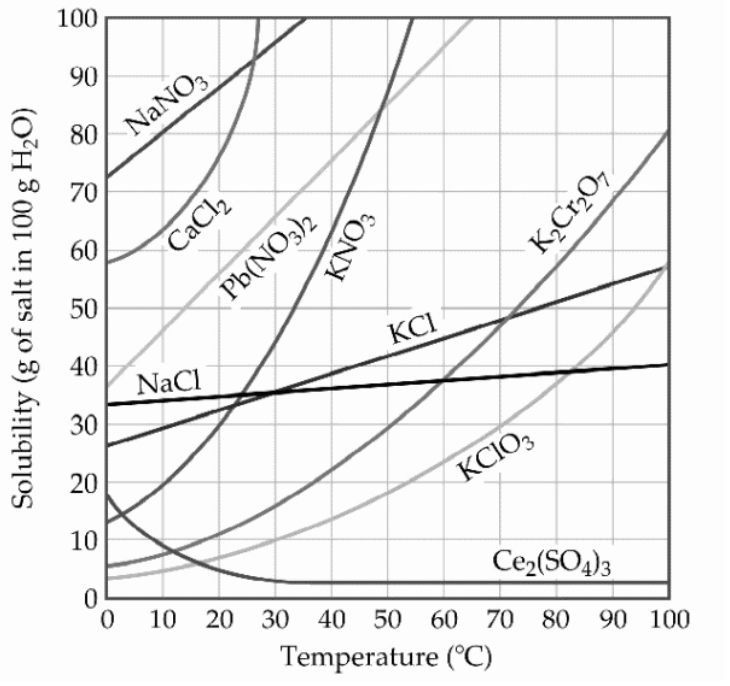
1062-1st Chem Exam-1070411(A)

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

1) 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) hydration
   B) supersaturation
   C) saturation
   D) crystallization
   E) dehydration

Answer: A



2) According to the above solubility vs. temperature figure, a sample of potassium nitrate (49.0 g) is dissolved in 101 g of water at 100 °C, with precautions taken to avoid evaporation of any water. When the solution is cooled to 30.0 °C and no precipitate is observed. This solution is _____.
   A) hydrated
   B) placated
   C) saturated
   D) unsaturated
   E) supersaturated

Answer: E

3) A solution is prepared by dissolving 15.0 g of NH_3 in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The molality of NH_3 in the solution is _____ m.
   A) 3.53 B) 0.00353 C) 60.0 D) 3.24 E) 0.882

Answer: A

4) What is the mole fraction of sodium chloride in aqueous solution that is 13.0% by mass sodium chloride and that has a density of 1.10 g/mL?

A) 0.505 B) 0.223 C) 0.483 D) 0.0462 E) 0.0442

Answer: E

5) Which of the following statements is false?

A) Nonpolar liquids tend to be insoluble in polar liquids.
B) The solubility of gases in water decreases with increasing temperature.
C) Substances with similar intermolecular attractive forces tend to be soluble in one another.
D) The solubility of a gas increases in direct proportion to its partial pressure above the solution.
E) The weaker the attraction between the solute and solvent molecules, the greater the solubility.

Answer: E

6) Colligative properties of solutions include all of the following except _____.

A) an increase in the osmotic pressure of a solution upon the addition of more solute
B) elevation of the boiling point of a solution upon addition of a solute to a solvent
C) depression of vapor pressure upon addition of a solute to a solvent
D) the increase of reaction rates with increase in temperature
E) depression of the freezing point of a solution upon addition of a solute to a solvent

Answer: D

7) Which of the following aqueous solutions will have the highest boiling point?

A) 0.20 m glucose
B) 0.10 m NaCl
C) 0.25 m sucrose
D) 0.10 m Na_2SO_4
E) 0.10 m $SrSO_4$

Answer: D

8) The principal reason for the extremely low solubility of NaCl in benzene (C_6H_6) is the _____.

A) weak solvation of Na^+ and Cl^- by C_6H_6
B) strength of the covalent bond in NaCl
C) hydrogen bonding in C_6H_6
D) strong solvent-solvent interactions
E) increased disorder due to mixing of solute and solvent

Answer: A

9) Which one of the following concentration units varies with temperature?

A) mass percent
B) molality
C) molarity
D) mole fraction
E) all of the above

Answer: C

10) The osmotic pressure of a solution formed by dissolving 45.0 mg of aspirin ($C_9H_8O_4$) in 0.250 L of water at 25 °C is _____ atm.

A) 24.5 B) 4.41 C) 2.05×10^{-3} D) 2.48 E) 0.0245

Answer: E

11) At 20 °C, an aqueous solution that is 12.0% by mass in ammonium chloride has a density of 1.0344 g/mL. What is the molarity of ammonium chloride in the solution? The formula weight of NH_4Cl is 53.50 g/mol.

A) 11.6 B) 2.55 C) 0.232 D) 2.32 E) 0.0862

Answer: D

12) A solution contains 30 ppm of benzene. The density of the solution is 1.00 g/mL. This means that _____.

