1042_1st Exam_1050330(A)

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

1) For the reaction: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ the rate law is:

$$\frac{\Delta[O_2]}{\Delta t} = k[N_2O_5]$$

At 300 K, the half-life is 2.50×10^4 seconds and the activation energy is 103.3 kJ/mol O_2. At the time when N_2O_5 is being consumed at a rate of 1.2×10^{-4} M/s, what is the rate at which NO_2 is being formed?

A) 3.0×10^{-5} M/s
B) 2.4×10^{-4} M/s
C) 6.0×10^{-5} M/s
D) 1.2×10^{-4} M/s
E) 4.8×10^{-4} M/s

Answer: B

2) The reaction has the rate law Rate = $k[A][B]^2$. Which will cause the rate to increase the most?

A) doubling [A]
B) quadrupling [A]
C) tripling [B]
D) doubling [B]
E) lowering temperature

Answer: C

3) The reaction A + B $\rightarrow$ C + D is second order in A and zero order in B. The value of k is 0.012 M^{-1} min^{-1}. What is the rate of this reaction when [A] = 0.125 M and [B] = 0.435 M?

A) 3.4×10^{-3} M min^{-1}
B) 1.3 M min^{-1}
C) 1.5×10^{-3} M min^{-1}
D) 1.9×10^{-4} M min^{-1}
E) 5×10^{-4} M min^{-1}

Answer: D

4) Data for the reaction A + B $\rightarrow$ C are given below. Find the rate constant for this system.

Experiment	[A], M	[B], M	Initial rate, M/s
1	0.030	0.060	2.5×10^{-5}
2	0.030	0.020	2.5×10^{-5}
3	0.060	0.060	10.0×10^{-5}

A) 2.8×10^{-2} M^2s^{-1}
B) 1.7×10^{-3} $M^{-1}s^{-1}$
C) 2.8×10^{-2} Ms^{-1}
D) 2.8×10^{-2} $M^{-1}s^{-1}$
E) 1.7×10^{-3} Ms^{-1}

Answer: D

5) In the first order, reaction A →products, [A] = 0.400 M initially and 0.250 M after 15.0 min, what will [A] be after 175 min?

A) 1.04×10^{-3} M
B) 2.31×10^{-1} M
C) 1.67×10^{-3} M
D) 3.70×10^{-2} M
E) 6.024×10^{-3} M

Answer: C

6) For the reaction A →products, the following data are obtained:

[A] = 1.512 M, t = 0 min
[A] = 1.490 M, t = 1.0 min
[A] = 1.469 M, t = 2.0 min

What is the rate constant, k, for the reaction?

A) 1.4×10^{-2} M^{-1} min^{-1}
B) 2.2×10^{-2} M^{-1} min^{-1}
C) 9.7×10^{-3} M^{-1} min^{-1}
D) 1.0×10^{-2} M^{-1} min^{-1}
E) 3.6×10^{-3} M^{-1} min^{-1}

Answer: C

7) A variable that has NO effect on reaction rate is:

A) energy of activation
B) concentration
C) catalyst
D) temperature
E) none of these

Answer: E

8) What is the rate constant at 305 K for the reaction:

$2N_2O_5 \rightarrow 2N_2O_4 + O_2$,

if $k = 3.46 \times 10^{-5}$ s^{-1} at 298 K and E_a = 106 kJ/mol?

A) 2.4×10^{-5} s^{-1}
B) 1.2×10^{-5} s^{-1}
C) 4.8×10^{-5} s^{-1}
D) 9.2×10^{-5} s^{-1}
E) 6.0×10^{-5} s^{-1}

Answer: D

9) For the reaction: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ the rate law is:

$$\frac{\Delta[O_2]}{\Delta t} = k[N_2O_5]$$

At 300 K, the half-life is 2.50×10^4 seconds and the activation energy is 103.3 kJ/mol O_2. What is the halflife at 310 K?

A) 6.57×10^3 s B) 2.49×10^4 s C) 9.51×10^6 s D) 1.87×10^{-1} s E) 9.51×10^4 s

Answer: A

10) What is the rate law for the following reaction and mechanism?

$2HgCl_2 + C_2O_4^{2-} \rightarrow 2Cl^- + 2CO_2 + Hg_2Cl_2$ (overall reaction)

$HgCl_2 + C_2O_4^{2-} \rightleftharpoons HgCl_2C_2O_4^{2-}$ (F)

$HgCl_2C_2O_4^{2-} + C_2O_4^{2-} \rightarrow Hg + 2Cl^- + CO_2 + C_2O_4CO_2^{2-}$ (S)

$Hg + HgCl_2 \rightarrow HgCl_2$ (F)

$C_2O_4CO_2^{2-} \rightarrow C_2O_4^{2-} + CO_2$ (F)

A) Rate = $k[HgCl_2][C_2O_4^{2-}]$

B) Rate = $k[HgCl_2]^2[C_2O_4^{2-}]$

C) Rate = $k[HgCl_2]^2[C_2O_4^{2-}]^2$

D) Rate = $k[HgCl_2]$

E) Rate = $k[HgCl_2][C_2O_4^{2-}]^2$

Answer: E

11) The first order reaction A $\rightarrow$ products has $t_{1/2}$ = 150 sec. What percent of the sample remains unreacted after 300 sec?

