

JBA 2019 – Chemistry Exam 2

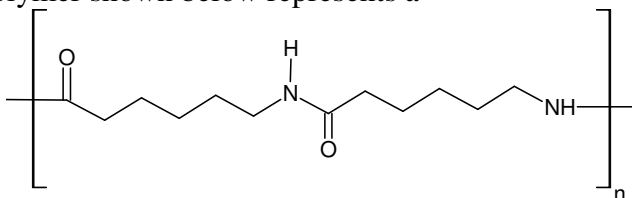
Name: _____ Score: _____/100 = _____/80

Multiple choice questions are worth two points each.

1. Constitutional isomers are compounds that have
- the same chemical formulas and molecular structures but different physical properties.
 - the same chemical formulas but different molecular structures and physical properties.
 - different chemical formulas and molecular structures but the same physical properties.
 - the same chemical formulas, molecular structures and physical properties.

Answer b

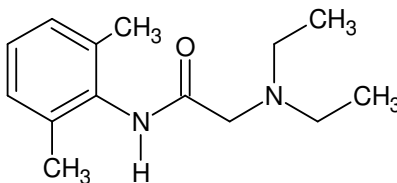
2. The segment of a polymer shown below represents a



- polyester
- polyamide.
- polyethylene.
- polystyrene.

Answer b

3. Lidocaine, shown below, is both a local anesthetic and an antiarrhythmic drug. In emergency medical situations, patients with irregular heartbeats frequently receive lidocaine injections or drips. What is the molecular formula of lidocaine?



- $C_{14}H_{20}N_2O$
- $C_{14}H_{17}N_2O$
- $C_{14}H_{13}N_2O$
- $C_{14}H_{22}N_2O$

Answer d

4. Which of the following contains the greatest number of moles of O?

- 2.3 mol H_2O
- 1.2 mol H_2O_2
- 0.9 mol $NaNO_3$
- 0.5 mol $Ca(NO_3)_2$

Answer d

Please write legibly! If I can't read it, I can't grade it!

5. Consider the reaction below. If 2.00 mol of A reacts with 3.00 mol B, what is the theoretical yield of C?



- a. 1.20 mol
b. 2.25 mol
c. 3.00 mol
d. 3.45 mol

Answer a

6. One can learn about the functional groups present in an organic compound by using the following technique.

- a. NMR spectroscopy
b. mass spectrometry
c. infrared spectroscopy
d. a really big magnifying glass.

Answer c

7. Which of these classes of compounds form most of the membranes for your cells?

- a. carbohydrates
b. lipids (or fats)
c. amino acids
d. nucleic acids.

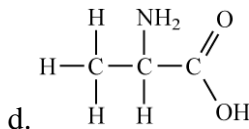
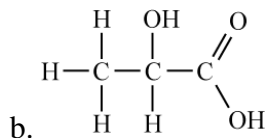
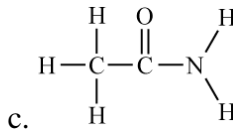
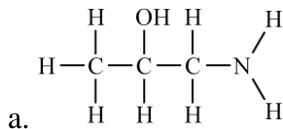
Answer b

8. What type of interaction is responsible for the secondary structure of proteins and the double-helix of DNA?

- a. ionic interactions
b. covalent bonding
c. hydrogen bonding
d. dispersion forces

Answer c

9. Amino acids are compounds that contain **both** amine and carboxylic acid groups. Which compound is an amino acid? is:



