

Q1. Which of the following bonds has the highest polarity?

- A. H-F
- B. H-Cl
- C. H-Br
- D. H-I

Answer: A. H-F

Explanation: Fluorine has the highest electronegativity, so the bond is most polar.

Q2. Which of the following molecules is linear in shape?

- A. CO<sub>2</sub>
- B. NH<sub>3</sub>
- C. CH<sub>4</sub>
- D. H<sub>2</sub>O

Answer: A. CO<sub>2</sub>

Explanation: CO<sub>2</sub> has two bonding pairs, no lone pair on central atom (C), so it's linear (180°).

Q3. In which of the following molecules is the central atom sp<sup>2</sup> hybridised?

- A. BF<sub>3</sub>
- B. BeCl<sub>2</sub>
- C. CH<sub>4</sub>
- D. NH<sub>3</sub>

Answer: A. BF<sub>3</sub>

Explanation: Boron forms three sigma bonds and no lone pair; hybridisation is sp<sup>2</sup>, trigonal planar.

Q4. The bond order of O<sub>2</sub> molecule is:

- A. 1
- B. 2
- C. 2.5
- D. 3

Answer: B. 2

Explanation:  $O_2$  has 16 electrons. Bond order =  $(\text{Bonding } e^- - \text{Antibonding } e^-)/2 = (10-6)/2 = 2$ .

Q5. Assertion (A):  $NH_3$  has a higher boiling point than  $PH_3$ .

Reason (R):  $NH_3$  forms hydrogen bonds but  $PH_3$  does not.

- A. Both A and R are true, and R is the correct explanation of A
- B. Both A and R are true, but R is not the correct explanation of A
- C. A is true, R is false
- D. A is false, R is true

Answer: A. Both A and R are true, and R is the correct explanation of A

Explanation: Hydrogen bonding in  $NH_3$  raises its boiling point.

Q6. Match the following molecules with their shapes:

Molecule	Shape
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- |           |                 |
|-----------|-----------------|
| A. $CH_4$ | 1. Angular/bent |
| B. $H_2O$ | 2. Tetrahedral  |
| C. $CO_2$ | 3. Linear       |

Options:

- A. A-2, B-1, C-3
- B. A-1, B-2, C-3
- C. A-3, B-2, C-1
- D. A-2, B-3, C-1

Answer: A. A-2, B-1, C-3

Explanation:  $CH_4$  = tetrahedral;  $H_2O$  = bent;  $CO_2$  = linear.

Q7. Which one of the following species is diamagnetic?

- A.  $O_2$
- B.  $O_2^+$
- C.  $B_2$
- D.  $C_2$

Answer: B.  $O_2^+$

Explanation:  $O_2^+$  loses one antibonding electron, making it diamagnetic (all paired electrons).

Q8. The lone pair–bond pair repulsion is maximum in:

- A.  $CH_4$
- B.  $NH_3$
- C.  $H_2O$
- D.  $BF_3$

Answer: C.  $H_2O$

Explanation:  $H_2O$  has two lone pairs, increasing lone pair–bond pair repulsion and decreasing bond angle.

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Q9. The number of sigma and pi bonds in  $CH_2=CH-CH_3$  is:

- A. 9 sigma, 1 pi
- B. 8 sigma, 1 pi
- C. 7 sigma, 2 pi
- D. 9 sigma, 2 pi

Answer: A. 9 sigma, 1 pi

Explanation: One double bond (1 sigma, 1 pi), rest are single (sigma). Total: 9  $\sigma$  and 1  $\pi$ .

Q10. Statement I: Bond angle in  $H_2O$  is less than that in  $NH_3$ .

Statement II: Lone pair–lone pair repulsion in  $H_2O$  is greater than in  $NH_3$ .

- A. Both statements are true
- B. Only I is true
- C. Only II is true
- D. Both statements are false

Answer: A. Both statements are true

Explanation:  $H_2O$  has 2 lone pairs;  $NH_3$  has 1. Repulsion compresses the bond angle more in  $H_2O$ .

Q11. Which of the following molecules contains a coordinate bond?

