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**HOUSTON COMMUNITY COLLEGE SYSTEM**

**DEPARTMENTAL FINAL EXAM**

**CHEM 1412- SUMMER 2018**

**VERSION B**

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**CHEM 1412 FINAL EXAM (SUMMER2018)**

***Version B***

Part I: Multiple Choice (2 points each)

Please mark your answer on you scantron.

1) For a first-order reaction, a plot of \_\_\_\_\_\_\_\_ versus \_\_\_\_\_\_\_\_ is linear.

A) ln [A]t, 

B) ln [A]t, t

C) , t

D) [A]t, t

E) t, 

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

 (NH4)2Se (s)  2NH3 (g) + H2Se (g)

A) [NH3][H2Se] / [(NH4)2Se]

B) [(NH4)2Se] / [NH3]2[H2Se]

C) 1 / [(NH4)2Se]

D) [NH3]2[H2Se]

E) [NH3]2[H2Se] / [(NH4)2Se]

3) Which of the following compounds does not contain a C=O bond?

A) alcohols

B) aldehydes

C) carboxylic acids

D) esters

E) none of the above

4) Which one of the following statements is true about the equilibrium constant for a reaction if ΔG° for the reaction is negative?

A) K = 0

B) K = 1

C) K > 1

D) K < 1

E) More information is needed.

5) Which one of the following could be a straight-chain alkane?

A) C9H20

B) C3H3

C) C4H6

D) C5H4

E) C3H6

6) The reaction

 2NO2 → 2NO + O2

follows second-order kinetics. At 300 °C, [NO2] drops from 0.0100 M to 0.00650 M in 100.0 s. The rate constant for the reaction is \_\_\_\_\_\_\_\_ M-1s-1.

A) 0.096

B) 0.65

C) 0.81

D) 1.2

E) 0.54

7) What is the oxidation number of sulfur in the S2O32– ion?

A) +2

B) +1

C) 0

D) -1

E) -2

8) Consider the following reaction at equilibrium:

 2CO2 (g)  2CO (g) + O2 (g) ΔH° = -514 kJ

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

A) increase the partial pressure of O2 (g)

B) decrease the partial pressure of CO2 (g)

C) decrease the value of the equilibrium constant

D) increase the value of the equilibrium constant

E) increase the partial pressure of CO

9) The Ka for HCN is 4.9 × 10-10. What is the value of Kb for CN-?

A) 2.0 × 10-5

B) 4.0 × 10-6

C) 4.9 × 104

D) 4.9 × 10-24

E) 2.0 × 109

10) What is the coefficient of the permanganate ion when the following equation is balanced?

 MnO4- + Br- → Mn2+ + Br2 (acidic solution)

A) 1

B) 2

C) 3

D) 5

E) 4

11) The conjugate base of HSO4- is \_\_\_\_\_\_\_\_.

A) OH-

B) H2SO4

C) SO42-

D) HSO4+

E) H3SO4+

12) The missing product from this reaction is \_\_\_\_\_\_\_\_.

 I → Te + \_\_\_\_\_

A) He

B) e

C) n

D) e

E) γ

13) A solution containing which one of the following pairs of substances will be a buffer solution?

A) NaI, HI

B) KBr, HBr

C) RbCl, HCl

D) CsF, HF

E) none of the above

14) Of the following, a 0.1 M aqueous solution of \_\_\_\_\_\_\_\_ will have the highest freezing point.

A) NaCl

B) Al(NO3)3

C) K2CrO4

D) Na2SO4

E) sucrose

15) The pH of a 0.55 M aqueous solution of hypobromous acid, HBrO, at 25.0 °C is 4.48. What is the value of Ka for HBrO?

A) 2.0 × 10-9

B) 1.1 × 10-9

C) 6.0 × 10-5

D) 3.3 × 10-5

E) 3.0 × 104

16) For a given reaction, ΔH = +22.2 kJ/mol and ΔS = +81.1 J/K-mol. The reaction is spontaneous \_\_\_\_\_\_\_\_. Assume that ΔH and ΔS do not vary with temperature.

