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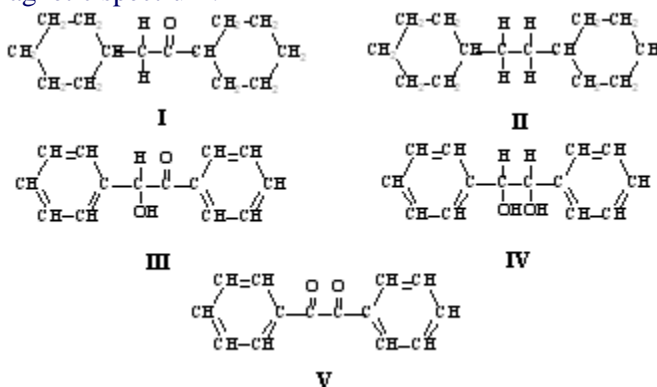
Be sure to mention the filename:

Chemistry\_Questions\_0078

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1.

Which of the following would absorb photons closer to the red end of the visible region of the electromagnetic spectrum?



Student  
Response

1. I
2. II
3. III
4. IV
5. V

2.

The shortest C–O bond length would be found in

Student Response

1. CO.
2. CH<sub>3</sub>OH.
3. CH<sub>2</sub>O.
4. CO<sub>2</sub>.
5. All have the same bond length.

3.

The carbon–carbon–oxygen bond angle in H<sub>2</sub>CCO is

Student Response

1. 109°.
2. 150°.
3. 90°.

4.  $180^\circ$ .

5.  $120^\circ$ .

4.

According to valence bond theory, which of the following would produce maximum overlap?

**Student Response**

1.  $3p - 3p$

2.  $2p - 2p$

3.  $2s - 2p$

4.  $2p - 3p$

5.  $2s - 2s$

5.

Which of the following molecules would have the shortest bond based on the valence bond theory?

**Student Response**

1. HF

2.  $\text{Cl}_2$

3. HCl

4. BrCl

5.  $\text{F}_2$

6.

What is the change in hybridization of the C atom in the following reaction:  $\text{C}_2\text{H}_2 + 2 \text{H}_2 \rightarrow \text{C}_2\text{H}_6$  ?

**Student  
Response**

1.  $sp$  to  $sp^2$

2.  $sp^3$  to  $sp^2$

3.  $sp^2$  to  $sp^3$

4.  $sp$  to  $sp^3$

5.  $sp^2$  to  $sp$

7.

Which of the following bonds is not possible?

**Student Response**

1. N=N

2. O=H

3. C=O

4. N=O

5. C=C

8.

In the molecular structure for the ion  $\text{CH}_2\text{CHCH}_2^+$ , which of the following statements is (are) *true*?

- I. Sigma bonds are formed from unhybridized carbon orbitals.
- II. Pi bonds are formed from unhybridized orbitals.
- III. All carbons are  $sp^2$  hybridized.

**Student Response**

- 1. II and III only
- 2. I, II, and III
- 3. II only
- 4. I and II only
- 5. I and III only

9.

$\text{N}_2$  interacts with a photon that results in a promotion of an electron from a bonding to an antibonding orbital. How many unpaired electrons are there in  $\text{N}_2$  after the promotion of an electron? The order of the molecular orbital diagram is  $(\sigma_{2s})(\sigma_{2s}^*)(\pi_{2p})(\sigma_{2p})(\pi_{2p}^*)(\sigma_{2p}^*)$ .

**Student Response**

- 1. 4
- 2. 3
- 3. 1
- 4. 2
- 5. 0

10.

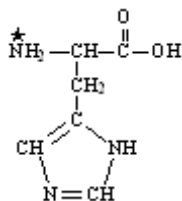
In which of the following species is C not  $sp^3$  hybridized?

