

MULTIPLE CHOICE QUESTIONS Part 1: Struktur, Bindning (Answers on page 14)

Topic: Atomic Orbitals, Molecular Orbitals Hybridization

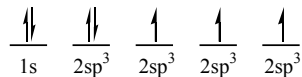
1. When the 1s orbitals of two hydrogen atoms combine to form a hydrogen molecule, how many molecular orbitals are formed?

A) 1
B) 2
C) 3
D) 4
E) 5

2. When the 1s orbitals of two hydrogen atoms combine to form a hydrogen molecule, which molecular orbitals are formed?

A) One bonding molecular orbital only
B) Two bonding molecular orbitals
C) One bonding molecular orbital and one antibonding molecular orbital
D) Two antibonding molecular orbitals
E) Three bonding molecular orbitals

3. The following electron configuration represents _____.



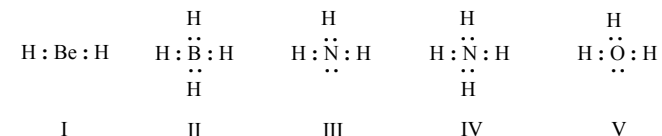
A) the ground state of boron.
B) the sp^3 hybridized state of carbon.
C) the sp^3 hybridized state of nitrogen.
D) the ground state of carbon.
E) an excited state of carbon.

4. Identify the atomic orbitals in the C-C sigma bond in ethyne.

A) ($2sp^2$, $2sp^2$)
B) ($2sp^3$, $2sp^3$)
C) ($2sp$, $2sp$)
D) ($2p$, $2p$)
E) ($2sp$, $1s$)

Topic: Lewis Structures, Formal Charges

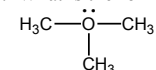
5. Listed below are electron dot formulas for several simple molecules and ions. All valence electrons are shown; however, electrical charges have been omitted deliberately.



Which of the structures actually bear(s) a positive charge?

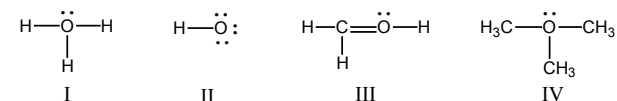
A) I
B) II
C) III
D) III & V
E) IV & V

6. What is the formal charge on oxygen in the following structure?



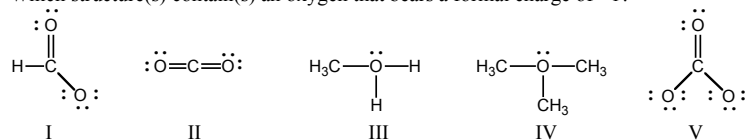
A) +2
B) +1
C) 0
D) -1
E) -2

7. In which structure(s) below does the oxygen have a formal charge of +1?



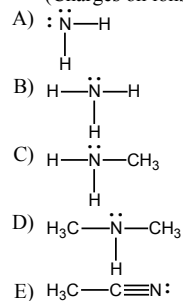
A) I only
B) II only
C) I and III
D) I and IV
E) I, III, and IV

8. Which structure(s) contain(s) an oxygen that bears a formal charge of +1?

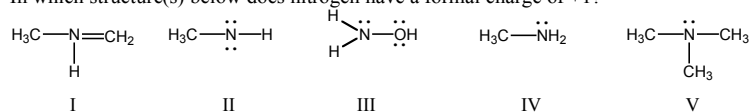


- A) I and II
 B) III and IV
 C) V
 D) II
 E) I and V

9. Which of the following molecules or ions has a nitrogen with a formal charge of -1? (Charges on ions have been omitted.)



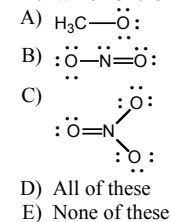
10. In which structure(s) below does nitrogen have a formal charge of +1?



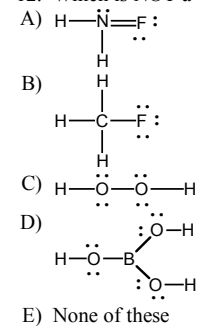
- A) I
 B) II and IV
 C) III and V
 D) I and V
 E) V

Topic: Lewis Structures, Formal Charges

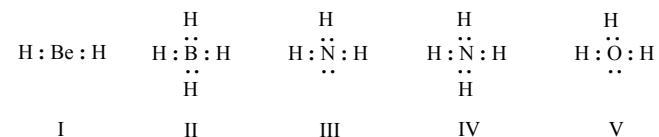
11. Which of the following is an ion with a single negative charge?



