CHM 2046 Exam 1 Review UF Teaching Center KEY

Different professors are covering different material in their classes. Therefore, the questions in this review are separated by chapter.

Chapter 16: Kinetics, Rate Laws

16.1 Cyclobutane decomposes in a first order reaction shown below.

$$C_4H_{8(g)} \rightleftharpoons 2C_2H_{4(g)}$$

Given that the initial concentration of C_4H_8 is 5M and the final concentration is 0.06M after 0.05 seconds, what is the rate constant and the expected rate law?

a. 65 s^{-1}; rate = $k[C_2H_4]^2$
b. 88 s^{-1}; rate = $k[C_4H_8]$
c. 92 s^{-1}; rate = $k[C_4H_8]$
d. 88 s^{-1}; rate = $k[C_2H_4]^2$
e. 65 s^{-1}; rate = $k[C_4H_8]$
f. 92 s^{-1}; rate = $k[C_2H_4]^2$

16.2 The decomposition of hydrogen bromide is shown below.

$$2HBr_{(g)} \rightleftharpoons H_{2(g)} + Br_{2(g)}$$

At 600 K, the rate constant is 1.50×10^{-5} L/mol s. At 800 K, the rate constant is 6.80×10^{-3} L/mol s. What is the activation energy for this reaction?

a. 1.82×10^{2} kJ/mol
b. 1.39×10^{2} kJ/mol
c. 1.58×10^{2} kJ/mol
d. 1.22×10^{2} kJ/mol
e. 2.02×10^{2} kJ/mol

16.3 Using the information in the previous question (16.2), determine what temperature should be used if you wanted the rate to be three times as fast as it is at 600K?

a. 576 K
b. 582 K
c. 626 K
d. 654 K
e. 730 K

16.4 A fictional reaction is shown below with its rate law.

$$2A + B + C \rightarrow 3D, \text{rate} = k[A]^2[B][C]$$

Which of the following mechanisms can be considered possible mechanisms for this reaction and rate law?

I: $A + B \rightleftharpoons X$ (fast)
$X + A + C \rightarrow 3D$ (slow)

II: $2A + B + C \rightarrow 3D$ (one step)

III: $B + C \rightleftharpoons X$ (slow)
$M + 2A \rightarrow 3D$ (fast)

a. I only

b. II only

c. III only

d. I and II

e. I, and III

f. I, II, and III

Chapter 17: Chemical Equilibrium, K & Q, Le Chatelier's Principle

17.1 Using Le Chatelier's Principle, match the correct shift for the given change.

	Change		Shift
a)	Increase in Concentration of X	I.	No shift
b)	Decrease in Concentration of X	II.	Away from heat
c)	Increase in Pressure	III.	Away from substance X
d)	Decrease in Pressure	IV.	Toward Heat
e)	Increase in Temperature	V.	Towards fewer moles of gas
f)	Decrease in Temperature	VI.	Towards substance X
g)	Catalyst	VII.	Towards more moles of gas

17.2 Ammonia is created on an industrial scale using the Haber-Bosch process shown below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92.4\ \text{kJ} * \text{mol}^{-1}$$

Predict the shift (left, right, or none) for each given change.

Change	**Shift**
Increase $[NH_3]$	Left
Decrease $[N_2]$	Left
Decrease $[NH_3]$	Right
Increase Pressure	Right
Increase Temperature	Left
Catalyst	No shift
Increase $[H_2]$	Right

17.3 A fictional reaction is shown below.

$$A_{(g)} + B_{(g)} \rightleftharpoons 3C_{(g)} \qquad \Delta H = +36\ \text{kJ mol}^{-1}$$

To favor the production of the product (C), under what conditions should this reaction be carried out?

a. High pressure, Low temperature

b. High pressure, High temperature

<u>c. Low pressure, High temperature</u>

d. Low pressure, Low temperature

17.4 Calculate Kc given the following reaction.

$$PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)} \qquad K_p = 4.07 \times 10^{-1}\ (\text{at } 226.85°\text{C})$$

If the Qc was 20.5, is the reaction at equilibrium? Or will it proceed to the left or to the right?

a. <u>Kc=16.7, proceed left until Qc=Kc</u>

b. Kc=38.5, proceed right until Qc=Kc

c. Kc=20.5, the reaction is at equilibrium

d. Kc=30.2, proceed right until Qc=Kc

17.5 The decomposition of phosgene is shown in the reaction below.

$$COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)} \qquad K_c = 6.3 \times 10^{-4} \text{ (at 500K)}$$

