

Question 1 Answer the following based on the Lewis Dot Structure for SF₂
16 Point



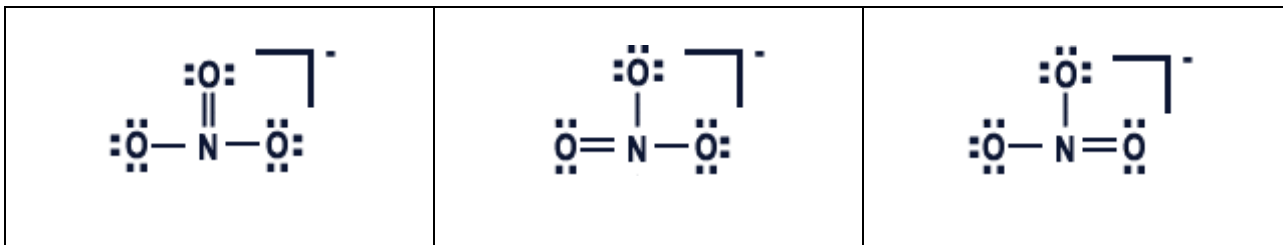
- Number of lone pairs on the central S atom is: **2**
- The central S atom forms **2** single bond(s).
- The central S atom forms **0** double bond(s).
- The Lewis structure has two or more resonance structure: True **False**

Answer the following based on the Lewis Dot Structure for O₃



- Number of lone pairs on the central O atom is: **1**
- The central O atom forms **1** single bond(s).
- The central O atom forms **1** double bond(s).
- The Lewis structure has two or more resonance structure: **True** False

Question 2 Draw the three resonance structures for NO₃⁻.
9 Points



Question 3 Some typical bond lengths are listed below:
4 Points

C-O 143 pm
C=O 122pm
C≡O 113pm

N-O 136 pm
N=O 115 pm
N≡O 108 pm

What would you anticipate the C-O bond length to be in H₂CO **122 pm**

What would you anticipate the N-O bond length to be in NO₃⁻ **~129 pm**

Question 4 Saturated hydrocarbons contain only single bonds. Answer the following questions with respect to the following molecules.
10 Points

1. C₅H₁₂

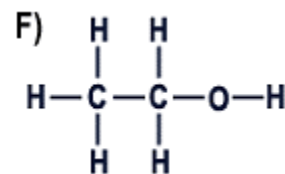
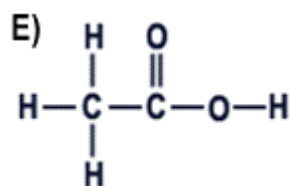
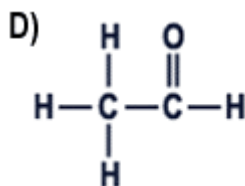
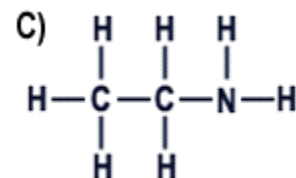
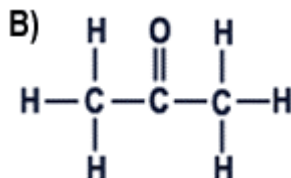
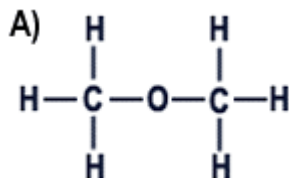
2. C₄H₈

3. C₈H₁₈

4. C₆H₁₀

- | | |
|-------------------------------------------|----------------------------------------------|
| a) A saturated hydrocarbon: 1 or 3 | d) An unsaturated hydrocarbon: 2 or 4 |
| b) Octane: 3 | e) An alkene: 2 |
| c) An alkyne: 4 | |

Question 5
16 Points



The questions below refer to the structural formulas given above for some organic molecules. Give the letter of the structure that depicts:

