

JBA 2024 – Chemistry Exam 2

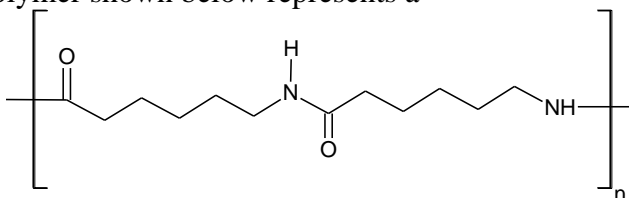
Name: _____ Score: _____/100

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

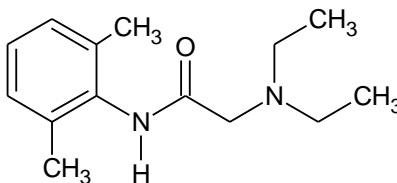
2. The segment of a polymer shown below represents a



- 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. How many moles of B need to react to produce 2 moles of C?



- a. 0.75 mol
b. 2.67 mol
c. 3.00 mol
d. 4.00 mol

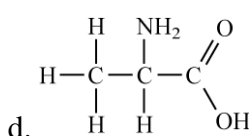
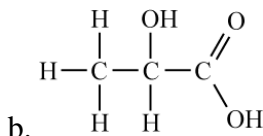
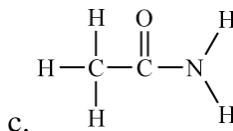
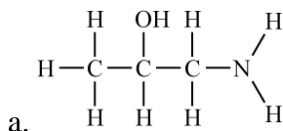
Answer b

6. One can learn about the environments of hydrogens or carbons present in an organic compound by using the following technique.

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

Answer c

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



Answer d

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

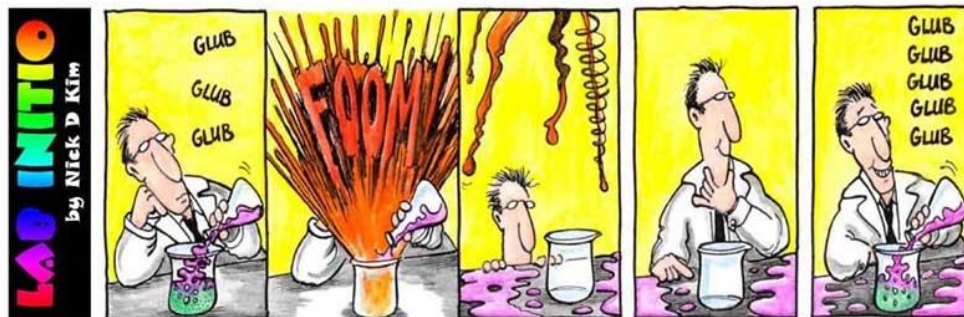
- a. carbohydrates
b. lipids (or fats)
c. amino acids
d. nucleic acids.

Answer b

9. What key role do carbohydrates serve in the body?

- a. They form cell walls
b. They encode genetic information
c. They are sources of energy
d. They serve no role in the body.

Answer c



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

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

<u>G</u> alkene	A. a compound with substituents on the same side of a double bond
<u>I</u> stereoisomers	B. a collection of atoms in a molecule that has predictable properties and reactivity
<u>F</u> chiral carbon	C. a bond that ties two polymer chains together
<u>H</u> mole	D. a compound with substituents on the opposite sides of a double bond
<u>K</u> saturated fat	E. a reactive species with one unpaired electron
<u>E</u> radical	F. an atom bonded to 4 different groups
<u>L</u> amphiphilic	G. a compound of carbon and hydrogen containing at least one carbon-carbon double bond
<u>C</u> crosslink	H. one Avogadro's number of anything
<u>D</u> trans-	I. compounds that have the same chemical formula and bonding but different arrangement in space
<u>B</u> functional group	J. a compound of carbon and hydrogen containing at least one carbon-carbon triple bond
	K. a water insoluble compound with no carbon-carbon multiple bonds
	L. a containing both hydrophobic and hydrophilic portions

11. Complete the following table. (6 points)

12. <u>147</u> g H ₂ O	=	8.14 mol H ₂ O	=	<u>4.90 x 10²⁴</u> molecules H ₂ O
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In order to relate moles and mass, we need to use the molar mass, so we must calculate the molar mass of water:

$$\frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{1.01 \text{ g}}{1 \text{ mol H}} + \frac{1 \text{ mol O}}{1 \text{ mol H}_2\text{O}} \times \frac{16.00 \text{ g}}{1 \text{ mol O}} = \frac{18.02 \text{ g}}{1 \text{ mol H}_2\text{O}}$$

