1-10 are True / False. (10pts)

1) Organic chemistry is the study of carbon containing compounds

2) A triple bond has two $\pi$ bonds and one $\sigma$ bond

3) All $\pi$ bonds are polar

4) Nitrogen is more electronegative than Phosphorous

5) Carbon has a larger atomic radius than Oxygen

6) Rubidium (Rb) is one of the alkali metals

7) Calcium’s electron configuration is $[\text{Ne}]3s^2$

8) Kinetics deals with the speeds of chemical reactions

9) The Hammond Postulate states that no two electrons in the same atom can have the same four quantum number values

10) A $\sigma$ bond places electron density directly along the internuclear axis

11) How many lone pairs are on each of these three molecules? (3pts)

(a) $\text{BH}_3$

(b) 

(c) 

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12) For the below molecule: (6pts)

How many...
- Carbons
- Hydrogens
- $\pi$ bonds
- Pairs of non-bonding electrons
- $sp^2$ hybridized carbons?

What is the hybridization of the Oxygen?

13) What is meant by the "mechanism" of a chemical reaction? (2pts)

14) Name the following two molecules in IUPAC terms. (3+3 pts)
15) Circle the *most stable* member of each threesome. (8pts)

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

(h)
16) Using line angle diagrams draw two different isomers of \textit{1,2-dimethylcyclopropane} and assign the appropriate \textit{stereodescriptor} terms to each isomer to differentiate between them. (4+2pts)

17) (2pts) Using the four below energy level diagrams:

(A) \hspace{1cm} (B)

(C) \hspace{1cm} (D)

i) Which energy level diagram depicts a two step exothermic reaction?

ii) Which energy level diagram has its second step as the rate limiting step?

18) What are the two components that make up \textit{ring strain}? (1pt)
19) What is meant by the term *Lewis Acid*? (1pt)

20) In terms of electrons, what happens to a *Leaving Group*? (1pt)

21) Use curly arrows to show how the left hand side resonance structure converts into the right hand structure. (4pts)

(a) \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{N} \\
\text{H} \\
\text{H} \\
\end{array}
\quad \xrightarrow{\text{curly arrows}} \quad
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{N} \\
\text{H} \\
\text{H} \\
\end{array}
\]

(b) \[
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{N} \\
\text{H} \\
\text{H} \\
\end{array}
\quad \xrightarrow{\text{curly arrows}} \quad
\begin{array}{c}
\text{H} \\
\text{C} \\
\text{N} \\
\text{H} \\
\text{H} \\
\end{array}
\]

*BONUS POINT*

*The molecule in Question 12 is a potent synthetic opioid pain medication, hundreds of times stronger than morphine, and responsible for thousands of overdoses this decade. What is the common (non-IUPAC) name of this molecule?*
1-10 are True / False. (10pts)

1) Organic chemistry is the study of carbon containing compounds \( \text{True} \)

2) A triple bond has two \( \pi \) bonds and one \( \sigma \) bond \( \text{True} \)

3) All \( \pi \) bonds are polar \( F \)

4) Nitrogen is more electronegative than Phosphorous \( \text{True} \)

5) Carbon has a larger atomic radius than Oxygen \( \text{True} \)

6) Rubidium (Rb) is one of the alkali metals \( \text{True} \)

7) Calcium’s electron configuration is \([\text{Ne}]3s^2\) \( F \)

8) Kinetics deals with the speeds of chemical reactions \( \text{True} \)

9) The Hammond Postulate states that no two electrons in the same atom can have the same four quantum number values \( F \)

10) A \( \sigma \) bond places electron density directly along the internuclear axis \( \text{True} \)

11) How many lone pairs are on each of these three molecules? (3pts)

(a) \( \text{BH}_3 \) \( \text{Zero} \)

(b) \( \begin{array}{c}
\text{OH} \\
\text{H}
\end{array} \) \( \text{Two} \)

(c) \( \begin{array}{c}
\text{Br} \\
\text{N}
\end{array} \) \( \text{Four} \)
12) For the below molecule: (6pts)

How many…

Carbons 22

Hydrogens 28

π bonds 7

Pairs of non-bonding electrons 4

sp² hybridized carbons? 13

What is the hybridization of the Oxygen?

sp²

13) What is meant by the “mechanism” of a chemical reaction? (2pts)

The step by step movement of electrons which describes how bonds are made and broken during a chemical reaction.

14) Name the following two molecules in IUPAC terms. (3+3 pts)

2,2,3-trimethylpentane

5-cyclooctylecane
15) Circle the *most stable* member of each threesome. (8pts)

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

(h)
16) Using line angle diagrams draw two different isomers of 1,2-dimethylecyclopropane and assign the appropriate stereodescriptor terms to each isomer to differentiate between them. (4+2pts)

![CIS and TRANS isomers]

17) (2pts) Using the four below energy level diagrams:

(A) \[ \uparrow E \]
\[ \text{Reaction Progress} \rightarrow \]

(B) \[ \uparrow E \]
\[ \text{Reaction Progress} \rightarrow \]

(C) \[ \uparrow E \]
\[ \text{Reaction Progress} \rightarrow \]

(D) \[ \uparrow E \]
\[ \text{Reaction Progress} \rightarrow \]

i) Which energy level diagram depicts a two step exothermic reaction?  

ii) Which energy level diagram has its second step as the rate limiting step?

18) What are the two components that make up ring strain? (1pt)

Angle strain & Torsional strain
19) What is meant by the term *Lewis Acid*? (1pt)

A *two electron acceptor*.

20) In terms of electrons, what happens to a *Leaving Group*? (1pt)

A group that gets disconnected and takes with it a pair of electrons via heterolytic bond cleavage.

21) Use curly arrows to show how the left hand side resonance structure converts into the right hand structure. (4pts)

(a) \[
\begin{align*}
\text{[Resonance structure]} & \leftrightarrow \\
\text{[Resonance structure]} & \\
\end{align*}
\]

(b) \[
\begin{align*}
\text{[Resonance structure]} & \leftrightarrow \\
\text{[Resonance structure]} & \\
\end{align*}
\]

*BONUS POINT*

The molecule in Question 12 is a potent synthetic opioid pain medication, hundreds of times stronger than morphine, and responsible for thousands of overdoses this decade. What is the common (non-IUPAC) name of this molecule?

Fentanyl (IUPAC name is \(\text{N-[(1-(2-Phenylethyl)-4-piperidyl)]-N-}\text{Phenylpropanamide}\))