A) at T < 274 K

B) at T > 274 K

C) at T > 298 K

D) at T < 298 K

E) at all temperatures

17) The solubility of manganese (II) hydroxide (Mn(OH)2) is 2.2 × 10-5 M. What is the Ksp of Mn(OH)2?

A) 1.1 × 10-14

B) 4.3 × 10-14

C) 2.1 × 10-14

D) 4.8 × 10-10

E) 2.2 × 10-5

18) Which structure below represents an amine?

A)



B)



C)



D)



E)



19) What is the molality of sodium chloride in solution that is 13.0% by mass sodium chloride and that has a density of 1.10 g/mL?

A) 2.23

B) 1.30

C) 2.56

D) 2.03

E) 1.10

20) The decay of a radionuclide with a half-life of 3.3 × 105 years has a rate constant (in yr-1) equal to \_\_\_\_\_\_\_\_.

A) 4.8 × 105

B) 2.1 × 10-6

C) 4.2 × 10-6

D) 2.8 × 103

E) 5.9 × 10-8

21) Which one of the following can be done to shorten the half-life of the radioactive decay of uranium-238?

A) freeze it

B) heat it

C) convert it to UF6

D) oxidize it to the +2 oxidation state

E) none of the above

22) Given the following reaction at equilibrium, if Kc = 1.90 × 1019 at 25.0 °C, Kp = \_\_\_\_\_\_\_\_.

 H2 (g) + Br2 (g)  2 HBr (g)

A) 5.26 × 10-20

B) 1.56 × 104

C) 6.44 × 105

D) 1.90 × 1019

E) none of the above

23) The concentration of CO2 in a soft drink bottled with a partial pressure of CO2 of 6.5 atm over the liquid at 29 °C is 2.2 × 10-1 M. The Henry's law constant for CO2 at this temperature is \_\_\_\_\_\_\_\_.

A) 2.2 × 10-1 mol/L-atm

B) 7.6 × 10-3 mol/L-atm

C) 5.6 × 10-3 mol/L-atm

D) 3.4 × 10-2 mol/L-atm

E) More information is needed to solve the problem.

24) The standard cell potential (E°cell) of the reaction below is +0.126 V. The value of ΔG° for the reaction is \_\_\_\_\_\_\_\_ kJ/mol.

 Pb (s) + 2H+(aq) → Pb2+ (aq) + H2 (g)

A) -24.3

B) +24.3

C) -12.6

D) +12.6

E) -50.8

25) Which reaction produces a decrease in the entropy of the system?

A) 4 NH3 (g) + 5 O2 (g) → 4 NO (g) + 6 H2O (g)

B) Na (s) + 1/2 Cl2 (g) → NaCl (s)

C) 2 HgO (s) → 2 Hg (l) + O2 (g)

D) UF6 (s) → U (s) + 3F2 (g)

E) H2O (s) → H2O (g)

26) A 50.0 mL sample of an aqueous H2SO4 solution is titrated with a 0.375 M NaOH solution. The equivalence point is reached with 62.5 mL of the base. The concentration of H2SO4 is \_\_\_\_\_\_\_\_ M.

A) 0.234

B) 0.469

C) 0.150

D) 0.300

E) 0.938

27) Calculate the maximum concentration (in M) of silver ions (Ag+) in a solution that contains 0.025 M of CO32-. The Ksp of Ag2CO3 is 8.1 × 10-12.

A) 1.8 × 10-5

B) 1.4 × 10-6

C) 2.8 × 10-6

D) 3.2 × 10-10

E) 8.1 × 10-12

28) The standard cell potential (E° cell) for the reaction below is +0.63 V. The cell potential for this reaction is \_\_\_\_\_\_\_\_ V when [ Zn2+] = 3.0 M and [Pb2+] = 2.0 × 10-4 M.