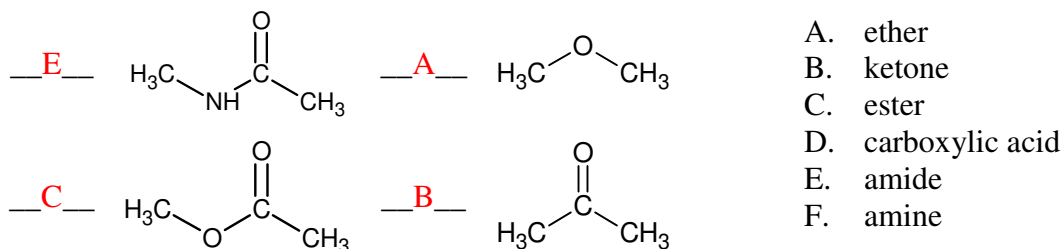
Answer d

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10. Match the term with its definition. (8 points)

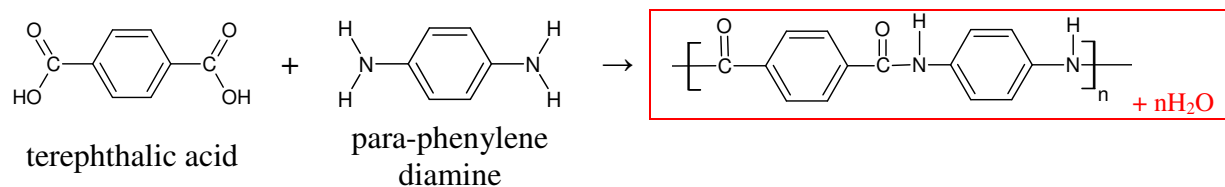
| | |
|----------------------------|---|
| <u>B</u> primary structure | A. covalent bond formed by overlap of s orbitals |
| <u>I</u> stereoisomers | B. the order of amino acids in a protein |
| <u>F</u> chiral center | C. a bond that ties two polymer chains together |
| <u>H</u> mole | D. species that determines the theoretical yield in a reaction |
| <u>E</u> radical | E. a reactive species with on unpaired electron |
| <u>C</u> crosslink | F. an atom bonded to 4 different groups |
| <u>D</u> limiting reactant | G. a water insoluble compound containing at least one carbon-carbon multiple bond |
| <u>G</u> unsaturated fat | H. one Avogadro's number of anything |
| | I. compounds that have the same chemical formula and bonding but different arrangement in space |
| | J. a water insoluble compound with no carbon-carbon multiple bonds |

11. Identify the functional group shown in each structure: (8 points)



12. Kevlar, a polyamide used to make bulletproof vests, is made from terephthalic acid and para-phenylenediamine.

a. Write the polymerization reaction for the formation of Kevlar, indicating the repeating structure for the polymer. (4 points)



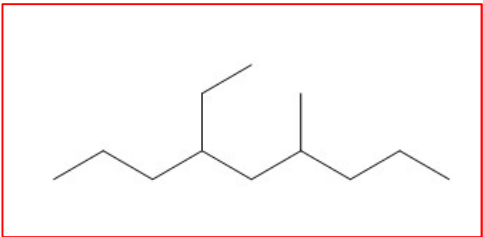
b. What type of polymerization reaction is this? Circle the correct answer. (2 points)

addition

condensation

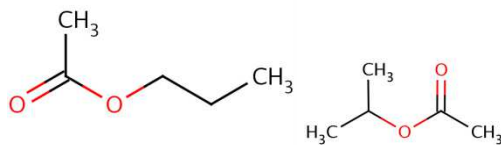
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13. Complete the table for the alkanes below. (8 points)

| <i>Structure</i> (<i>Line angle or Lewis structures are acceptable</i>) | <i>Name</i> |
|---|-------------------------|
|  | 4-ethyl-6-methyl nonane |
| $\begin{array}{c} \text{H}_3\text{C}-\text{CH}-\text{CH}_3 \\ \\ \text{CH}_2 \\ \\ \text{H}_3\text{C}-\text{CH}_2-\text{C}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ | 2,4,4-trimethylhexane |

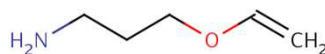
14. Draw organic compounds that fit the following criteria (there may be more than one structure that fits the criteria, you only need to draw one example for each):

a. A compound that contains an ester and has the formula $\text{C}_5\text{H}_{10}\text{O}_2$. (4 points)