A) the molarity of the solution is 30 M
B) there are 30 mg of benzene in 1.0 L of this solution
C) 100 g of the solution contains 30 g of benzene
D) the solution is 30% by mass of benzene
E) 100 g of the solution contains 30 mg of benzene

Answer: B

13) 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) 0.54 B) 0.096 C) 0.65 D) 1.2 E) 0.81

Answer: A

Please answer question 14 and 15 based on the table below:

$$2\,ClO_2\,(aq) + 2\,OH^-\,(aq) \rightarrow ClO_3^-\,(aq) + ClO_2^-\,(aq) + H_2O\,(1)$$

Experiment Number	$[ClO_2]$ (M)	$[OH^-]$ (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

14) What is the overall order of the reaction?

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

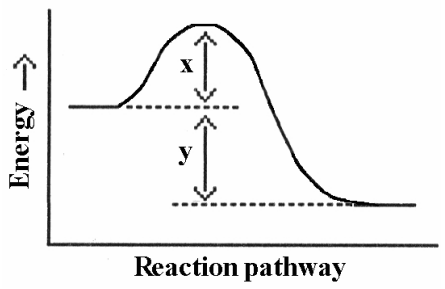
Answer: D

15) What is the magnitude of the rate constant for the reaction?

A) 4.6 B) 713 C) 230 D) 1.15×10^4 E) 115

Answer: C

16) Which energy difference in the energy profile below corresponds to the activation energy for the reversed reaction?



A) x B) y C) y - x D) x - y E) x + y

Answer: E

17) The half-life of a first-order reaction is 13 min. If the initial concentration of reactant is 0.13 M, it takes _____ min for it to decrease to 0.085 M.

A) 8.0 B) 10. C) 7.0 D) 11 E) 12

Answer: A

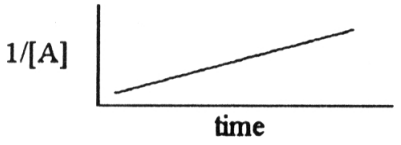
18) In general, as activation energy increases, reaction rate _____.

A) stays the same regardless of whether the reaction is exothermic or endothermic
B) goes down regardless of whether the reaction is exothermic or endothermic
C) goes down if the reaction is endothermic
D) goes down if the reaction is exothermic
E) none of the above

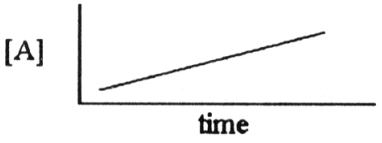
Answer: B

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

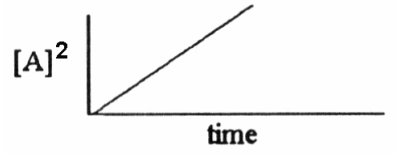
A)



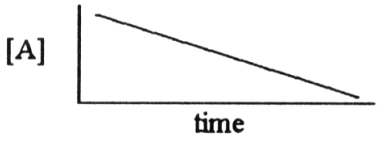
B)



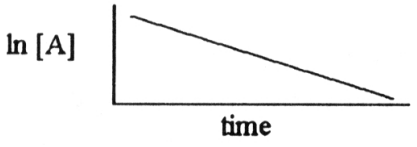
C)



D)



E)



Answer: A

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

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

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

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

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

Answer: D

21) A catalyst can increase the rate of a reaction _____.
A) by increasing the overall activation energy (E_a) of the reaction
B) by changing the value of the frequency factor (A)
C) by increasing the value of equilibrium constant (K)
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

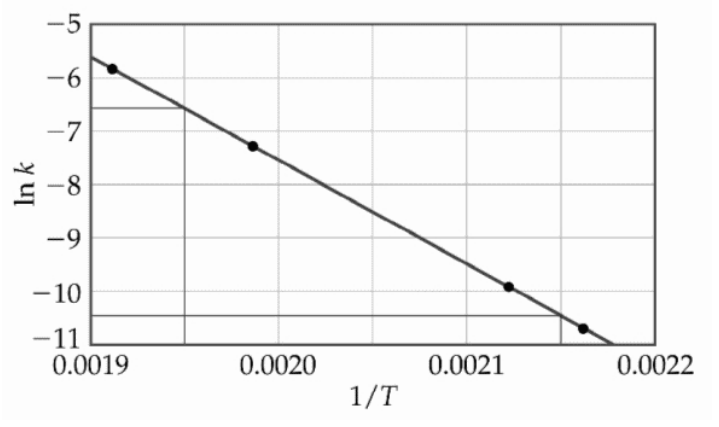
22) As the temperature of a reaction is increased, the rate of the reaction increases because the _____.
A) reactant molecules collide more frequently and with greater energy per collision
B) activation energy is lowered
C) reactant molecules collide less frequently and with greater energy per collision
D) reactant molecules collide less frequently
E) reactant molecules collide more frequently with less energy per collision

Answer: A

23) 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 results.



