}}$

E) none of the above

Answer: E