- A.  $\text{CO}_2$
- B.  $\text{NH}_3$
- C.  $\text{NH}_4^+$
- D.  $\text{CH}_4$

Answer: C.  $\text{NH}_4^+$

Explanation: The lone pair on N donates to  $\text{H}^+$ , forming a coordinate bond.

Q12. Which of the following is not true for an ionic compound?

- A. High melting and boiling point
- B. Good electrical conductivity in solid state
- C. Usually soluble in water
- D. Formed between metals and non-metals

Answer: B. Good electrical conductivity in solid state

Explanation: In solid state, ions are fixed. They conduct only in molten or aqueous states.

Q13. Bond angle in  $\text{BF}_3$  is:

- A.  $120^\circ$
- B.  $109.5^\circ$
- C.  $104.5^\circ$
- D.  $180^\circ$

Answer: A.  $120^\circ$

Explanation:  $\text{BF}_3$  has  $\text{sp}^2$  hybridisation with trigonal planar shape.

Q14. Which molecule has zero dipole moment?

- A.  $\text{NH}_3$
- B.  $\text{H}_2\text{O}$
- C.  $\text{CO}_2$
- D.  $\text{SO}_2$

Answer: C.  $\text{CO}_2$

Explanation: Though bonds are polar, the linear geometry cancels dipoles — net  $\mu = 0$ .

Q15. Which of the following is correct order of bond length?

- A.  $C-C > C=C > C\equiv C$
- B.  $C=C > C-C > C\equiv C$
- C.  $C\equiv C > C=C > C-C$
- D.  $C-C = C=C = C\equiv C$

Answer: A.  $C-C > C=C > C\equiv C$

Explanation: Bond length decreases with increasing bond order.

Q16. In which of the following species is the bond angle maximum?

- A.  $H_2O$
- B.  $NH_3$
- C.  $CH_4$
- D.  $CO_2$

Answer: D.  $CO_2$

Explanation:  $CO_2$  is linear ( $180^\circ$ ), while  $CH_4$  ( $109.5^\circ$ ),  $NH_3$  ( $\sim 107^\circ$ ),  $H_2O$  ( $\sim 104.5^\circ$ ).

Q17. The hybridisation of central atom in  $ClO_3^-$  is:

- A.  $sp$
- B.  $sp^2$
- C.  $sp^3$
- D.  $dsp^2$

Answer: C.  $sp^3$

Explanation:  $ClO_3^-$  has 3 bond pairs and 1 lone pair. Steric number = 4  $\rightarrow sp^3$  hybridisation.

Q18. The correct decreasing order of bond strength among  $O_2$ ,  $O_2^+$ , and  $O_2^-$  is:

- A.  $O_2^+ > O_2 > O_2^-$
- B.  $O_2^- > O_2 > O_2^+$
- C.  $O_2 > O_2^+ > O_2^-$
- D.  $O_2^- > O_2^+ > O_2$

Answer: A.  $O_2^+ > O_2 > O_2^-$

Explanation: Bond order:  $O_2^+ = 2.5$ ,  $O_2 = 2$ ,  $O_2^- = 1.5$ ; higher bond order = stronger bond.

Q19. Assertion (A):  $BF_3$  is a Lewis acid.

Reason (R): Boron in  $BF_3$  has incomplete octet.

- A. Both A and R are true, and R is the correct explanation of A
- B. Both A and R are true, but R is not the correct explanation
- C. A is true, R is false
- D. A is false, R is true

Answer: A. Both A and R are true, and R is the correct explanation of A

Explanation: Boron has only 6 electrons  $\rightarrow$  can accept  $e^-$  pair  $\rightarrow$  acts as Lewis acid.

Q20. Match the following molecules with the correct hybridisation:

Molecule	Hybridisation
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- A.  $BeCl_2$  1.  $sp^3$
- B.  $CH_4$  2.  $sp$
- C.  $NH_3$  3.  $sp^3$
- D.  $CO_2$  4.  $sp$

Options:

- A. A-2, B-1, C-3, D-4
- B. A-2, B-1, C-1, D-4
- C. A-2, B-3, C-3, D-4
- D. A-1, B-2, C-3, D-4

Answer: C. A-2, B-3, C-3, D-4

Explanation:  $BeCl_2$  and  $CO_2 \rightarrow sp$ ;  $CH_4$  and  $NH_3 \rightarrow sp^3$ .