 Pb2+ (aq) + Zn (s) → Zn2+ (aq) + Pb (s)

A) 0.51

B) 0.86

C) 0.40

D) 0.75

E) 0.63

29) The reaction shown below is responsible for creating 14C in the atmosphere. What is the bombarding particle?

 N + \_\_\_\_\_ → C + H

A) alpha particle

B) electron

C) neutron

D) positron

E) proton

30) Use the following Table 20.2 to solve for question 30.

**Table 20.2**

 

The standard cell potential (E°cell) for the voltaic cell based on the reaction below is \_\_\_\_\_\_\_\_ V.

 Sn2+ (aq) + 2Fe3+ (aq) → 2Fe2+ (aq) + Sn4+ (aq)

A) +0.46

B) +0.617

C) +1.39

D) -0.46

E) +1.21

31) The value of ΔG° for a reaction conducted at 25 °C is 2.8 kJ/mol. The equilibrium constant for a reaction is \_\_\_\_\_\_\_\_ at this temperature.

A) 1.13

B) -4.2

C) 0.32

D) -1.13

E) More information is needed.

32) A buffer solution with a pH of 4.78 is prepared with \_\_\_\_\_\_\_\_ M formic acid and 0.90 M sodium formate. The Ka of formic acid is 1.8 × 10-4.

A) 0.083

B) 0.17

C) 3.3 × 103

D) 9.8

E) 0.041

33) The Keq for the equilibrium below is 7.52 × 10-2 at 480.0 °C.

 2Cl2 (g) + 2H2O (g)  4HCl (g) + O2 (g)

What is the value of Keq at this temperature for the following reaction?

 2HCl (g) + O2 (g)  Cl2 (g) + H2O (g)

A) 13.3

B) 3.65

C) -0.0376

D) 5.66 × 10-3

E) 0.274

34) A solution containing which one of the following pairs of substances will be a buffer solution?

A) NaI, HI

B) KBr, HBr

C) RbCl, HCl

D) CsF, HF

E) none of the above

35) The vapor pressure of pure ethanol at 60 °C 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) 0.498

B) 0.413

C) 0.790

D) 0.367

E) 0.0918

Part II: Problem Solving (5 points each)

Please show all your work for full credit. Partial credit will be given.

1) Given the following reaction:

 CO (g) + 2 H2(g)  CH3OH (g)

In an experiment, 0.42 mol of CO and 0.42 mol of H2 were placed in a 1.00-L reaction vessel. At equilibrium, there were 0.29 mol of CO remaining. Keq at the temperature of the experiment is \_\_\_\_\_\_\_\_.

2) A uniform deposit of 10.0 grams of silver is needed to completely coat a metal spoon with silver. How long ( in minutes ) would a current of 12.0 A have to be passed through a solution of AgNO3 to silver-coat the metal spoon ?

3) A particular first-order reaction has a rate constant of 1.35 × 102 s-1 at 25.0 °C. What is the magnitude of k at 75.0 °C if Ea = 55.3 kJ/mol?

4) The half-life for beta decay of strontium-90 is 28.8 years. A milk sample is found to contain 10.3 ppm strontium-90.

a) How many years would pass before the strontium-90 concentration would drop to 1.0 ppm?

b) Write the balanced equation for the radioactive decay of strontium-90, and identify the decay product.

5) A solution is prepared by dissolving 6.00 g of an unknown nonelectrolyte in enough water to make 1.00 L of solution. The osmotic pressure of this solution is 0.750 atm at 25.0 °C. What is the molecular weight (g/mol) of the unknown solute?

6) The value of ΔG° for the following reaction is -48 kJ/mol

N2 (g) + 3H2 (g)  2NH3 (g)

a) What is the value of ΔG for this reaction at 400C when the reaction mixture initially contains 0.50 moles of N2 (g), 1.0 mole of H2 (g) and 2.0 moles of NH3 (g) in a 1 L reaction vessel?

b) Given the initial conditions above, will the forward or the backward reaction predominate as the reaction mixture reaches equilibrium?