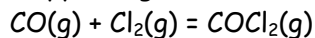
- | | | | |
|----------------------|----------|----------------------------------|----------|
| 1. An alcohol | F | 5. A ketone | B |
| 2. An amine | C | 6. An ether | A |
| 3. A carboxylic acid | E | 7. Greatest number of lone pairs | E |
| 4. An aldehyde | D | 8. Greatest number of bond pairs | B |

Question 6
6 Points

Some typical bond energies in kJ per mole are listed below:

C-O	351	Cl-Cl	243
C=O	803	C-Cl	330
C≡O	1075		

Use these values to determine the enthalpy change for the following reaction:

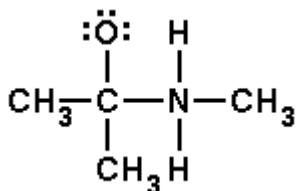


Bonds Broken: $\text{C}\equiv\text{O} + \text{Cl}-\text{Cl}$ $1075 + 243 = 1318 \text{ kJ}$

Bonds Formed: $2(\text{C}-\text{Cl}) + \text{C}=\text{O}$ $2(330) + 803 = 1463 \text{ kJ}$

Enthalpy Change: Bonds Broken - Bonds Formed $1318 - 1463 = -145 \text{ kJ}\cdot\text{mol}^{-1}$

Question 7
4 Points



The molecule depicted on the left is an unstable intermediate in an organic reaction.

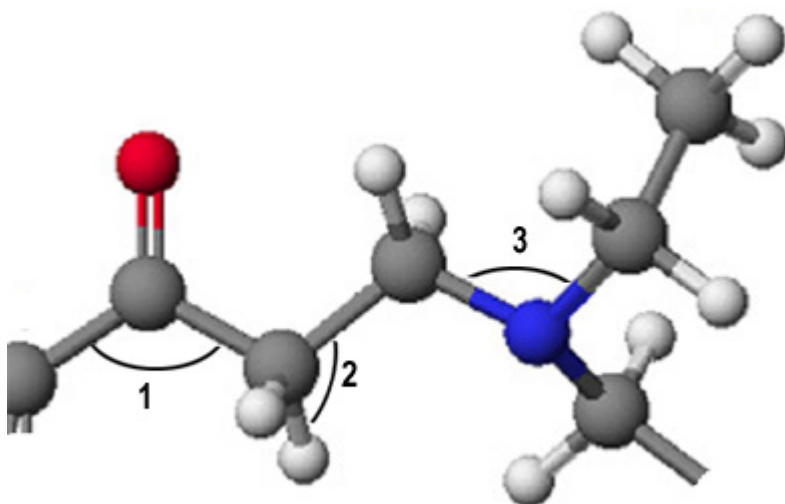
What is the formal charge on:

- The nitrogen atom. **+1**
- The oxygen atom. **-1**

Question 8 Give the Electron Pair Geometry (epg) and the Molecular Geometry (mg) for the following molecules:
16 Points

- | | | |
|-------------------------|-----------------------------|-----------------------------|
| 1. CCl_4 | epg: Tetrahedron | mg: Tetrahedron |
| 2. NCl_3 | epg: Tetrahedron | mg: Trigonal Pyramid |
| 3. NO_2^- | epg: Trigonal Planar | mg: Bent or Angular |
| 4. H_2S | epg: Tetrahedron | mg: Bent or Angular |

Question 9
9 Points



A portion of the molecule Novocain is depicted on the left. What are the bond angles about 1, 2 and 3?

1. **120**
2. **109**
3. **109**

Question 10 The molecular geometry for the following five molecules is given below. Label these molecules as either Polar or Non Polar.
10 Points

- | | | |
|-----------------------------|-----------------|------------------|
| 1. CF_4 | Tetrahedron | Non Polar |
| 2. CH_2Cl_2 | Tetrahedron | Polar |
| 3. H_2CO | Trigonal Planar | Polar |
| 4. N_2 | Linear | Non Polar |
| 5. HCN | Linear | Polar |