Calculate the equilibrium partial pressures of $COCl_2$, CO, and Cl_2 when the initial partial pressure of $COCl_2$ is 0.28 atm.

a. $COCl_2$=0.5 atm, CO=0.24 atm, Cl_2=0.014 atm

b. $COCl_2$=0.071 atm, CO=Cl_2=0.85 atm

c. $COCl_2$=0.26 atm, CO= Cl_2=0.024 atm

d. $COCl_2$=0.29 atm, CO=0.21 atm, Cl_2=0.79 atm

e. $COCl_2$=0.21 atm, CO= Cl_2=0.073 atm

Chapter 18: Acid-Base Equilibrium (Not all professors are covering Chapter 18)

18.1 Calculate the $[H_3O^+]$, pH, $[OH^-]$, and pOH, of 0.5 M of H_2SO_4.

a. $[H_3O^+]$= 0.5 M, pH=0.30, $[OH^-]$=2×10^{-14} M, pOH=13.70

b. $[H_3O^+]$=0.25M, pH=0.60, $[OH^-]$=5×10^{-10} M, pOH=10.5

c. $[H_3O^+]$=0.15 M, pH=0.90, $[OH^-]$=0.27 M, and pOH=13.2

d. $[H_3O^+]$=0.90 M, pH=3.1, $[OH^-]$=8.1×10^{-5} M, and pOH=10.9

18.2 Define each of the following and provide an example.

A Brønsted-Lowry acid is a proton donor. An example is HCl.

A Brønsted-Lowry base is a proton acceptor. An example is NH_3.

A Lewis acid is an electron pair acceptor. An example is BF_3.

A Lewis base is an electron pair donor. An example is H_2O.

18.3 Methylamine (CH_3NH_2) has a K_b of 4.4×10^{-4}. What is the pH of 5 M CH_3NH_2?

a. 10.94

b. 7.62

c. 12.67

d. 13.63

18.4 Potassium propionate (KCH_3CH_2COO) is a food preservative that is most commonly used as an antimicrobial agent in bread. What is the pH of 0.38 M KCH_3CH_2COO at 298K? The K_a of propionic acid is 1.34×10^{-5}.

a. 10.13

b. 8.34

c. 9.86

<u>d. 9.23</u>

18.5 Which of the following is a potential Lewis acid?

a. Cl^-

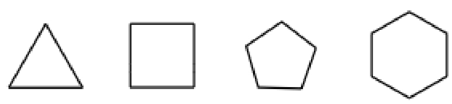
b. OH^-

<u>c. BCl_3</u>

d. NH_4^+

<u>Chapter 15: Organic Chemistry (Not all professors are covering Chapter 15)</u>

15.1 What are the names of these four structures, in order (left to right)?



a. Cyclohexane, Cyclobutane, Cycloheptane, Cyclooctane

<u>b. Cyclopropane, Cyclobutane, Cyclopentane, Cyclohexane</u>

c. Cyclopropane, Cyclooctane, Cyclononane, Cyclohexane

d. Cyclobutane, Cyclopropane, Cyclohexane, Cyclononane

e. Cyclodecane, Cyclononane, Cyclopropane, Cyclohexane

15.2 Draw an example of each functional group.

a. Alkane  hexane

b. Alkene  2-hexene

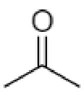
c. Alkyne  2-hexyne

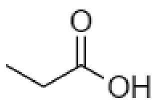
d. Alcohol  propanol

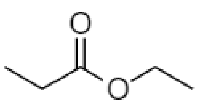
e. Ether  dipropylether

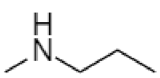
f. Halide  1-bromohexane

g. Aldehyde  butyraldehyde

h. Ketone  acetone/2-propanone

i. Carboxylic Acid  propionic acid/methyl acetic acid

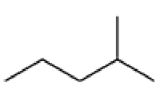
j. Ester  ethyl propanoate

k. Amine  N-methyl-1-propanamine

15.3 C_6H_{14} has 5 different constitutional isomers. Draw each and name according to IUPAC naming rules.


Hexane

a.



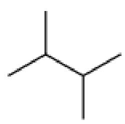
b. 2-methylpentane

c. 

3-methylpentane

d. 

2,2-dimethylbutane

e. 

2,3-dimethylbutane