12. Which is NOT a correct Lewis structure?



13. Listed below are electron dot formulas for several simple molecules and ions. All valence electrons are shown; however, electrical charges have been omitted deliberately.

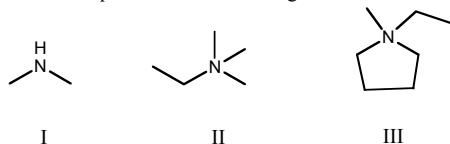


Which of the structures is negatively charged?

- A) I
 B) II
 C) III
 D) IV
 E) V

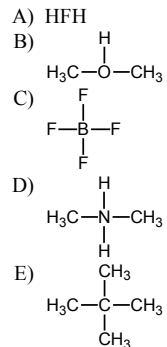
Topic: Lewis Structures, Formal Charges

14. Which compound contains a nitrogen atom with a formal positive charge?

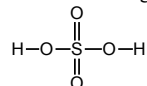


- A) I
 B) II
 C) III
 D) More than one of the above
 E) None of the above

15. In which of these cases does the central atom have a zero formal charge?



16. The formal charge on sulfur in sulfuric acid is:



- A) 0
 B) -1
 C) +1
 D) -2
 E) +2

Topic: Lewis Structures, Formal Charges Molecular Geometry

17. Expansion of the valence shell to accommodate more than eight electrons is possible with:

- A) Fluorine
 B) Nitrogen
 C) Carbon
 D) Sulfur
 E) Beryllium

18. Based on VSEPR theory, which of the following would have a trigonal planar shape?

- A) $\text{CH}_3)_3\text{N}$
 B) HCN
 C) NH_4^+
 D) CH_3^-
 E) CH_3^+

19. What shape does the methyl cation, CH_3^+ , have?

- A) Octahedral
 B) Tetrahedral
 C) Trigonal planar
 D) Linear
 E) Trigonal pyramidal

20. What bond angle is associated with a tetrahedral molecule?

- A) 120°
 B) 109.5°
 C) 180°
 D) 90°
 E) 45°

21. What would be the spatial arrangement of the atoms of the methyl anion, $:\text{CH}_3^-$?

- A) Octahedral
 B) Tetrahedral
 C) Trigonal planar
 D) Linear
 E) Trigonal pyramidal

22. Which of these structures would be a perfectly regular tetrahedron?

- A) CH_3Br
 B) CH_2Br_2
 C) CHBr_3
 D) CBr_4
 E) More than one of these

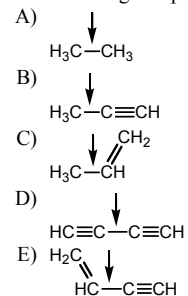
Topic: Periodic Properties, Electronegativity

23. Select the most electronegative element.
- A) H
B) O
C) N
D) B
E) C

Topic: Atomic Orbitals, Hybridization

24. In which molecule is the central atom sp^3 hybridized?
- A) CH_4
B) NH_3
C) H_2O
D) All of these
E) None of these
25. Which compound has the shortest carbon-carbon bond(s)?
- A) CH_3CH_3
B) $CH_2=CH_2$
C) $HC\equiv CH$
D) $CH_3CH_2CH_3$
E) All carbon-carbon bonds are the same length.
26. Which of the following contains an sp^2 -hybridized carbon?
- A) CH_4
B) CH_3^-
C) CH_3CH_3
D) CH_3^+
E) $HC\equiv CH$

27. Which is the shortest of the carbon-carbon single bonds indicated by arrows in the following compounds?



Topic: Atomic Orbitals, Bonding

28. Which of these substances contains both covalent and ionic bonds?
- A) NH_4Cl
B) H_2O_2
C) CH_4
D) HCN
E) H_2S

Topic: Atomic Orbitals, Periodic Trends, Electronegativity

29. The greatest degree of ionic character is anticipated for the bond between:
- A) H and C
B) H and Cl
C) C and Cl
D) H and Br
E) Br and Cl