A) 100% B) 50% C) 0.0% D) 25% E) 12.5%

Answer: D

12) If the half-life of a reaction depends on the concentration of the reactant, then the reaction cannot be _____ order.

A) third
B) zero
C) second
D) first
E) none of these

Answer: D

13) The rate constant for a first-order reaction is $k = 0.00073\ s^{-1}$. Determine the percent of reactant that has decomposed after 500 s.

A) 69% B) 43% C) 31% D) 57% E) 37%

Answer: C

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

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

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

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

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

Answer: A

15) Given the following:

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

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

Find the value of the equilibrium constant for the following equilibrium reaction:

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

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

Answer: B

16) Consider the following reaction.
$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$
At equilibrium at a certain temperature, $[H_2O(g)] = 0.12$ M, and $[CO(g)] = [H_2(g)] = 1.2$ M. If suddenly these concentrations are increased by 0.50 M, which of the following is true?

A) Since K_c does not change, nothing happens.
B) more products are formed
C) $K_c = 4.66$
D) more $H_2O(g)$ will be formed

Answer: B

17) For the reaction: $3\ Fe(s) + 4\ H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4\ H_2(g)$ what is the effect on equilibrium of increasing temperature of an exothermic reaction?

A) The reaction shifts to the right.
B) The K_p is doubled.
C) The reaction shifts to the left.
D) The K_p is decreased.
E) There is no change.

Answer: C, D

18) For the reaction; $N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$, the equilibrium amount of NH_3 will be increased by:
I. increaseing the pressure II. adding H_2 III. removing N_2 IV. decreasing the pressure

A) III only B) II, III C) I, II D) I, III E) II, IV

Answer: C

19) For the following reaction
$O_2(g) \rightleftharpoons 2O(g)$
what conditions favor production of oxygen atoms?

A) low temperature and high pressure
B) high temperature and high pressure
C) high temperature and low pressure
D) low temperature and low pressure

Answer: C

20) Consider the following equation:
$N_2O_4(g) \rightleftharpoons 2\ NO_2(g)$ $K_c = 5.8 \times 10^{-3}$
If the initial concentration of $N_2O_4(g) = 0.040$ M and the initial concentration of $NO_2(g)$ is 0 M, what is the equilibrium concentration of $N_2O_4(g)$?

A) 2.3×10^{-6} M
B) 3.3×10^{-2} M
C) 1.9×10^{-2} M
D) 1.7×10^{-2} M
E) 2.6×10^{-2} M

Answer: B

21) For the reaction $2\ NO(g) \rightleftharpoons N_2O_4(g)$ K_p equals:

A) $K_c(RT)$ B) RT/K_c C) K_c D) K_c/RT E) $K_c(RT)^2$

Answer: D

22) Given the following reactions,

$2PCl_3(g) \rightleftharpoons 2P(g) + 3Cl_2(g)$ $K_c = 0.0667$

$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ $K_c = 4.0$

calculate K_c for the reaction below.

$2P(g) + 5Cl_2(g) \rightleftharpoons 2PCl_5(g)$

A) 23 B) 240 C) 1.1 D) 60

Answer: B

23) For a reaction, the reaction quotient, $Q_c > K$, the reaction:

A) shifts to the left
B) shifts to the right
C) is exothermic
D) is at equilibrium
E) is endothermic

Answer: A

24) At a certain temperature, $K_c = 0.0500$ and $\triangle H = +39.6$ kJ for the reaction below.

$2MgCl_2(s) + O_2(g) \rightleftharpoons 2MgO(s) + 2Cl_2(g)$

Calculate K_c for the reaction

$MgO(s) + Cl_2(g) \rightleftharpoons MgCl_2(s) + \frac{1}{2}O_2(g)$

and indicate whether the value will be larger or smaller at a lower temperature.

A) 4.47, larger B) 0.224, smaller C) 0.224, larger D) 400, smaller

Answer: A

25) For the reaction: $2\ NO_2(g) \rightleftharpoons 2\ NO(g) + O_2(g)$, the partial pressure of $O_2(g)$ at equilibrium is 0.3500 atm. P_{total} = 1.0866 atm. What is K_p for this reaction?

