CHEM 115 Transition **MLA #1** **Name:** ANSWER KEY

Part One: Multiple choice questions **(2 pt each)**

1. Which of the following does *not* describe a ***solution***?
   a) soda pop b) a 15 *karat* gold/nickle bracelet c) atmospheric air d) chocolate chip cookies

2. *Percent* (%) *concentration* is based on which of the following units x 100%
   a) g/mol b) mol/L c) mL/mol d) g/mL e) mg/L

3. Calculations of concentration typically involve dividing the ________ or ________ of the solute by the __________ of the solvent.

Concentration =	(or) of **solute**
	( ) of **solvent**

   a) mass or moles; mass b) mass or moles; volume c) volume or mass; moles
   d) moles or volume; mass e) volume or moles; volume

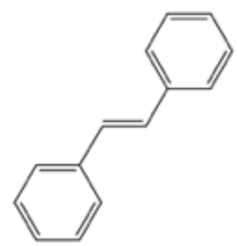
4. Which of the following molecules would you expect to be the most hydrophobic?
   a) butanone b) butane c) butanol d) butanal e) butanoic acid

5. Which of the following ionic compounds produces the most *equivalents of cation* in aqueous solution?
   a) NH_4Cl b) $MgSO_4$ c) NaBr d) $LiNO_3$ e) KCN

6. Which of the following bonds are rotationally '*constrained*' with regards to the two carbons involved?
   a) Alkenes b) Alkanes c) Alkynes d) a & b e) a & c f) all of them

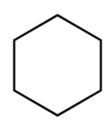
7. What is the relationship between the two molecules shown below & to the right?

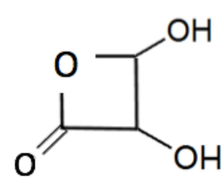
   

   a) Rotational isomers
   b) Structural isomers
   c) Geometric isomers
   d) none of the above (same molecule)

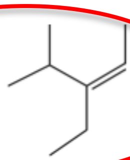
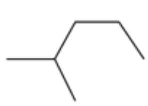
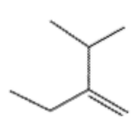
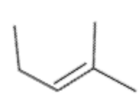
8. What molecular geometry describes each of the carbons involved in a molecule of *cyclohexane*?
   a) Tetrahedral d) Trigonal planar
   b) Bent e) Trigonal pyramidal
   c) Linear

9. Why would the molecule below be unlikely to exist in a natural biomolecule?
   a) cyclic hydrocarbons can't contain oxygen atoms
   b) it contains an ester bond
   c) it has too much ring strain
   d) it has a carbonyl and alcohol groups
   e) it has too many oxygens

10. Which of the following molecules requires *cis* or *trans* in its name to identify which geometric isomer it represents?

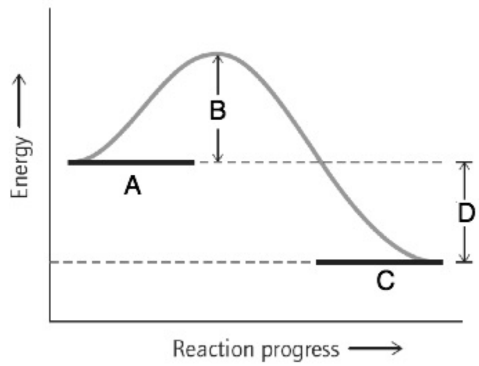
    a)  b)  c)  d)  e) a & d

11. Aromatic hydrocarbons are unusual molecules in that their structures are flat due to the carbons being in the _______________ geometry:
a) tetrahedral c) linear e) trigonal pyramidal
b) bent d) trigonal planar

12. What is wrong with the reaction shown below?
a) It is missing a product
b) It is missing a reactant
c) It has the wrong coefficients
d) Physical states are missing
e) The arrow points the wrong way

$$H_2SO_{3(aq)} \rightarrow H_2O_{(l)} + 2\ SO_{2\ (g)}$$

For the questions below, refer to the energy diagram shown to the right. ***CIRCLE*** the correct letter.



13. Which letter represents the total quantity of bond energy left in the products of the reaction?
A. B. C. D.

14. Which letter represents the <u>change in bond energy</u> over the course of the reaction?
A. B. C. D.

15. Which quantity would you expect to change if a catalyst were added to this reaction?
A. B. C. D.

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16. Which of the following would *not* increase the rate of a reaction?
a) increasing temperature c) adding a catalyst e) they all would increase the rate
b) increasing [reactant] d) increasing [product]

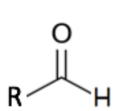
17. What is the **pH** of a solution that contains a hydronium ion concentration [H_3O^+] = 2.73 x 10^{-4} M?
a) 3.56 b) 2.73 c) 11.37 d) 1.74 e) 5.37

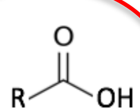
18. The reaction shown below describes the role of carbon dioxide and breathing in the blood buffer system. What would happen if a strong base were added to this system?