Topic: Atomic Orbitals, Hybridization

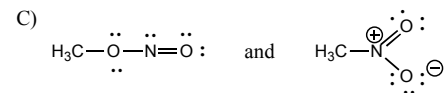
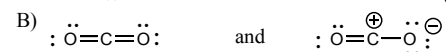
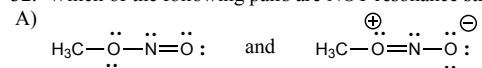
30. Which molecule contains an sp -hybridized carbon?
- A) HCN
B) $CH_2=CH_2$
C) CH_3Cl
D) $\begin{array}{c} H \\ | \\ C=O \\ | \\ H \end{array}$
E) CH_3CH_3

Topic: Atomic Orbitals, Lewis structures, Resonance

31. Which of the structures below is not expected to contribute to the CO_2 resonance hybrid?
- A) $O=C^+-O^-$
B) $O^--C^+=O$
C) $O=C=O$
D) $^-O-C^+-O^-$
E) $O^--C\equiv O^+$

Topic: Atomic Orbitals, Lewis Structures, Resonance

32. Which of the following pairs are NOT resonance structures?



- D) Each of these pairs represents resonance structures.
E) None of these pairs represents resonance structures.

Topic: Empirical and Molecular Formulas

33. What is the empirical formula for cyclohexane? (Its molecular formula is C_6H_{12} .)

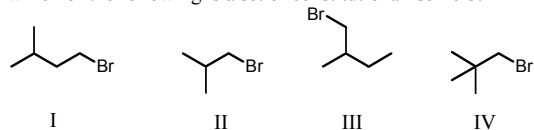
- A) CH
B) CH_2
C) C_2H_4
D) C_6H_6
E) C_2H_2

34. A compound consists only of carbon, hydrogen and oxygen. Elemental analysis gave: C, 70.5%, H, 13.8%. The molecular weight of the compound was found to be 103 ± 3 . What is the molecular formula for the compound?

- A) $\text{C}_6\text{H}_{12}\text{O}$
B) $\text{C}_5\text{H}_{12}\text{O}_2$
C) $\text{C}_3\text{H}_2\text{O}_4$
D) $\text{C}_3\text{H}_6\text{O}_3$
E) $\text{C}_6\text{H}_{14}\text{O}$

Topic: Isomerism

35. Which of the following is a set of constitutional isomers?



- A) I and II
B) II and III
C) I, II, and III
D) II, III, and IV
E) I, III, and IV

Topic: General

36. Credit for the first synthesis of an organic compound from an inorganic precursor is usually given to:

- A) Berzelius
B) Arrhenius
C) Kekule
D) Wohler
E) Lewis

Topic: Isomerism

37. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ are examples of what are now termed:

- A) Structural isomers
B) Resonance structures
C) Functional isomers
D) Empirical isomers
E) Constitutional isomers

Topic: Hybridization

38. What is the approximate hybridization state of the oxygen molecule in ethanol, $\text{C}_2\text{H}_5\text{OH}$?

- A) sp
B) sp^2
C) sp^3
D) p^3
E) d^2sp^3

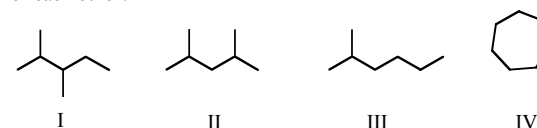
Topic: Lewis structures, Hybridization

39. Which molecule has a non-linear structure (i.e., for which molecule are the nuclei not in a straight line)?

- A) $\text{O}=\text{C}=\text{O}$
B) $\text{H}-\text{O}-\text{H}$
C) $\text{H}-\text{Cl}$
D) $\text{H}-\text{C}=\text{N}$
E) $\text{H}-\text{C}=\text{C}-\text{H}$

Topic: Isomerism

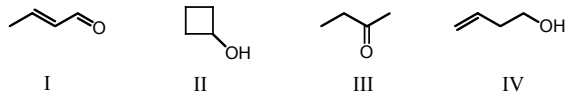
40. Which of the following structures represent compounds that are constitutional isomers of each other?



