

Midterm 3, Fall 2009

Record your name on the top of this exam and on the scantron form.

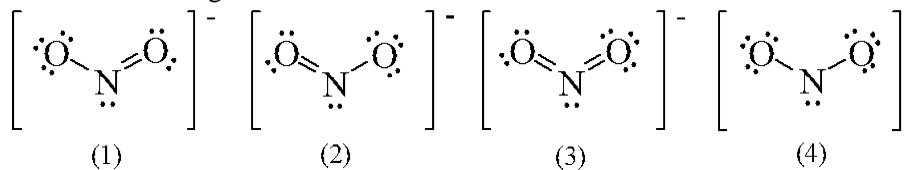
Record the test ID letter in the top right box of the scantron form.

Record all of your answers on the scantron form.

Turn in both your answer sheet at the end of the period. You have 50 minutes. **GOOD LUCK !**

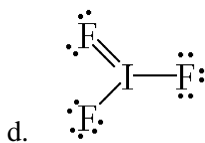
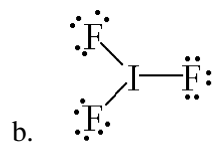
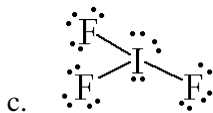
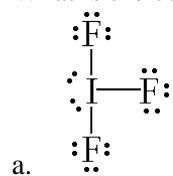
- Which combination of atoms is most likely to produce a compound with covalent bonds?
 - Na and Cl
 - Al and O
 - S and Br
 - Pb and F
- A sulfur atom has ____ valence electrons.
 - 2
 - 6
 - 16
 - 28
- How many **lone pairs** of electrons are assigned to the carbon atom in carbon monoxide?
 - 0
 - 1
 - 2
 - 3
- What is the hybridization of each carbon atom in C_2H_2 ?
 - sp
 - sp^2
 - sp^3
 - p

- Which of the following are resonance structures for nitrite ion, NO_2^- ?

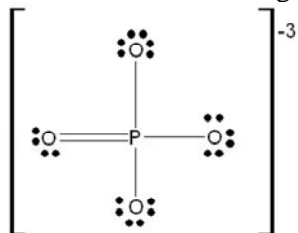


- 1 and 2
 - 2 and 4
 - 3 and 4
 - 1, 2, and 3
- Which of the following elements is most likely to form a molecular structure that disobeys the octet rule?
 - B
 - C
 - O
 - F

7. What is the correct Lewis structure for IF_3 ?



8. What is the formal charge on P in the phosphate resonance structure shown below?



- a. 0
b. +1
c. +3
d. +5

9. Use VESPR theory to predict the molecular geometry around either carbon atom in ethylene, C_2H_4 .

- a. linear
b. bent
c. trigonal-planar
d. tetrahedral

10. What are the approximate $\text{F}-\text{Br}-\text{F}$ bond angles in BrF_5 ?

- a. 90° and 180°
b. 109.5°
c. 90° and 120°
d. 120°

11. Place the following molecules in order from smallest to largest $\text{H}-\text{N}-\text{H}$ bond angles: NH_4^+ , NH_3 , and NH_2^- .

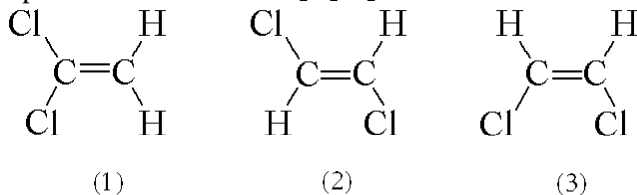
- a. $\text{NH}_4^+ < \text{NH}_3 < \text{NH}_2^-$
b. $\text{NH}_4^+ < \text{NH}_2^- < \text{NH}_3$
c. $\text{NH}_2^- < \text{NH}_3 < \text{NH}_4^+$
d. $\text{NH}_2^- < \text{NH}_4^+ < \text{NH}_3$

12. Which of the following compounds has polar covalent bonds: NaBr , Br_2 , HBr , and CBr_4 ?

- a. HBr only
b. Br_2 only
c. NaBr only
d. HBr and CBr_4

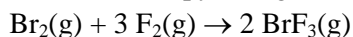
13. Choose which central atom in the following molecules is most electronegative.
- PH₃
 - CH₄
 - H₂S
 - H₂O
14. Which of the following statements is/are correct?
- The atom with the lowest electronegativity is usually the central atom in a molecule.
 - As the difference in electronegativity between two bonded atoms increases, the percent ionic character of the bond increases.
 - Electronegativity decreases down each group of the periodic table.
- 1 only
 - 2 only
 - 2 and 3 only
 - 1, 2, and 3

15. Three possible structures of C₂H₂Cl₂ are shown below. Which of these molecules are polar?



- 1 only
 - 2 only
 - 3 only
 - 1 and 3
16. In molecules, as bond order increases,
- bond length decreases and bond energy increases.
 - bond length increases and bond energy is unchanged.
 - bond length is unchanged and bond energy increases.
 - both bond length and bond energy increase.
17. Use Lewis structures to predict the bond order for a carbon-oxygen bond in carbonate ion, CO₃²⁻.
- 1/2
 - 1
 - 4/3
 - 3/2

18. Calculate the enthalpy change ($\Delta_r H$) for the reaction below,

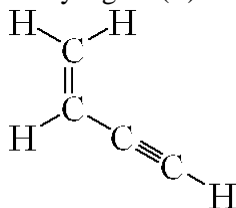


given the bond enthalpies of the reactants and products.

