Chem 51, Spring 2015 NAME KEY

Chapter 9 (Acids, Bases and Buffers in the Body) 100 points

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) __A__ (is) are compounds that donate a H^+ in water.

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

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

Section 9.2 Strong Acids and Bases and Neutralization Reactions.

Use these answers for Questions 5-8.
A) ammonia
B) acetic acid
C) nitric acid
D) magnesium hydroxide

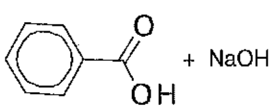
5. (9.2) __C__ is a strong acid.

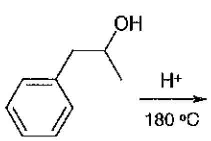
6. (9.2) __D__ is a strong base.

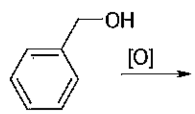
7. (9.4) __B__ is a weak acid.

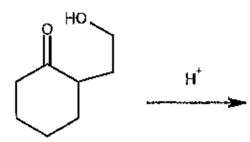
8. (9.4) __A__ is a weak base.

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

(A) 

B) 

C) 

D) 

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

$$2\ HBr(aq) + Ca(OH)_2(s) \longrightarrow 2\ H_2O_{(l)} + CaBr_{2\,(aq)}$$

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)*** 19.19 − 0.00 = 19.19	19.19 mL
(2 pt) Volume in Liters of NaOH used *(Show calculation)* 19.19 mL × 1 L/1000 mL =	0.01919 L

(4 pt) Moles of NaOH used in titration 4.611×10⁻³ mole NaOH
(Show calculation)

$0.01919\ L \times 0.2403\ \frac{mol}{L} = 4.611\times10^{-3}\ mol$

(2 pt) Moles of $HC_2H_3O_2$ neutralized by NaOH 4.611×10^{-3} mole of $HC_2H_3O_2$

same as NaOH

(6 pt) Molarity of $HC_2H_3O_2$ 1.15 M $HC_2H_3O_2$
(Show calculation)

$\frac{4.611\times10^{-3}\ mol}{4.00\ mL \times \frac{1\ L}{1000\ mL}} = 1.153\ M$ round to 3 sig. fig

(4 pt) Grams of $HC_2H_3O_2$ (molar mass = 60.06 g/mol) 0.27969 g $HC_2H_3O_2$
(Show calculation)

$4.611\times10^{-3}\ mol \times 60.06\ g/mol = 0.27969\ g$

(4 pt) Percent (m/v) $HC_2H_3O_2$ ~~7.00~~ 6.92 % $HC_2H_3O_2$
(Show calculation)

$\frac{0.27969\ g}{4.00\ mL} \times 100 = 6.997\ \%$ round to 3 s.f.

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).

$$CO_2 + H_2O \rightleftarrows H_2CO_3 \rightleftarrows H^+ + HCO_3^-$$

A) Metabolic acidosis causes a decrease in CO_2. increases pH
B) Increased respiration (panting) causes a decrease in CO_2 which in turn increases H^+. This is called respiratory alkalosis. decreases
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. pH increases

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^+ B) H_2O C) O^- D) O_2 E) O^{-2}

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

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

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

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

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 __C__ solutions the pH is equal to 7.

16. (9.5) A solution of pH 8 is more __E__ than a solution of pH 5.

17. (9.5) In __D__ solutions the pH is less than 7

18. (9.5) In __D__ solutions $[OH^-]$ is less than $[H_3O^+]$.

19. (9.5) A solution that contains $[H_3O^+] = 1.2 \times 10^{-8}$ is __E__.

20 pt

20. (9.5) If the pH of an aqueous solution increases the molar concentration of ___A___
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 $[H_3O^+] = 1.2 \times 10^{-3}$? 2.92
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? 4.57×10^{-3}
A) 2.3×10^{-3} M B) 4.6×10^{-3} M C) 2.2×10^{-12} M D) 1.2×10^{1} M

Section 9.6 pKa

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

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

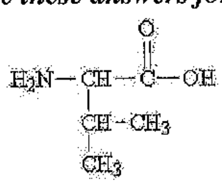
23. (9.6) Which form will predominate when the pH of the solution is at blood pH? 7.4 < 10.32 acidic
A) HCO_3^- B) CO_3^{-2} C) H_2CO_3 D) H_2O E) All of these

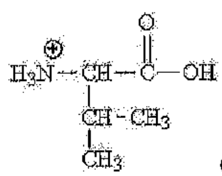
Section 9.7 Amino Acids: Common Biological Weak Acids

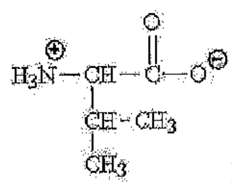
24. Under what conditions can amino acids be found in an un-ionized form?

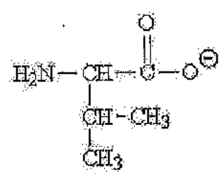
a. at low pH b. at pH = 7 c. at high pH d. amino acids are never found in un-ionized form

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?

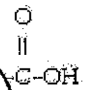
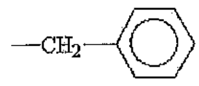
25. pH = 1.2 B

26. pH = 11.2 D

27. pH = 6.0 C

16 pt

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

A)  B) $-CH_2-OH$ C) $-CH_3$ D) $-NH_2$ E) 

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~~ 32 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 10

A) Metabolic acidosis
B) Respiratory acidosis
C) Metabolic alkalosis
D) Respiratory alkalosis

	Patient	Normal
pH:	7.85 alkaline	7.33 - 7.43
pCO_2:	27 mm Hg	38 - 50 mm Hg
$[HCO_3^-]$:	16 mmol/L	22 - 28 mmol/L

Hyperventillation

(12 pt) A patient who weighs 155 lb is prescribed a medication three times a day that comes in a 0.4% (m/v) 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*

? teasp/dose = 155 lb × 1 kg/2.2 lb × 1.0 g med/kg day × 1 day/3 doses × 100 mL susp/0.4 g med × 1 tsp/5 mL = 1174 tsp/dose