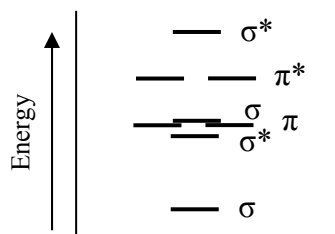
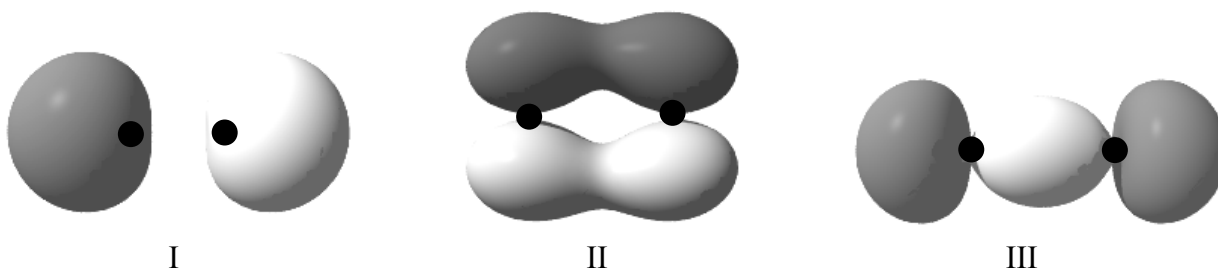


1. Which of the following diatomic species, according to the molecular orbital diagram below, is paramagnetic with the lowest bond order?

- a) N_2^+
- b) CN^-
- c) O_2
- d) F_2
- e) F_2^-



Questions 2 and 3 refer to the following 3 representations of molecular orbitals of a diatomic molecule. Atomic nuclei are represented by ●



2. Which of the molecular orbitals above are bonding orbitals?

- a) I only
- b) II only
- c) III only
- d) II and III
- e) all of them

3. Which of the above are π or π^* molecular orbitals?

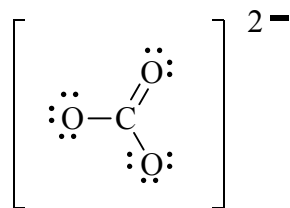
- a) I
- b) II
- c) III
- d) II and III
- e) all of them

4. Which of H_2O , CH_3Cl , H_2S and O_2 would you expect to form strong hydrogen bonds?

- a) H_2O only
- b) H_2O and H_2S only
- c) H_2O and O_2 only
- d) H_2O , CH_3Cl and H_2S only
- e) all of them

5. One resonance structure of the carbonate ion is shown below. What is the bond order of the carbon–oxygen bonds in CO_3^{2-} ?

- a) 1.0
- b) 1.33
- c) 1.5
- d) 1.66
- e) 2.0



6. What is the molecular geometry of the NO_3^- ion?

- a) trigonal planar
- b) tetrahedral
- c) trigonal pyramidal
- d) T-shaped
- e) square planar

7. What is the molecular geometry of the ClO_4^- ion?

- a) trigonal planar
- b) tetrahedral
- c) trigonal bipyramidal
- d) octahedral
- e) T-shaped

8. In which of the following are the atoms arranged in order of DECREASING first ionisation energy?

- a) Br, As, Se, Ge
- b) Li, Na, K, Rb
- c) P, S, Si, Al
- d) Kr, Ar, Ne, He
- e) Be, B, C, N

9. What is the concentration of lead in a water sample with an absorbance of $A = 0.0068$ if a reference sample containing 0.0100 ppm lead has an absorbance of 0.0165?

- (a) 0.0041 ppm (b) 4.1 ppm (c) 0.24 ppm (d) 0.011 ppm (e) 0.0038 ppm

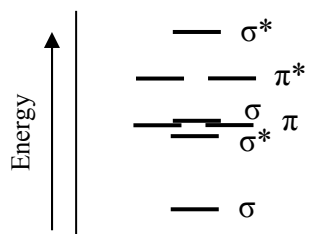
10. The addition of solutes can result in boiling point elevation. Which one of the following sets of 0.1 M solutions is arranged in order of increasing boiling point?