Therefore, the molar mass of H₂O is 18.02 g/mol

Now the conversion between moles and grams:

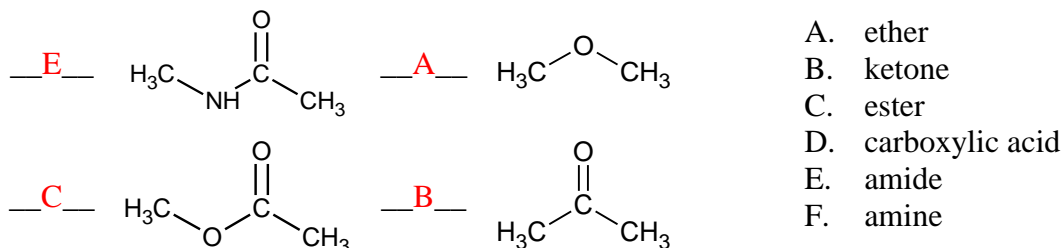
$$8.14 \text{ mol H}_2\text{O} \times \frac{18.02 \text{ g}}{1 \text{ mol H}_2\text{O}} = 146.68 \text{ g} = \mathbf{147 \text{ g H}_2\text{O}}$$

To convert between moles and molecules, we use Avogadro's number that tells us that 1 mol = 6.022 x 10²³ molecules.

$$8.14 \text{ mol H}_2\text{O} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol H}_2\text{O}} = 4.9019 \times 10^{24} \text{ molecules} = \mathbf{4.90 \times 10^{24} \text{ molecules H}_2\text{O}}$$

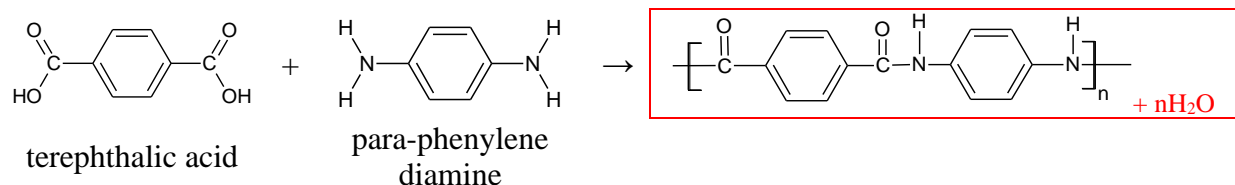
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12. Identify the functional group shown in each structure: (4 points)



13. 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

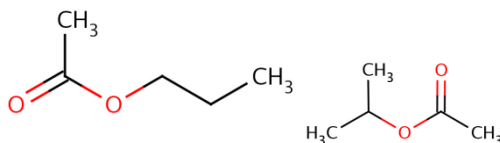
14. Complete the table for the alkanes below. (6 points)

Structure (Line angle or Lewis structures are acceptable)	Name
	4-ethyl-6-methyl nonane
	2,4,4-trimethylhexane

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

15. 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):

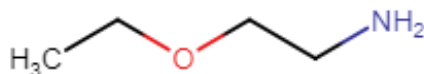
a. A compound that contains an ester and has the formula $C_5H_{10}O_2$. (4 points)



Here are examples of possible structures:

b. A compound that contains an amine and an ether and has the formula $C_4H_{11}NO$. (4 points)

There was an error in this question, I meant the formula to be $C_4H_{13}NO$ (13 hydrogens, not 11) this is an example of a possible structure

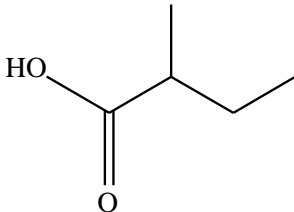
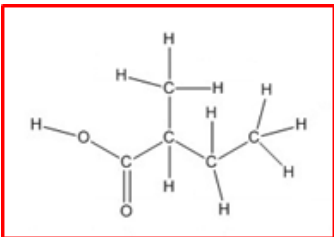
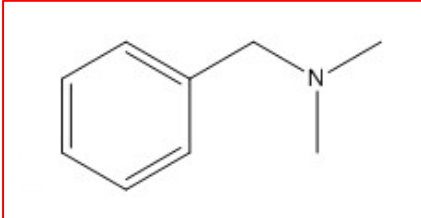
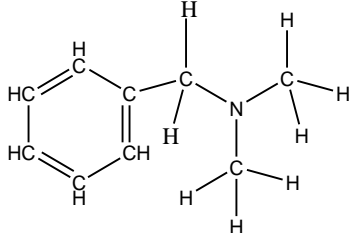
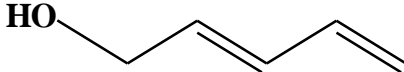
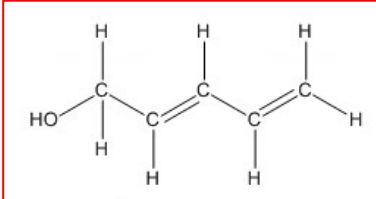


