Chem 51, Spring 2016
Exam 9 (Chp 9)

Name KEY

105 pt

Mark your scantron to answer Questions 1 -25.. Each question has only one answer unless otherwise stated. Each multiple choice question is worth 2 pt.

CHP 9 (Acids and bases)

Use the following to answer Questions 1 and 2. ***Mark all that apply.***

A) produces H_3O^+ in water
B) has a sour taste
C) has a slippery, soapy feel
D) turns blue litmus blue
E) pH is less that 7

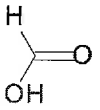
1. (9.1) Which one is characteristic of an acid? *Mark all that apply.* A, B, E

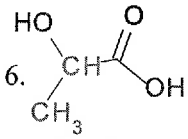
2. (9.1) Which one is characteristic of a base? *Mark all that apply.* C, D

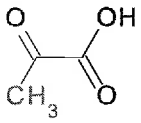
3. (9.2) Which one of the following is a strong acid? ***Mark all that apply***
(A) HCl (B) H_2SO_4 C) HF D) NaOH E) H_2O

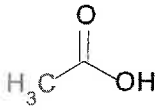
4. (9.2) Which of the following is a neutralization reaction?
A) $H_2O + H_2CO_3 \leftrightarrows HCO_3^- + H_3O^+$
(B) $HF + Na_2CO_3 \rightarrow H_2CO_3 + 2\,NaF$ acid HF / base Na_2CO_3
C) $2HCl + Zn \rightarrow H_2 + ZnCl_2$
D) $3NaOH + AlCl_3 \rightarrow 3NaCl + Al(OH)_3$

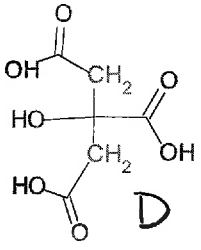
For Questions 5-9 match the following answers with the carboxylic acids shown.
A) Formic acid B) acetic acid D) citric acid E) pyruvic acid AB) lactic acid

5.  A

6.  AB

7.  E

8.  B

9.  D

10. (9.3) Consider the following equilibrium that occurs in blood: $CO_2 + H_2O \leftrightarrows H^+ + HCO_3^-$

If the following conditions exist:		The patients has:
P_{CO2} = 26 mm Hg	(normal = 38-50 mm Hg) low	(A) Respiratory Alkalosis
HCO_3^- = 15 mmol/L	(nomal = 22-28 mmol/L) low	B) Metabolic Alkalosis
pH = 7.81	(nomal =7.33-7.43) H^+ low	C) Repiratory Acidosis
		D) Metabolic Acidosis

11. (9.3) Indicate which of the substances occur in higher amount in the following equilibrium when acid is added. ***Mark all that apply.***

$$\uparrow \quad \uparrow \quad \leftarrow \qquad \uparrow$$
$$CH_3CO_2H + H_2O \leftrightarrows CH_3CO_2^- + H_3O^+$$
$$\downarrow$$

(A) CH_3CO_2H (B) H_2O C) $CH_3CO_2^-$ (D) H_3O^+ E) all are higher

12. (9.4) Identify the Bronsted-Lowry acid/conjugate base pair in the following reaction.
$H_2O + H_2CO_3 \leftrightarrows HCO_3^- + H_3O^+$