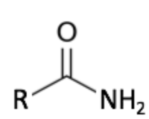
$$CO_2 + H_2O \rightleftharpoons H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$$

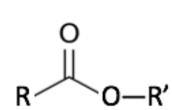
a) [CO_2] would increase c) [HCO_3^-] would increase
b) [H_2CO_3] would increase d) all components except H_2O would increase

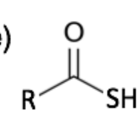
19. Which of the following functional groups is likely to be *ionized* in aqueous solution?

a) 

b) 

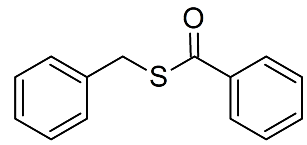
c) 

d) 

e) 

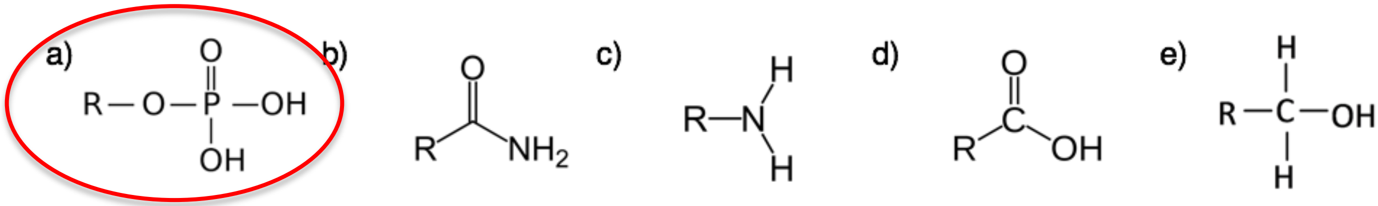
20. What is the relative difference in **[H_3O^+]** between water (pH 7.2) and ammonia (pH 11.2)?
a) 4x b) 100x c) 40x d) 10,000x e) 40,000x

21. What functional group is shown in the molecule to the right?



a) Ether
b) Ester
c) Amide
d) Sulfhydryl
e) Thioester
e) Ketothione

22. Which of the following functional groups has the <u>most negative charge</u> at physiological pH (7.2)?



23. Which of the following is always a product of an acid-base neutralization reaction?

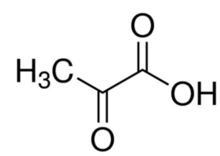
a) H_3O^+ b) OH^- c) H_2O d) a & b e) all three

24. Which of the following pairs of molecules would compose a good buffer system?

a) CH_3COOH & CH_3COO^-
c) CH_3CHO & CH_3CO^-
b) CH_3NH_2 & CH_3NH^-
d) CH_3OH & CH_3O^-

Part Two: Organic Structures & Nomenclature

25. Pyruvic acid ($CH_3COCOOH$) is shown to the right. It is an important intermediate in human metabolism that we will study later this semester. **(6 pts)**



a. <u>**Write out the equilibrium reaction**</u> for pyruvic acid and its conjugate base when it is dissolved in aqueous solution.

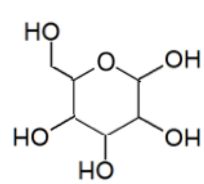
$$CH_3COCOOH + H_2O \rightleftharpoons CH_3COCOO^- + H_3O^+$$

b. If the strong base sodium hydroxide (NaOH) were added to a solution of pyruvic acid at equilibrium, <u>**which direction**</u>—left (toward reactants) or right (toward products)—would the reaction shift?

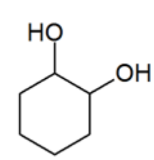
Would decrease H_3O^+, so shift reaction right, toward products

26. Briefly explain in simple terms why **glucose** (shown below) is highly soluble in water, whereas a similar organic molecule, ***cyclohexane-1,2-diol***, is not. **(3 pts)**

The ratio of C:O provides a simple way of measuring polar versus non-polar character of a molecule. Molecules with a ratio near 1:1 are soluble, whereas molecules with much more carbon than oxygen are too non-polar to dissolve in water



glucose

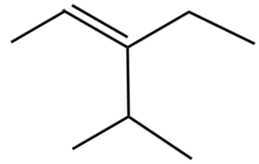


cyclohexane-1,2-diol

Glucose: $C_6H_{12}O_6$, C:O = 1:1
Cyclohexane-1,2-diol: $C_6H_{12}O_2$, C:O = 3:1

27. Provide proper IUPAC **names** or **structures** for the following organic molecules **(12 pts, 3 pts ea)**

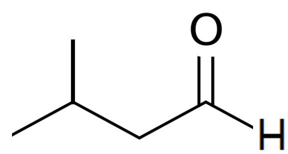
a) 3-ethyl-4-methyl-2-pentene
(provide name)



b) **propyl 2-butenyl ether**

(draw the structure →)

c) 3-methyl-butanal
(provide name)



d) **N,N-dimethyl-hexanamine**

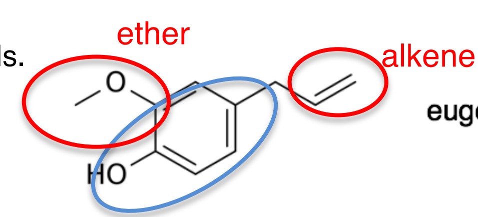
(draw the structure →)

28. Eugenol and zingerone are two similar aromatic compounds found in a variety of "essential oils". Both are based on a similar core aromatic group, but have different functional groups that decorate this structure.