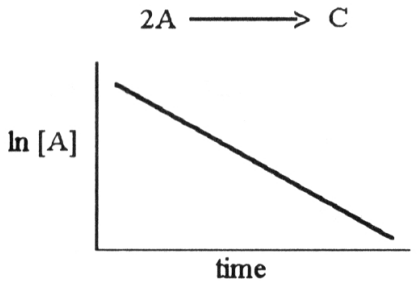
The energy of activation of this reaction is _____ kJ/mol.
A) 1.6×10^5 B) 4.4×10^{-7} C) 1.9×10^4 D) 160 E) 4.4×10^{-4}

Answer: D

24) The rate of a reaction depends on _____.
A) collision energy
B) collision frequency
C) collision orientation
D) all of the above
E) none of the above

Answer: D

25) The graph shown below depicts the relationship between concentration and time for the following chemical reaction.



The slope of this line is equal to _____.

A) -1/k B) $\ln [A]_0$ C) -k D) k E) 1/k

Answer: C

26) The rate constant for a particular zero-order reaction is 0.075 M s^{-1}. If the initial concentration of reactant is 0.537 M it takes _____ s for the concentration to decrease to 0.100 M.

A) 5.8 B) -0.047 C) -5.8 D) 0.040 E) 7.2

Answer: A

27) At equilibrium, _____.

A) all chemical reactions have ceased
B) the rate constants of the forward and reverse reactions are equal
C) the rates of the forward and reverse reactions are equal
D) the value of the equilibrium constant is 1
E) the limiting reagent has been consumed

Answer: C

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

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

Answer: A

29) The equilibrium expression for K_p for the reaction below is _____.

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

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

Answer: D

30) The K_{eq} for the equilibrium below is 7.52×10^{-2} at 480.0 °C.

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

What is the value of K_{eq} at this temperature for the following reaction?

$$2HCl\,(g) + \frac{1}{2}O_2\,(g) \rightleftharpoons Cl_2\,(g) + H_2O\,(g)$$

A) 5.66×10^{-3} B) 0.274 C) 3.65 D) -0.0376 E) 13.3

Answer: C

31) Given the following reaction at equilibrium, if $K_c = 1.90 \times 10^{19}$ at 25.0 °C, K_p = _____.

$$H_2\,(g) + Br_2\,(g) \rightleftharpoons 2\,HBr\,(g)$$

A) 1.56×10^{4}
B) 1.90×10^{19}
C) 6.44×10^{5}
D) 5.26×10^{-20}
E) none of the above

Answer: B

32) How is the reaction quotient used to determine whether a system is at equilibrium?
A) At equilibrium, the reaction quotient is undefined.
B) The reaction is at equilibrium when $Q = K_{eq}$.
C) The reaction is at equilibrium when $Q > K_{eq}$.
D) The reaction is at equilibrium when $Q < K_{eq}$
E) At equilibrium, the reaction quotient can be either $Q > K_{eq}$ or $Q < K_{eq}$.

Answer: B

33) Of the following equilibria, only _____ will shift to the right in response to a decrease in volume.
A) $2HI\,(g) \rightleftharpoons H_2\,(g) + I_2\,(g)$
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) $N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$
E) $2\,Fe_2O_3\,(s) \rightleftharpoons 4\,Fe\,(s) + 3O_2\,(g)$

Answer: D

34) 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) a decrease in the total pressure (T constant)
B) addition of some N_2 to the reaction vessel (V and T constant)
C) some removal of NH_3 from 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: A

35) The effect of a catalyst on an equilibrium is to _____.

A) increase the rate at which equilibrium is achieved without changing the composition of the equilibrium mixture
B) increase the rate of the forward reaction only
C) shift the equilibrium to the right
D) increase the equilibrium constant so that products are favored
E) slow the reverse reaction only

Answer: A

36) Consider the following chemical reaction:

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

At equilibrium in a particular experiment, the concentrations of CO and H_2 were 0.15 M and 0.36M, respectively. What is the equilibrium concentration of CH_3OH? The value of K_{eq} for this reaction is 14.5 at the temperature of the experiment.

A) 7.61×10^{-3} M
B) 2.82×10^{-1} M
C) 14.5 M
D) 3.72×10^{-3} M
E) 1.34×10^{-3} M

Answer: B

37) 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) 2.80
C) 17.5
D) 14.5
E) none of the above

Answer: C

38) For the endothermic reaction

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

Le Châtelier's principle predicts that _____ will result in an increase in the number of moles of CO_2.

A) decreasing the temperature
B) increasing the temperature
C) increasing the pressure
D) removing some of the $CaCO_3(s)$
E) none of the above

Answer: B

39) 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 removing O_2 (g) to the reaction container will _____.

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

Answer: C

40) Phosphorous trichloride and phosphorous pentachloride equilibrate in the presence of molecular chlorine according to the reaction:

$$PCl_3\,(g) + Cl_2\,(g) \rightarrow PCl_5\,(g)$$

An equilibrium mixture at 450 K contains
$P_{PCl_3} = 0.224$ atm,
$P_{Cl_2} = 0.284$ atm, and
$P_{PCl_5} = 4.24$ atm. What is the value of K_p at this temperature?

A) 3.74 B) 1.50×10^{-2} C) 66.6 D) 8.36 E) 2.70×10^{-1}

Answer: C