**Student Response**

- 1.  $\text{CH}_4$
- 2.  $\text{C}_2\text{H}_6$
- 3.  $\text{CH}_2\text{Cl}_2$
- 4.  $\text{CH}_3\text{OH}$
- 5.  $\text{C}_2\text{H}_4$

11.

In a molecule of histidine as shown below, what is the hybridization on the nitrogen designated with the star?



**Student  
Response**

1.  $sp^3d^2$
2.  $sp$
3.  $sp^3d$
4.  $sp^3$
5.  $sp^2$

**12.**

Which response contains all the characteristics listed that should apply to  $PF_3$ ?

1. trigonal planar
2. one unshared pair of electrons on P
3.  $sp^2$ -hybridized phosphorus atom
4. polar molecule
5. polar bonds

**Student  
Response**

- A. 2, 4, and 5
- B. 1, 3, and 5
- C. 2, 3, and 4
- D. 1, 2, and 4
- E. 1, 4, and 5

**13.**

Which of the following would break apart into free radicals (an atom with one unpaired electron) when a photon promotes one electron to an antibonding orbital?

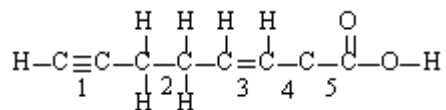
- I.  $B_2$    II.  $C_2$    III.  $N_2$    IV.  $O_2$    V.  $F_2$

**Student Response**

1. I and V
2. I only
3. II, III, and IV
4. V only
5. I, II, and III

**14.**

In the following flat representation of the molecule, which of the numbered carbon-to-carbon bonds actually shows the shape of that portion of the molecule?



**Student Response**

1. 1
2. 2
3. 3
4. 4
5. 5

15.

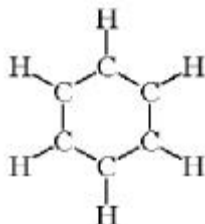
Consider the bonding in the following using valence bond theory. For which would  $\Delta_{\text{diss}}H$  be the smallest?

**Student Response**

1. SrH<sub>2</sub>
2. BeH<sub>2</sub>
3. BaH<sub>2</sub>
4. CaH<sub>2</sub>
5. MgH<sub>2</sub>

16.

The skeletal structure of benzene C<sub>6</sub>H<sub>6</sub> is shown below.



Using standard enthalpies of formation, the enthalpy of formation from gaseous carbon and hydrogen atoms is  $-5525.6$  kJ.



When calculated using bond energies, enthalpy of formation is calculated as  $-5310$  kJ. Which of the following can explain the discrepancy in these two values:

- I. Benzene has delocalized orbitals.
- II. Bond energies are average energies of bonds.
- III. Carbon and hydrogen are in the gas phase.

**Student Response**

1. I and II only
2. III only
3. I only

4. I, II, and III
5. II only

17.

Which of the following species has a bond order of 2?

1.  $\text{NO}^-$
2.  $\text{O}_2$
3.  $\text{O}_2^-$

**Student Response**

- A. 3 only
- B. 1 and 3 only
- C. 2 only
- D. 1 only
- E. 1 and 2 only

18.

The hybridization of the central atom in a molecule is described as  $sp^2$ . The arrangement in space of the hybrid orbitals about that atom is

**Student Response**

1. linear.
2. octahedral.
3. trigonal bipyramidal.
4. tetrahedral.
5. trigonal planar.

19.

Which of the following species would be expected to be paramagnetic?

**Student Response**

1. NO
2.  $\text{NO}_2^-$
3.  $\text{SO}_3$
4.  $\text{OCN}^-$
5.  $\text{NO}_2^+$

20.

When a carbon atom has  $sp^3$  hybridization, it has

**Student Response**

1. one  $\pi$  bond and three  $\sigma$  bonds.
2. four  $\sigma$  bonds.
3. two  $\pi$  bonds and two  $\sigma$  bonds.
4. four  $\pi$  bonds.

5. three  $\pi$  bonds and one  $\sigma$  bond.