(6 pts)

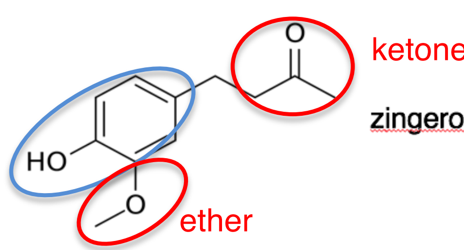
a. **Identify the name** of the core aromatic structure that is common to both compounds.

Phenol (blue ring)



eugenol (clove oil)

b. **Circle** and **name** all of the other functional groups found on each of these compounds.



zingerone (ginger extract)

Part Three: Problem Solving Calculations *(Make sure that you keep track of significant figures!)*

The nutritional label for **chocolate milk** is shown to the right. Answer the following questions based on this label.

Nutrition Facts	
Serving Size 1 cup (249g)	
Servings Per Container 8	
Amount Per Serving	
Calories 210	Calories from Fat 80
	% Daily Value*
Total Fat 8g	**13%**
Saturated Fat 5g	**26%**
Trans Fat 0g	
Cholesterol 30mg	**10%**
Sodium 200mg	**9%**
Total Carbohydrate 27g	**9%**
Dietary Fiber 1g	**5%**
Sugars 25g	
Protein 9g	
Vitamin A 6%	• Vitamin C 0%
Calcium 30%	• Iron 6%
Vitamin D 30%	
*Percent Daily Values are based on a 2,000 calorie diet.	

29. Based on the caloric density of fat (9 Cal/gram), **calculate the number of Joules** of energy that are derived from fat a single serving of chocolate milk. **(4 pts)**

$$\frac{8\text{ g}}{} \left| \frac{9\text{ Cal}}{1\text{ g}} \right| \frac{1000\text{ cal}}{1\text{ Cal}} \left| \frac{4.184\text{ J}}{1\text{ cal}} \right. = 301{,}248\text{ J} = \mathbf{300{,}000\text{ J}}$$

or **3×10^5 J**

1 sig fig

30. Drinking a glass of milk is a good treatment for heartburn, which is caused by excess stomach acid leaking into the esophagus. If drinking a glass of milk changed your stomach pH from 2.37 to 6.21 in a volume of 1.25 liters, how many moles of acid would be getting neutralized? **(6 pts)**

$\Delta\text{ pH} = 6.21 - 2.37 = 3.84$ $[H_3O^+] = 10^{-pH} = 10^{(-3.84)} = 1.45 \times 10^{-4}\text{ M}$

$$M = \text{mol/L} = \frac{1.45 \times 10^{-4}\text{ mol}}{1\text{ L}} \left| \frac{1.25\text{ L}}{} \right. = \mathbf{1.81 \times 10^{-4}\text{ mol}}$$

3 sig fig

31. A single serving of chocolate milk is 1 cup (= 237 mL). Given this volume and information from the nutritional label, calculate the molarity (**M**) of cholesterol (386.7 g/mol) in chocolate milk. **(6 pts)**

$$\frac{30\text{ mg}}{} \left| \frac{1\text{ g}}{1000\text{ mg}} \right| \frac{1\text{ mol}}{386.7\text{ g}} = 7.8 \times 10^{-5}\text{ mol}$$

1 or 2 sig fig

$$M = \text{mol/L} = \frac{7.8 \times 10^{-5}\text{ mol}}{237\text{ mL}} \left| \frac{1000\text{ mL}}{1\text{ L}} \right. = \mathbf{3.3 \times 10^{-4}\text{ M}}$$

32. Balance the reaction shown below & calculate the mass of iron (III) oxide (159.69 g/mol) produced from the oxidation of 50.0 grams of pure iron (55.85 g/mol) with oxygen. **(9 pts)**

$\underline{\ 4\ }$ Fe (s) + $\underline{\ 3\ }$ O_2 (g) → $\underline{\ 2\ }$ Fe_2O_3 (s)

$$\frac{50.0\text{ g}}{} \times \frac{1\text{ mol (Fe)}}{55.85\text{ g}} \times \frac{2\text{ mol }(Fe_2O_3)}{4\text{ mol (Fe)}} \times \frac{159.69\text{ g}}{1\text{ mol }(Fe_2O_3)} = \mathbf{71.5\text{ g}}$$

3 sig fig