Here are examples of possible structures:

b. A compound that contains an amine and an ether and has the formula $\text{C}_4\text{H}_{11}\text{NO}$. (4 points)



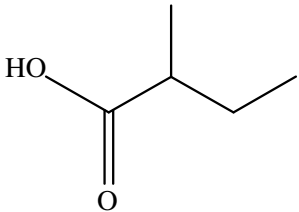
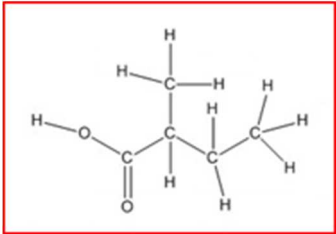
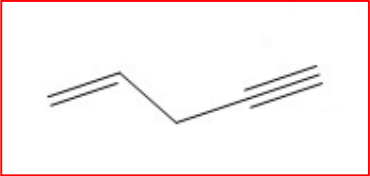
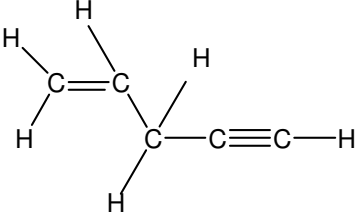
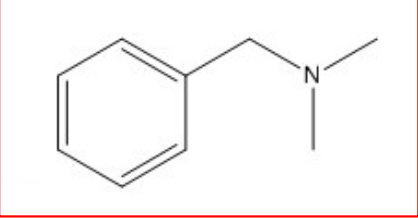
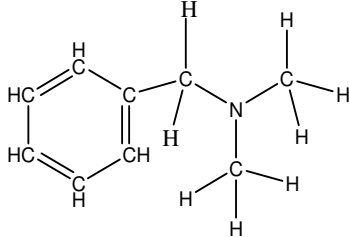
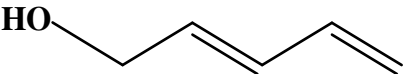
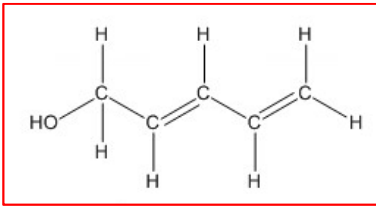
Here's an example of one possible structure:

15. Compounds that can serve as monomers for polymerization reactions must have one key property. What property is this? Show how this property appears in both addition and condensation polymerization. (6 points)

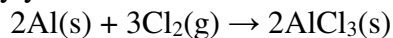
Monomers must be able to react in two locations in order for the polymer to continue to grow. For addition polymerization, the alkene produces a di-radical that can react in two locations and continue to grow. For condensation polymerization, the monomers must have two functional groups that can react independently. (Example structures would be useful here.)

Please write legibly! If I can't read it, I can't grade it!

16. Complete the following table (12 points)

| <i>Line angle</i> | <i>Lewis Structure</i> | <i>Molecular Formula</i> |
|---|--|--------------------------|
|  |  | $C_5H_{10}O_2$ |
|  |  | C_5H_6 |
|  |  | $C_9H_{13}N$ |
|  |  | C_5H_8O |

17. For the reaction below, what is the limiting reactant when 0.253 g aluminum reacts with 0.482 g Cl_2 ? You must justify your answer with a calculation. (8 pts)



If aluminum is the L.R. how much $AlCl_3$ could be made?

$$0.253 \text{ g-Al} \times \frac{1 \text{ mol-Al}}{26.98 \text{ g-Al}} \times \frac{2 \text{ mol-AlCl}_3}{2 \text{ mol-Al}} = 0.00938 \text{ mol AlCl}_3 \times \frac{133.34 \text{ g AlCl}_3}{1 \text{ mol AlCl}_3} = 1.25 \text{ g AlCl}_3$$