- a) glucose < NaCl < NH_3 < Na_2SO_4
- b) glucose < HBr < Na_3PO_4 < Na_2SO_4
- c) Na_2SO_4 < Na_3PO_4 < HBr < glucose
- d) glucose < HBr < Na_2SO_4 < Na_3PO_4
- e) HBr < Na_2SO_4 < Na_3PO_4 < glucose

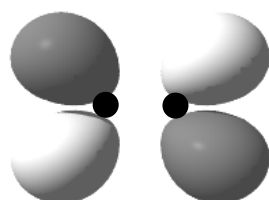
Correct answers: 1E, 2D, 3B, 4A, 5B, 6A, 7B, 8B, 9A, 10D

1. Which of the following diatomic species, according to the molecular orbital diagram below, is diamagnetic with the highest bond order?

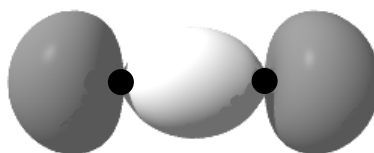
- a) N_2^+
- b) CN^-
- c) O_2
- d) F_2
- e) F_2^-



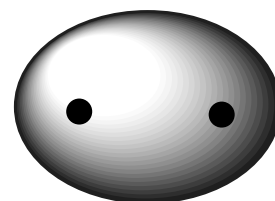
Questions 2 and 3 refer to the following 3 representations of molecular orbitals of a diatomic molecule. Atomic nuclei are represented by ●



I



II



III

2. Which of the molecular orbitals above are antibonding orbitals?

- a) I
- b) II
- c) I and II
- d) II and III
- e) none of them

3. Which of the above are π or π^* molecular orbitals?

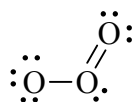
- a) I
- b) II
- c) III
- d) I and II
- e) none of them

4. Which of H_2O_2 , CH_3OH , HF and H_2 would you expect to form strong hydrogen bonds?

- a) H_2 only
- b) H_2O_2 and HF only
- c) H_2O_2 and CH_3OH only
- d) H_2O_2 , CH_3OH and HF only
- e) all of them

5. One resonance structure of ozone is shown below. What is the bond order of the oxygen–oxygen bonds in O_3 ?

- a) 1.0
- b) 1.33
- c) 1.5
- d) 1.66
- e) 2.0



6. What is the molecular geometry of the BeF_2 molecule?

- a) trigonal planar
- b) tetrahedral
- c) trigonal pyramidal
- d) T-shaped
- e) linear

7. What is the molecular geometry of the SF_6 molecule?

- a) trigonal planar
- b) tetrahedral
- c) trigonal bipyramidal
- d) octahedral
- e) T-shaped

8. In which of the following are the atoms arranged in order of DECREASING atomic radius?

- a) Li, Na, K, Rb, Cs
- b) P, Si, Al, Mg, Na
- c) Ca, K, Cl, S, P
- d) As, Se, Br, Kr, K
- e) Na, Mg, B, C, N

9. What is the concentration of copper in a water sample with an absorbance of $A=0.035$ if a reference sample containing 0.100 ppm copper has an absorbance of 0.083?

- (a) 0.024 ppm (b) 0.24 ppm (c) 0.042 ppm (d) 0.029 ppm (e) 0.035 ppm

10. The addition of solutes can result in boiling point elevation. Which one of the following sets of 0.1 M solutions is arranged in order of increasing boiling point?

- a) sucrose < $NaCl$ < CH_3COOH < Na_2SO_4
- b) sucrose < HCl < Na_3PO_4 < K_2SO_4
- c) sucrose < CH_3COOH < $MgCl_2$ < K_3PO_4
- d) HBr < Na_2SO_4 < Na_3PO_4 < sucrose
- e) Na_2SO_4 < K_3PO_4 < HBr < sucrose

Correct answers: 1B, 2A, 3A, 4D, 5C, 6E, 7D, 8E, 9C, 10C