- A) I and II
B) I and III
C) I, II, and III
D) I, II, III, and IV
E) II and III

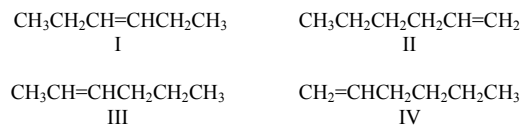
Topic: Isomerism

41. Which compound is not an isomer of the others?



- A) I
 B) II
 C) III
 D) IV
 E) All of the above are isomers of each other.

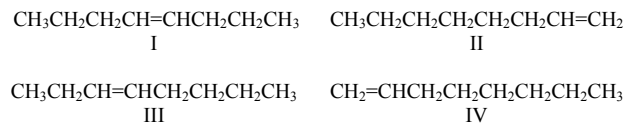
42. Consider the following:



Which two structures represent the same compound?

- A) I and II
 B) II and III
 C) I and III
 D) II and IV
 E) None of these

43. Consider the following:

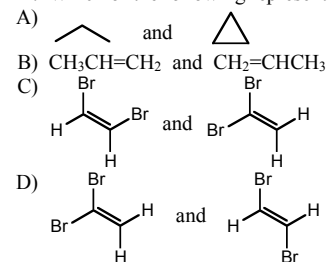


Which structures can exist as cis-trans isomers?

- A) I and II
 B) I and III
 C) I and IV
 D) II and III
 E) I alone

Topic: Isomerism

44. Which of the following represent a pair of constitutional isomers?



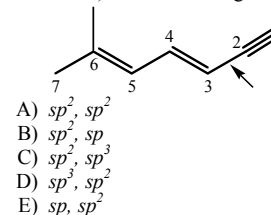
E) More than one of these

45. Cis-trans isomerism is possible only in the case of:

- A) $\text{CH}_2=\text{CBr}_2$
 B) $\text{CH}_2=\text{CHBr}$
 C) $\text{BrCH}=\text{CHBr}$
 D) $\text{Br}_2\text{C}=\text{CHBr}$
 E) $\text{Br}_2\text{C}=\text{CBr}_2$

Topic: Atomic Orbitals, Hybridization, Bonding

46. Identify the atomic orbitals involved in the C-2---C-3 sigma bond (indicated by an arrow) in the following molecule:



Topic: Molecular Geometry

47. Based on the VSEPR theory, which of the following would have a tetrahedral arrangement of electrons around the central atom?

- A) BH_3
 B) NO_2^-
 C) SiH_4
 D) CO_3^{2-}
 E) SO_3

Topic: Periodic Trends, Electronegativity

48. Select the least electronegative element

- A) P
- B) N
- C) Mg
- D) Si
- E) K

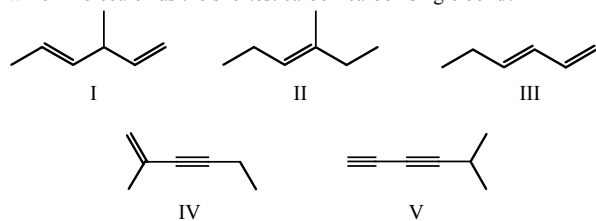
Topic: Atomic Orbitals, Hybridization

49. In which molecule(s) can the molecular geometry be attributed to an sp^2 hybridized central atom?

- A) PBr_3
- B) CH_4
- C) $CHCl_3$
- D) HNO_2
- E) None of the above has an sp^2 hybridized central atom

Topic: Bonding, Atomic Orbitals, Hybridization

50. Which molecule has the shortest carbon-carbon single bond?



- A) I
- B) II
- C) III
- D) IV
- E) V

Svar: Part 1: Struktur, Bindning

Fråga	Svar	Rätt/Fel	Kpmmentar
1	B		
2	C		
3	C		
4	C		
5	E		
6	B		
7	E		
8	B		
9	A		
10	A		
11	D		
12	A		
13	B		
14	D		
15	E		
16	A		
17	D		
18	E		
19	C		
20	B		
21	E		
22	D		
23	B		
24	D		
25	C		
26	D		
27	D		
28	A		
29	B		
30	A		
31	D		
32	C		
33	B		
34	E		
35	E		
36	D		
37	E		
38	C		
39	B		
40	C		
41	A		
42	D		
43	B		
44	E		
45	C		
46	E		
47	C		
48	E		
49	D		
50	E		