If chlorine is the L.R. how much $AlCl_3$ could be made?

$$0.482 \text{ g-Cl}_2 \times \frac{1 \text{ mol-Cl}_2}{70.90 \text{ g-Cl}_2} \times \frac{2 \text{ mol-AlCl}_3}{3 \text{ mol-Cl}_2} = 0.00453 \text{ mol AlCl}_3 \times \frac{133.34 \text{ g AlCl}_3}{1 \text{ mol AlCl}_3} = 0.604 \text{ g AlCl}_3$$

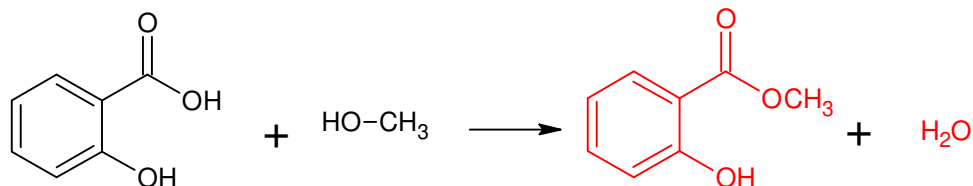
Since less $AlCl_3$ is produced when all of the Cl_2 is consumed, Cl_2 must be the limiting reagent.

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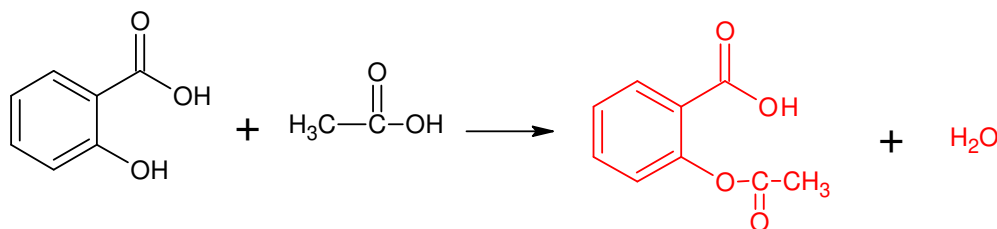
18. Alcohols and carboxylic acids react to form esters by the process shown below.



- a. Complete the reaction of salicylic acid with methanol to form methyl salicylate (oil of wintergreen). (4 points)



- b. Complete the reaction of salicylic acid with acetic acid to form acetylsalicylic acid (aspirin). (4 points)



19. You need to determine the identity of an unknown acid, represented by HA. You have two proposed formulas, $\text{C}_7\text{H}_6\text{O}_2$ and $\text{C}_5\text{H}_{10}\text{O}_2$. To determine the molar mass of the acid, you titrate the acid with 0.110 M NaOH. If 0.250 grams of the acid requires 22.25 mL of NaOH. Balanced reaction: $\text{HA} + \text{NaOH} \rightarrow \text{NaA} + \text{H}_2\text{O}$

- a. How many moles of the acid must have reacted? (5 points)

$$0.02225 \text{ L NaOH} \times \frac{0.110 \text{ mol NaOH}}{1 \text{ L NaOH}} \times \frac{1 \text{ mol HA}}{1 \text{ mol NaOH}} = 0.0024475 \text{ mol HA}$$

- b. Calculate the molar mass of the acid and determine which of the two formulas is the correct formula for the acid. (5 points)

From our experimental results, the molar mass must be:

$$\frac{0.250 \text{ g HA}}{0.0024475 \text{ mol HA}} = 102.1 \text{ g/mol}$$

If $\text{C}_7\text{H}_6\text{O}_2$ is the correct formula, the molar mass would be 122.12 g/mol and if $\text{C}_5\text{H}_{10}\text{O}_2$ is the correct formula, the molar mass would be 102.1 g/mol, therefore, the correct formula is $\text{C}_5\text{H}_{10}\text{O}_2$.