*Use your Scantron to answer questions 1-43. Each answer is worth 2 pt. There is only one answer per question unless it states otherwise.*

## Section 9.1 Acids and Bases - Definitions

1. (9.1) What kind of taste do carboxylic acids have?
     A) sweet     B) sour     C) fruity     D) slippery     E) salty

---

*Use these answers for questions 2-4*
  A) acid(s)    B) base(s)     C) neutral     D) alcohols     E) water

2. (9.1) _____ (is) are compounds that donate a $H^+$ in water.

3. (9.1) _____ (is) are neutralized by an acid.

4. (9.2) HCl is the _____ found in our stomachs.

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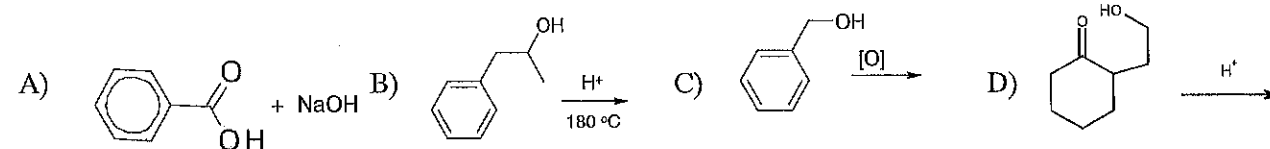## Section 9.2 Strong Acids and Bases and Neutralization Reactions.

5. (9.2) _____ is a strong acid.

6. (9.2) _____ is a strong base.

7. (9.4) _____ is a weak acid.

8. (9.4) _____ is a weak base.

Use these answers for Questions 5-8.
A) ammonia

B) acetic acid

C) nitric acid

D) magnesium hydroxide

9. (9.2) Which one of these reactions is an acid-base neutralization reaction?



(6 pt)      Complete and balance the following neutralization reaction.*[include (s), (l), (g), (aq) as appropriate]*

$$HBr(aq) + Ca(OH)_2(s) \longrightarrow$$

**24 pt**

The following data was obtained from titration of 4.00 mL vinegar with 0.2403 M NaOH to determine the molar and % concentration of acetic acid. Complete the calculations indicated using the following data.

|  | TRIAL 1 |
|---|---|
| Initial NaOH level in buret | 0.00 mL |
| Final NaOH level in buret (End point) | 19.19 mL |
| (2 pt) Volume (mL) of NaOH used *(Show calculation)* |  |
| (2 pt) Volume in Liters of NaOH used *(Show calculation)* |  |

(4 pt) Moles of NaOH used in titration                    _____mole NaOH
*(Show calculation)*

(2 pt) Moles of $HC_2H_3O_2$ neutralized by NaOH                    _____mole of $HC_2H_3O_2$

(6 pt) Molarity of $HC_2H_3O_2$                    _____M $HC_2H_3O_2$
*(Show calculation)*

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

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

**24 pt**

## Section 9.3 Chemical Equilibrium

10. Considering LeChateliers principle which of the following statements (the underlined portion) is correct?

> Use the following equilibrium equation (the one that occurs in blood).
> $$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$
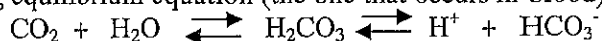
   A) Metabolic acidosis causes a decrease in $CO_2$.
   B) Increased respiration (panting) causes a decrease in $CO_2$ which in turn increases $H^+$. This is called respiratory alkalosis.
   C) When $CO_2$ increases, an increase in $H^+$ results, and in turn pH increases. This is called respiratory alkalosis.
   D) If $HCO_3^-$ increases then $H^+$ decreases and $CO_2$ increases, thereby resulting in alkalosis.

11. The following reaction is *exothermic*. Which of the following will drive the reaction to the right?

   $$CH_4 (g) + 2 O_2 (g) \leftrightarrow CO_2 (g) + 2 H_2O (g) + heat$$
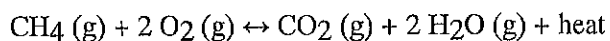
   A) A decrease in $O_2$      B) A decrease in $CH_4$      C) The removal of $CO_2$      D) The addition of $CO_2$

## Section 9.4 Weak Acids and Bases

12. (9.4) What is the conjugate base of $OH^-$?

   A) $H_3O^+$      A) $H_2O$      B) $O^-$      C) $O_2$      D) $O^{-2}$

13. (9.4) What is the conjugate acid of $OH^-$?

   A) $H_3O^+$      A) $H_2O$      B) $O^-$      C) $O_2$      D) $O^{-2}$

14. (9.4) In this equilibrium equation, $HCO_3^-$ is an      A) Acid      B) Base      C) Conjugate Acid      D) Conjugate Base

   $$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$$

## Section 9.5 pH and the pH Scale

> **Use these answers for questions 15-19**
>    A) aqueous      B) electrolyte      C) neutral      D) acidic      E) basic
>
> 15. (9.5) In _____ solutions the pH is equal to 7.
>
> 16. (9.5) A solution of pH 8 is more _____ than a solution of pH 5.
>
> 17. (9.5) In _____ solutions the pH is less than 7
>
> 18. (9.5) In _____ solutions $[OH^-]$ is less than $[H_3O^+]$.
>
> 19. (9.5) A solution that contains $[H_3O^+] = 1.2 \times 10^{-8}$ is _____.

