**STUDY GUIDE** - *Ch. 4.2 - Carbon atoms can form diverse molecules by bonding to four other atoms.* **NAME:** _____

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** *Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** *AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie.** *Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** ***First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.*

1. Why does an atom's **electron configuration determine the chemical characteristics of an atom**?

2. a. What do we mean when we talk about the **number of valence electrons an atom has** versus **an atoms' valence**?

   **Number of Valence Electrons =**

   **An Atom's Valence =**

   b. Is the number of covalent bonds an atom can form equal to the atom's number of valence electrons or its valence?

3. **Study figure 4.3.** Make sure you know the difference between a **molecular formula and structural formula**. Pay also attention to the 3-D shape of the sample molecules especially ethane and ethene based on if the carbons are bonded together by a single bond vs double bond.

4. a. Draw a **Bohr Model (electron distribution diagram) of an atom of carbon**, showing the number and energy shell/level location of all the electrons carbon does have. *(Study Figure 4.4 to answer this question)*

   b. How many **valence electrons does carbon have**?

c. Draw the **Lewis Dot Structure for an atom of carbon**. *(These only show an atom's valence electrons)*

d. What is the **valence of carbon**?

e. Why does carbon's valence make **carbon** the **central atom in the chemistry of life**?

5. Based on the Lewis Dot Structures and Bohr Models of Oxygen, Nitrogen, and Hydrogen provided in Figure 4.4, what is the **maximum number of covalent bonds** each of these atoms can form?

   a. O =
   b. N =
   c. H =

6. a. What are **hydrocarbons**?

   b. Covalently-bonded carbon chains form "skeletons." **Carbon skeletons** vary in length and can be **1. straight**, **2. branched**, **3. arranged in closed rings,** and **4. can contain double bonds**, which can vary in location and number. Draw one sample hydrocarbon showing each of these four types of variations.

   1.

   2.

   3.

   4.

   c. Molecules like **fats** and **petroleum** *(a fossil fuel because it is composed of partially decomposed remains of organisms that lived millions of years ago)* either contain sections that are largely hydrocarbon-like (fats) or are full hydrocarbons (petroleum). What are **two important characteristics of hydrocarbons**.

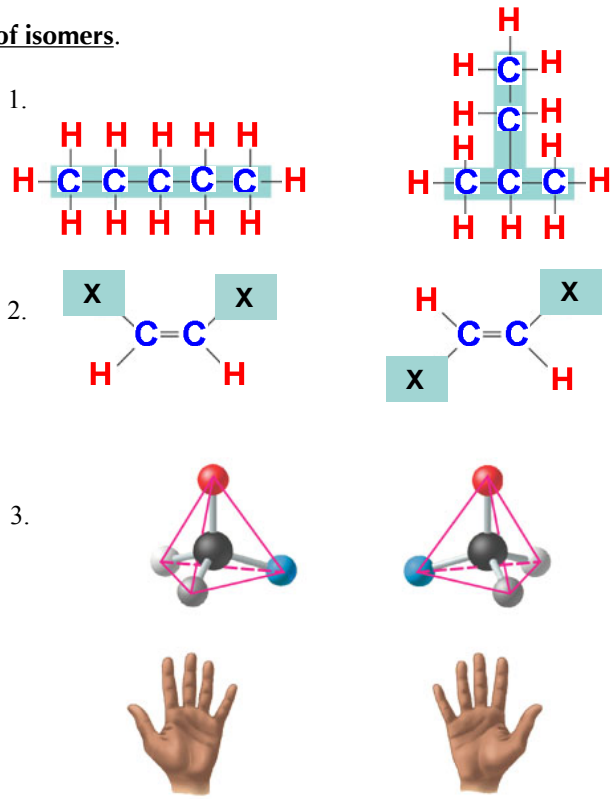
   1.

   2.

7. a. Hydrogen atoms attached to carbon skeletons in hydrocarbons can be replaced with atoms of other elements like C, N, O, P, S etc... What is an **isomer**? ***(Remember, form fits function: If shape changes, function changes)***

b. Use the diagram below to label and explain the **three types of isomers**.

| | |
|---|---|
| 1. | |
| 2. | |
| 3. | |



c. Note, structural isomers may also differ from each other also in the location of double bonds, not just the arrangement of single covalent bonds. Let's take another look at the two structural isomers displayed in part 1 of the figure above. As it turns out, there are actually three structural isomers of $C_5H_{12}$, not just the two displayed above. Determine and draw the structural formula of the third isomer below. Remember, ***though the arrangement of the atoms changes, the molecular formula must not!*** *(Hint: Moving the ascending branch found on the middle carbon over left or right to the first or third horizontal carbon does NOT result in a new isomer. Doing so only creates a differently drawn versions of the linear isomer already displayed on the left. Similarly, moving, for example, the right most horizontal carbon up one carbon vertically, also does not create a new isomer as you end up the same isomer already displayed on the right, just drawn differently. Moving that carbon up vertically by two carbons also just results in the linear isomer already drawn on the left).*

8. How do enantiomers highlight how molecules display emergent properties based on their atomic structure (not just the atoms the molecules contain but also their arrangement in space)?

9. Draw the trans isomers of $C_2H_2Cl_2$. *(Check your answer for accuracy by going to the **Ch.4.2 Concept Check Question** answer for Question 1.b in Appendix A of your textbook)*

10. Can propane $C_3H_8$ form isomers? *(Check your answer for accuracy by going to the **Ch.4.2 Concept Check Question** answer for Question 4 in Appendix A)*