A) 2.86 B) 128 C) 0.350 D) 182 E) 66.9

Answer: B

26) A mixture, containing 0.0750 M HCl(g) and 0.0330 M $O_2(g)$ is allowed to come to equilibrium at 480 °C.

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

At equilibrium $[Cl_2] = 0.030$ M. What is the value of K_c?

A) 890 B) 0.13 C) 1.3 D) 480 E) 1.1×10^{-3}

Answer: A

27) Which of the following is the strongest base?

A) Cl^- B) H_2O C) NO_3^- D) ClO_4^- E) F^-

Answer: E

28) Choose the INCORRECT statement. The term pH:

A) = $-\log [H_3O^+]$
B) = $-\ln [H^+]$
C) is more convenient than exponential notation
D) refers to the "potential" of hydrogen ion
E) = 14 - pOH

Answer: B

29) 0.272 g of a monoprotic solid acid (mw = 189 g/mol) is dissolved in water to produce 25.0 mL of a solution with pH = 4.93. Determine the ionization constant of the acid.

A) 2.8×10^{-7} B) 4.1×10^{-8} C) 2.4×10^{-9} D) 1.4×10^{-10} E) 2.1×10^{-4}

Answer: C

30) For which of the following polyprotic acids is the first ionization step approximately 100%?

A) H_2CO_3 B) H_2S C) H_3PO_4 D) H_2SO_3 E) H_2SO_4

Answer: E

31) What is the $[HPO_4^{-2}]$ of a solution labeled "0.10 M Phosphoric Acid"?

$[K_{a1} = 7.1 \times 10^{-3}; K_{a2} = 6.3 \times 10^{-8}; K_{a3} = 4.2 \times 10^{-13}]$

A) 1.6×10^{-9} B) 4.2×10^{-13} C) 1.6×10^{-16} D) 6.3×10^{-8} E) 7.1×10^{-3}

Answer: D

32) The pH of a solution of $NH_4C_2H_3O_2$ is approximately 7. The best explanation is:

A) Aqueous ammonia and acetic acid have approximately equal ionization constants.
B) Ammonium acetate is a weak electrolyte.
C) The salt is a product of a strong acid and a strong base.
D) This salt does not react with water.
E) All salts of weak acids and weak bases are neutral.

Answer: A

33) Which species in the following reaction acts as a Lewis acid?

$$CuSO_4(s) + 4NH_3(aq) \rightarrow Cu(NH_3)_4^{2+}(aq) + SO_4^{2-}(aq)$$

A) $Cu(NH_3)_4^{2+}$
B) Cu^{2+}
C) SO_4^{2-}
D) NH_3
E) All are acids.

Answer: B

34) Consider the reaction:

$$HC_2H_3O_2 + H_2O \rightarrow H_3O^+ + C_2H_3O_2^-$$

Choose the pair of substances that are both bases in the reaction.

A) H_2O and $C_2H_3O_2^-$
B) $HC_2H_3O_2$ and $C_2H_3O_2^-$
C) $HC_2H_3O_2$ and H_3O^+
D) H_2O and H_3O^+
E) all are bases

Answer: A

35) A saturated aqueous solution of calcium hydroxide is approximately 0.13% calcium hydroxide, by mass, and has a density of 1.02 g ml^{-1}. What is the pH of such a solution?

A) 11.95 B) 12.25 C) 12.75 D) 13.00 E) 12.55

Answer: E

36) Hypochlorous acid (HOCl) has an ionization constant of 3.2×10^{-8}. What is its percent ionization in 1.0 M and 0.10 M solutions, respectively?

A) 0.57% and 0.18%
B) 0.32% in both
C) 0.032% and 0.0032%
D) 0.57% in both
E) 0.018% and 0.057%

Answer: E

37) For the following compound, predict whether the solution is acidic, basic or neutral and why: $NaC_2H_3O_2$.

A) basic because it is a weak base
B) acidic because it is a strong acid
C) neutral because there is no hydrolysis
D) basic because it is the salt of a weak acid
E) acidic because it is the salt of a weak base

Answer: D

38) What is the pH of a 0.052 M solution of sodium acetate? $K_a = 1.8 \times 10^{-5}$

A) 5.3 B) 10.0 C) 3.0 D) 8.7 E) 11.0

Answer: D

39) List the following acids in order of increasing strength:

HBrO HIO HClO

A) HIO < HClO < HBrO
B) HBrO < HIO < HClO
C) HClO < HIO < HBrO
D) HClO< HBrO < HIO
E) HIO < HBrO < HClO

Answer: E

40) Which indication of relative acid strengths is INCORRECT?

A) HCl > HF
B) $H_2SO_3 > HNO_3$
C) $HClO_2 > HClO$
D) $CH_3CO_2H > CH_3CH_2OH$
E) $H_2SO_4 > H_2SO_3$

Answer: B