**20 pt**

20. (9.5) If the pH of an aqueous solution increases the molar concentration of _____
   A) hydronium ion decreases.
   B) hydronium ion increases.
   C) hydroxide ion decreases.
   D) there is no change in the hydronium or hydroxide ion concentration.

> Use the following equation for Questions 21 and 22.     $pH=-log[H_3O^+]$ and $[H_3O^+]=10^{-pH}$
>
> 21. (9.5) What is the pH of a solution that has a $[H_3O^+] = 1.2 \times 10^{-3}$?
>    A) 1.20          B) 2.92          C) 11.08          D) 12.80
>
> 22. (9.5) What is the $[H_3O^+]$ concentration in a solution that has a pH = 2.34?
>    A) $2.3 \times 10^{-3}$ M      B) $4.6 \times 10^{-3}$ M      C) $2.2 \times 10^{-12}$ M      D) $1.2 \times 10^1$ M

### Section 9.6 pKa

Consider the following equilibrium for $HCO_3^-$ whose pKa = 10.32.

$$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$$
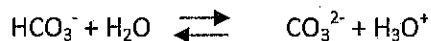
23. (9.6) Which form will predominate when the pH of the solution is at blood pH?
   A) $HCO_3^-$          B) $CO_3^{-2}$          C) $H_2CO_3$          D) $H_2O$          E) All of these

### Section 9.7 Amino Acids: Common Biological Weak Acids

24. Under what conditions can amino acids be found in an un-ionized form?

   a. at low pH      b. at pH = 7      c. at high pH          d. amino acids are never found in un-ionized form
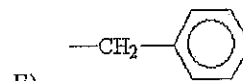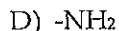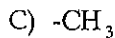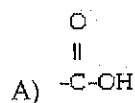
*Use these answers for Questions 25-27*



A)          B)          C)          D)
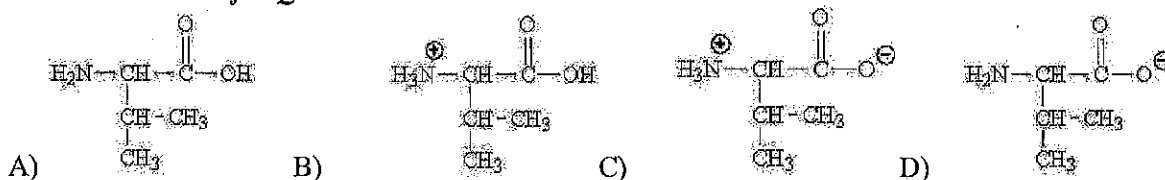
For the amino acid Val (pI = 6.0) what species exists at each of the following pH's?
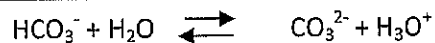
25. pH = 1.2

26. pH = 11.2

27. pH = 6.0

**16 pt**

28. Which of the following functional groups of an amino acid would be ionic at high pH?

A) $-\overset{\overset{\displaystyle O}{\|}}{C}-OH$    B) $-CH_2-OH$    C) $-CH_3$    D) $-NH_2$    E) $-CH_2-\bigcirc$
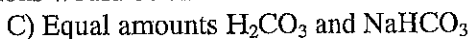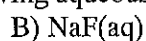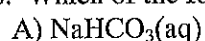
## Section 9.8 Buffers and Blood: The Bicarbonate Buffer System

Consider the following equilibrium for $HCO_3^-$ whose pKa = 10.32.

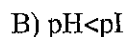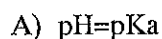$$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$$

29. At which pH is $HCO_3^-$ the best buffer?    A) 2.0    B) 7.0    C) 9.0    D) 10.0    E) 12.0

30. Which of the following aqueous solutions would be the best buffer?
   A) $NaHCO_3(aq)$    B) $NaF(aq)$    C) Equal amounts $H_2CO_3$ and $NaHCO_3$    D) $HF(aq)$    E) $HCl(aq)$

31. At what pH are amino acids the best buffers?

   A) pH=pKa    B) pH<pI    C) pH=pI    D)pH>pI

Use the following equilibrium equation (the one that occurs in blood) for question 29 below.
$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$
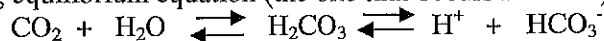
32.    Which condition would most likely be responsible for this patient's condition?    Question 1 of 1

| A) Metabolic acidosis | | Patient | Normal |
|---|---|---|---|
| B) Respiratory acidosis | pH: | 7.85 | 7.33 - 7.43 |
| C) Metabolic alkalosis | $pCO_2$: | 27 mm Hg | 38 - 50 mm Hg |
| D) Respiratory alkalosis | $[HCO_3^-]$: | 16 mmol/L | 22 - 28 mmol/L |

(12 pt) A patient who weighs 155 lb is prescribed a medication three times a day that comes in a 0.4% suspension. If the daily dose is 1.0 g/kg/day how many teaspoons are given each time the medicine is administered? *Useful information: 1 kg = 2.2 lb and 1 tsp = 5 mL*

**22 pt**