16. Compounds that can serve as monomers for polymerization reactions must have one key property in order for polymer chains to grow. What property is this? Show how this property appears in both addition and condensation polymerization. (6 points)

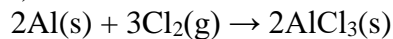
Monomers must be able to react in two locations in order for the polymer to continue to grow. For addition polymerization, the alkene produces a di-radical that can react in two locations and continue to grow. For condensation polymerization, the monomers must have two functional groups that can react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

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

17. Complete the following table (12 points)

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

18. For the reaction below, what is the mass of $AlCl_3$ that is formed when 0.482 g Cl_2 reacts with an excess of aluminum? (8 pts)



The process requires us to convert from grams of chlorine to moles of chlorine using its molar mass, then use the balanced reaction to convert to moles of aluminum chloride, before using the molar mass of aluminum chloride to determine grams of aluminum chloride.

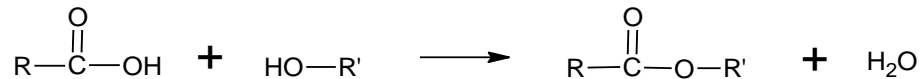
$$0.482 \text{ g-}Cl_2 \times \frac{1 \text{ mol } Cl_2}{70.90 \text{ g-}Cl_2} = 0.006798 \text{ mol } Cl_2$$

$$0.006798 \text{ mol-}Cl_2 \times \frac{2 \text{ mol } AlCl_3}{3 \text{ mol-}Cl_2} = 0.00453 \text{ mol } AlCl_3$$

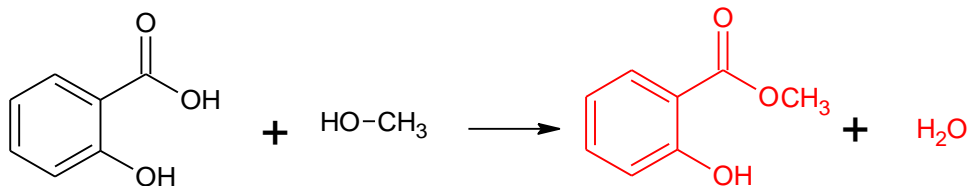
$$0.00453 \text{ mol-}AlCl_3 \times \frac{133.34 \text{ g } AlCl_3}{1 \text{ mol } AlCl_3} = 0.604 \text{ g } AlCl_3$$

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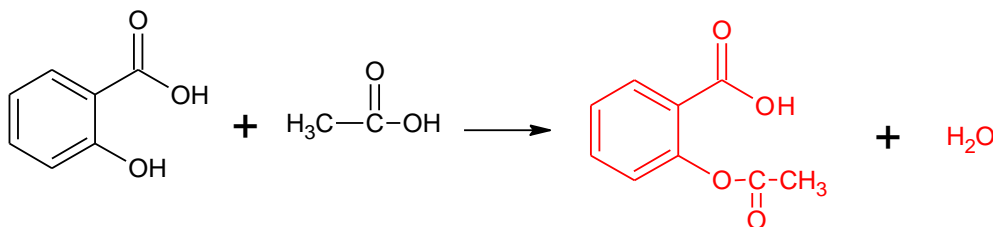
19. Alcohols and carboxylic acids react to form esters by the process shown below.



- 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)



13. Nucleic acids are the building blocks of DNA.

- a. Every nucleic acid in DNA has three components. What are they? (3 points)

A sugar, a phosphate group and a nitrogen containing base

- b. Why types of intermolecular forces hold DNA strands together to form a double helix? (3 points)

Hydrogen bonding interactions

- c. In DNA, adenine and thymine are complementary bases, as are cytosine and guanine. If a segment of a single strand of DNA has the sequence, -ATTCGTAA-, what would the complementary sequence be? (4 points)

Since A is complementary to T and C is complementary to G, the sequence would be:
-TAAGCATT-