Bond	Bond Enthalpy (kJ/mol·rxn)
Br–Br	193
F–F	155
Br–F	249

- a. –836 kJ
 b. –89 kJ
 c. +89 kJ
 d. +99 kJ
19. Which one of the statements concerning valence bond (VB) and molecular orbital (MO) bond theories is correct?
 a. MO theory predicts that electrons are localized between pairs of atoms.
 b. In VB theory, bonding electrons are delocalized over the molecule.
 c. MO theory can provide a quantitative picture of orbital energies and bonding.
 d. VB theory can provide a quantitative picture of orbital energies and bonding.

20. How many sigma (σ) bonds and pi (π) bonds are in the following molecule?



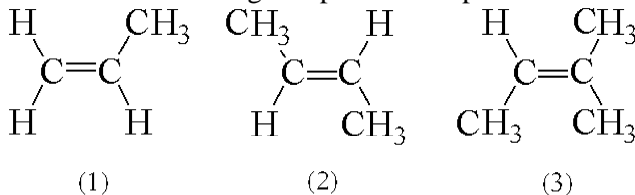
- a. seven σ and three π
 b. seven σ and two π
 c. five σ and five π
 d. five σ and three π
21. What is the hybridization of each carbon atom in benzene, C_6H_6 ? Benzene contains a six-member carbon ring.
 a. sp
 b. sp^2
 c. sp^3
 d. sp^3d
22. Which of the following characteristics apply to SO_2 ?
 1. linear molecular shape
 2. bent molecular shape
 3. nonpolar molecule
 4. polar molecule
- a. 1 only
 b. 1 and 3
 c. 2 only
 d. 2 and 4

23. Dichloromethane, CH_2Cl_2 , is a common organic solvent. Which of the following statements concerning dichloromethane is/are CORRECT?

1. CH_2Cl_2 has two isomers.
2. CH_2Cl_2 is nonpolar.
3. The hybridization of the central carbon atom is sp^3 .

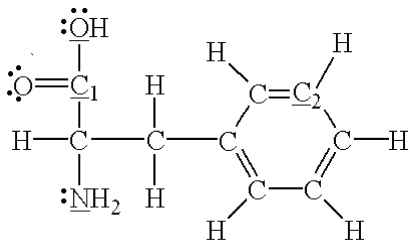
- a. 1 only
- b. 2 only
- c. 3 only
- d. 1 and 2

24. For which of the following compounds is it possible for *cis* and *trans* isomers to exist?



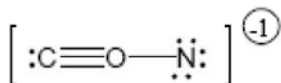
- a. 1 only
- b. 2 only
- c. 3 only
- d. 1 and 2

25. Which of the underlined atoms (C_1 , C_2 , N, and O) has 109 degree bond angles?



- a. C_1 and C_2
- b. C_1 , N, and O
- c. N and O
- d. O and C_2

26. What is the **formal charge** on each atom in the Lewis structure for CON^- (below)?



- a. $\text{C} = -1, \text{O} = +2, \text{N} = -2$
- b. $\text{C} = +1, \text{O} = 0, \text{N} = -2$
- c. $\text{C} = +5, \text{O} = -2, \text{N} = -4$
- d. $\text{C} = -2, \text{O} = +1, \text{N} = 0$

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Answer Section

MULTIPLE CHOICE

1. ANS: C	PTS: 1	TOP: 8.1 Chemical Bond Formation
2. ANS: B	PTS: 1	TOP: 8.2 Covalent Bonding and Lewis Structures
3. ANS: B	PTS: 1	TOP: 8.2 Covalent Bonding and Lewis Structures
4. ANS: A	PTS: 1	TOP: 8.2 Covalent Bonding and Lewis Structures
5. ANS: A	PTS: 1	TOP: 8.4 Resonance
6. ANS: A	PTS: 1	TOP: 8.5 Exceptions to the Octet Rule
7. ANS: A	PTS: 1	TOP: 8.5 Exceptions to the Octet Rule
8. ANS: A	PTS: 1	TOP: 8.6 Molecular Shapes
9. ANS: C	PTS: 1	TOP: 8.6 Molecular Shapes
10. ANS: A	PTS: 1	TOP: 8.6 Molecular Shapes
11. ANS: C	PTS: 1	TOP: 8.6 Molecular Shapes
12. ANS: D	PTS: 1	TOP: 8.7 Bond Polarity and Electronegativity
13. ANS: D	PTS: 1	TOP: 8.7 Bond Polarity and Electronegativity
14. ANS: D	PTS: 1	TOP: 8.7 Bond Polarity and Electronegativity
15. ANS: D	PTS: 1	TOP: 8.8 Bond and Molecular Polarity
16. ANS: A	PTS: 1	TOP: 8.9 Bond Properties: Order, Length, Energy
17. ANS: C	PTS: 1	TOP: 8.9 Bond Properties: Order, Length, Energy
18. ANS: A	PTS: 1	TOP: 8.9 Bond Properties: Order, Length, Energy
19. ANS: C	PTS: 1	TOP: 9.1 Orbitals and Theories of Chemical Bonding
20. ANS: A	PTS: 1	TOP: 9.2 Valence Bond Theory
21. ANS: B	PTS: 1	TOP: 9.2 Valence Bond Theory
22. ANS: D	PTS: 1	TOP: 9.2 Valence Bond Theory
23. ANS: C	PTS: 1	TOP: 9.2 Valence Bond Theory
24. ANS: B	PTS: 1	TOP: 9.2 Valence Bond Theory
25. ANS: C	PTS: 1	TOP: 9.2 Valence Bond Theory
26. ANS: A	PTS: 1	TOP: 9.2 Valence Bond Theory