A) H_2O/ HCO_3^- (B) H_2CO_3/ HCO_3^- C) H_2O / H_2CO_3 D) H_2O / H_3O^+ E) H_3O^+ / HCO_3^-

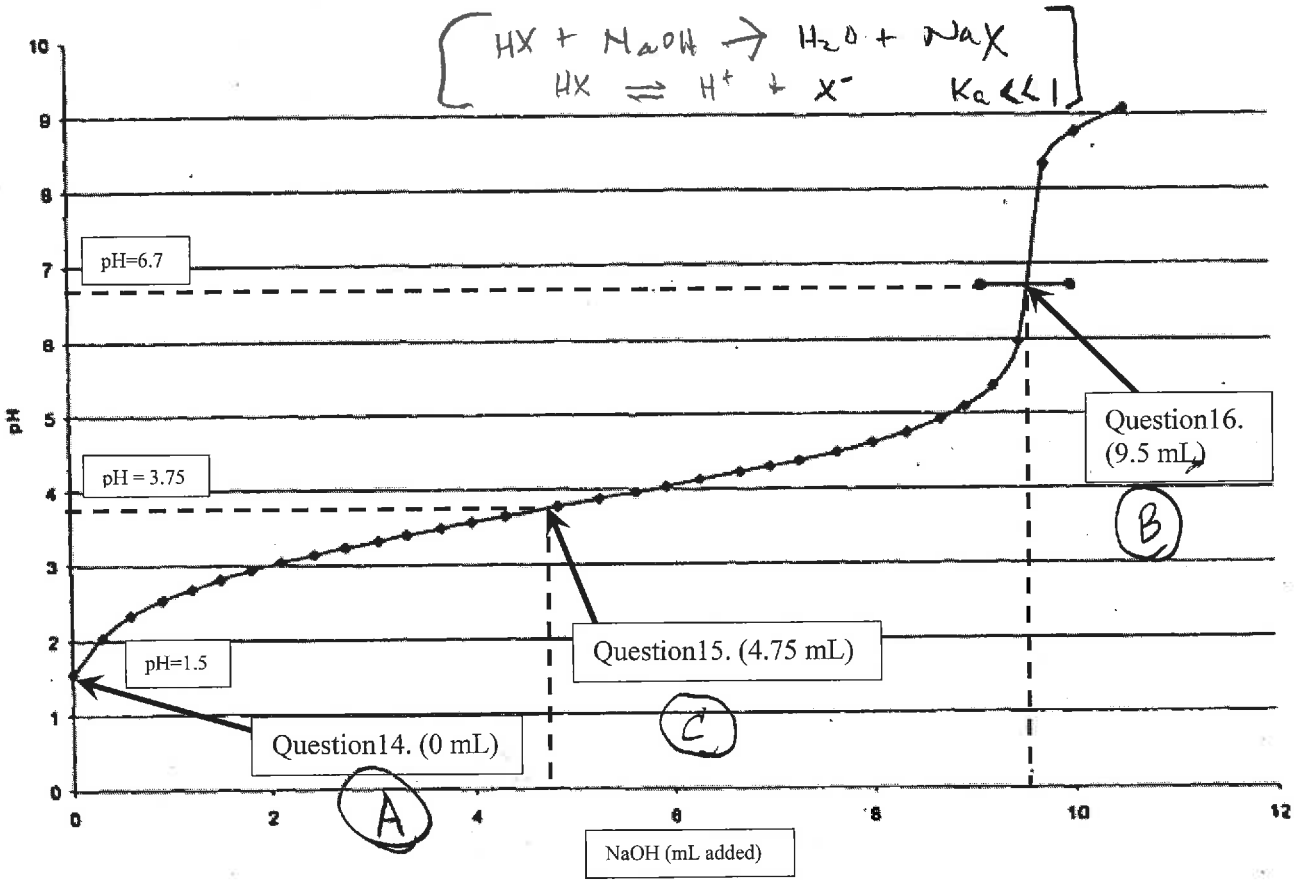
24 pt

13. (9.5) Which of the following statements correctly describes the hydronium-hydroxide balance in the given solution?
(A) In acids, $[OH^-]$ is less than $[H_3O^+]$
B) In bases, $[OH^-] = [H_3O^+]$
C) In neutral solutions, $[H_3O^+] = [H_2O]$.
D) In bases, $[OH^-]$ is less than $[H_3O^+]$.
E) In bases, $[OH^-]$ is less than $[H_2O]$.

(9.5) For a solution that has a HCl conc. of 7.7×10^{-10} M: $H^+ = 7.7 \times 10^{-10}$ M
(2 pt) Is this an acidic or basic solution? basic

(2 pt) What is the pH?	(2 pt) What is the pOH?	(2) What is the $[H^+]$	(2 pt) What is the [OH]?
9.11	4.89	7.7×10^{-10}	1.3×10^{-5}

A typical titration curve for a weak acid looks like this. The generic formula for a monoprotic acid is represented by "HX". What is(are) the major species present where the arrows are along this titration curve? Use these to answer Questions 14-15 (the arrows): A) HX B) X^- C) equal HX and X^- D) neither HX nor X^-



17. Using the titration curve above, identify the acid by it's pK_a
(A) $HCHO_2$, pKa=3.74 B) $HC_2H_3O_2$, pKa=4.76 C) H_2CO_3, pKa=6.35 D) HCO_3^-, pKa= 9.3

18. (9.6) Which of the following is the strongest acid?
(A) nitrous acid, pKa= 3.35 B) carbonic acid, pKa=6.35 C) formic acid, pKa=3.74 D) acetic acid, pKa=4.76

22 pt

19. (9.7) What functional groups are found in all amino acids? ***Mark more than one answer.***

A. carboxylic acid B. aromatic C. amide D. amine E. alcohol

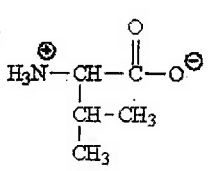
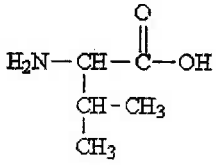
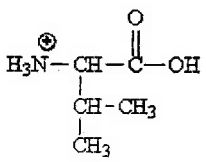
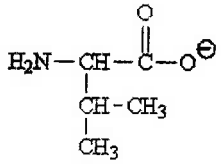
20. (9.7) Substances that can act both as an acid and as a base are called

A) neutral B) amphiphatic C) indicators D) amphoteric E) isoteric

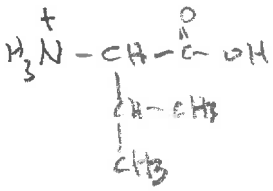
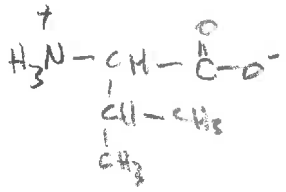
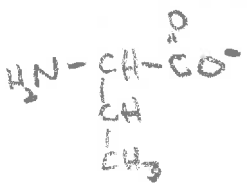
21. (9.7) The isoelectric point of an amino acid is defined as:

A) the pH at which the amino acid exits in the zwitterion form
B) the pH at which it exists in the basic form
C) the pH at which it exists in the acidic form
D) the pH equals the pKa

22. (9.7) Which of the following represents the zwitterion form of the amino acid valine?

A) 
B) 
C) 
D) 

(9 pt) (9.7) Draw the major structures of valine that would be present at the following pH's *(use the table of pI's)*

pH=2.4 C	pH=6 A	pH= 9.9 D
		

23. (9.8) Considering this equilibrium which occurs in blood, $CO_2 + H_2O \leftrightarrows H^+ + HCO_3^-$
Which of the following would be the cause of metabolic alkalosis? ↓ alkali (pH↑)

A) Hyperventilation where the level of CO_2 in blood decreases rapidly.
B) Ketoacidosis, that occurs in starvation or diabetes, where blood pH decreases.
C) When holding ones breath or with impaired breathing where the level of CO_2 in blood increases.
D) When ingesting huge amounts of alkali for an acid stomach which in turn causes blood levels of pH to increase.

24. (9.8) Which of the following could be a buffer?

A) HCl + NaCl B) HF +NaF C) NaF + HCl D) NaCl + HF

(6 pt) Calculate the number of tablets needed per dose for a drug that is 35 mg per tablet and is administered to a 35 lb child once a day at 5 mg/kg body weight.

$$35\,\text{lb} \times \frac{1\,\text{kg}}{2.2046\,\text{lb}} \times \frac{5\,\text{mg drug}}{1\,\text{kg}} \times \frac{1\,\text{tablet}}{35\,\text{mg}} = 2.3\ \text{tablets}$$

27 pt

25. (9.8) In a buffer system of K_2CO_3 and $KHCO_3$ ($pK_a = 9.3$)
A) the K_2CO_3 neutralizes added acid.
B) the K_2CO_3 neutralizes added base.
C) the K_2CO_3 is not necessary.
D) the $KHCO_3$ neutralizes added H_2O.

(9.8) Answer the following questions about the buffer system in Question 25.

(3 pt) What is the purpose of this buffer?

To maintain pH at 9.3

(4 pt) What should be the concentrations (in molarity) of the two chemicals that are combined to create this buffer?

They should be equal molarity. The higher the molarity the greater the buffer capacity

What are the acid/conjugate base and base/conjugate acid in this buffer system?

(2 pt) Ackd/conj. Base:

HCO_3^- / CO_3^{2-}

(2 pt) Base/con,. Acid:

CO_3^{2-} / HCO_3^-

Write the chemical equations for what happens when an acid (H^+) or a base (OH^-) is added to this buffering system.

(2 pt) Added acid: (K_2CO_3)

$H^+ + CO_3^{2-} \longrightarrow HCO_3^-$ (prevents decrease pH)

(2 pt) Added base:

$^-OH + HCO_3^- \longrightarrow H_2O + CO_3^{2-}$ (prevent increase in pH)

($KHCO_3$)

17 pt

A titration analysis was performed where 5.00 mL of vinegar was titrated with 0.1994 M NaOH solution. Calculate the concentration (M, %) of acid (HAc) in the vinegar using the following data from the titration.

	TRIAL 1
Initial NaOH level in buret	0.51 mL
Final NaOH level in buret (End point)	44.45 mL
(2 pt) Volume (mL) of NaOH used *(Show calculation)* 43.94 mL	44.45 − 0.51 = 43.94
(2 pt) Volume in Liters of ~~NaOH~~ used *(Show calculation)* 0.04394 L	43.94 mL × 1 L / 1000 mL = .04394 L

(4 pt) Moles of NaOH used in titration 0.008762 mole NaOH
(Show calculation)

$0.04394\ L \times \frac{0.1994\ mol\ NaOH}{1\ L} = 0.0087616\ mol\ NaOH$

(2 pt) Moles of $HC_2H_3O_2$ neutralized by NaOH 0.008762 mole of $HC_2H_3O_2$
(Show calculation)

$NaOH + HAc \rightarrow H_2O + NaAc$

$0.008762\ mol\ NaOH \times \frac{1\ mol\ HAc}{1\ mol\ NaOH} = 0.008762\ mol\ HAc$

(6 pt) Molarity of $HC_2H_3O_2$ 1.75 M $HC_2H_3O_2$
(Show calculation)

$\frac{0.008762\ mol\ HAc}{5.00\ mL\ vin} \times \frac{1000\ mL}{1\ L} = \frac{1.75\ mol\ HAc}{1\ L}$

(4 pt) Grams of $HC_2H_3O_2$ (molar mass = 60.06 g/mol) 0.5262 g $HC_2H_3O_2$
(Show calculation)

$0.008762\ mol\ HAc \times \frac{60.06\ g\ HAc}{1\ mol\ HAc} = 0.5262\ g$

(4 pt) Percent (m/v) $HC_2H_3O_2$ 10.5 % $HC_2H_3O_2$
(Show calculation)

$\frac{0.5262\ g}{5.00\ mL} \times 100 = 10.5$

24 pt