Q21. Which of the following is the correct order of bond angles?

- A.  $CH_4 > NH_3 > H_2O$

- B.  $\text{H}_2\text{O} > \text{NH}_3 > \text{CH}_4$
- C.  $\text{NH}_3 > \text{CH}_4 > \text{H}_2\text{O}$
- D.  $\text{CH}_4 > \text{H}_2\text{O} > \text{NH}_3$

Answer: A.  $\text{CH}_4 > \text{NH}_3 > \text{H}_2\text{O}$

Explanation: Due to increasing lone pair repulsion, bond angle decreases:  $109.5^\circ > \sim 107^\circ > \sim 104.5^\circ$ .

Q22. Which of the following contains pi bonds only?

- A.  $\text{O}_2$
- B. CO
- C.  $\text{H}_2$
- D.  $\text{N}_2$

Answer: A.  $\text{O}_2$

Explanation:  $\text{O}_2$  has a sigma bond and a pi bond. But among these, only  $\text{O}_2$  has a pure pi in MO terms after antibonding adjustment (with unpaired electrons in  $\pi^*$ ).

(Note: Trick Q — CO and  $\text{N}_2$  both have sigma + pi bonds;  $\text{H}_2$  has only sigma)

Q23. Statement I: A molecule with zero dipole moment may be polar.

Statement II: Geometry of molecule may cancel out individual bond dipoles.

- A. Both statements are true
- B. Only I is true
- C. Only II is true
- D. Both statements are false

Answer: A. Both statements are true

Explanation: Ex:  $\text{CO}_2$  is polar in bonds but has zero dipole moment due to symmetry.

Q24. Which of the following is paramagnetic?

- A.  $\text{O}_2$
- B.  $\text{CO}_2$
- C.  $\text{N}_2$
- D.  $\text{H}_2\text{O}$

Answer: A.  $O_2$

Explanation:  $O_2$  has two unpaired electrons in  $\pi^*$  orbitals.

Q25. In  $NH_4^+$  ion, the N–H bonds are formed by:

- A. sp hybrid orbitals
- B.  $sp^2$  hybrid orbitals
- C.  $sp^3$  hybrid orbitals
- D.  $d^2sp^3$  hybrid orbitals

Answer: C.  $sp^3$  hybrid orbitals

Explanation:  $NH_4^+$  has 4 sigma bonds, no lone pair — tetrahedral  $\rightarrow$   $sp^3$  hybridisation.

Q26. The molecule with most ionic character is:

- A. HF
- B. HCl
- C. HBr
- D. HI

Answer: A. HF

Explanation: Greatest electronegativity difference  $\rightarrow$  most polar  $\rightarrow$  most ionic character.

Q27. Assertion (A): CO has dipole moment.

Reason (R): CO is linear, so net dipole moment is zero.

- A. A true, R false
- B. A false, R true
- C. Both A and R are true, but R is not the correct explanation
- D. A true, R true and R explains A

Answer: A. A true, R false

Explanation: Though CO is linear, the difference in electronegativity leads to dipole moment ( $\sim 0.112$  D).

Q28. The molecule which is planar among the following is:



- A.  $\text{NH}_3$
- B.  $\text{CH}_4$
- C.  $\text{BF}_3$
- D.  $\text{PCl}_3$

Answer: C.  $\text{BF}_3$

Explanation:  $\text{BF}_3$  has  $\text{sp}^2$  hybridisation  $\rightarrow$  planar structure (trigonal planar).

Q29. Which of the following has three lone pairs on central atom?

- A.  $\text{H}_2\text{O}$
- B.  $\text{XeF}_2$
- C.  $\text{ClF}_3$
- D.  $\text{I}_3^-$

Answer: B.  $\text{XeF}_2$

Explanation:  $\text{XeF}_2$  has 5 electron pairs: 2 bonding, 3 lone  $\rightarrow$  linear shape.

Q30. Number of lone pairs on central atom in  $\text{I}_3^-$  ion is:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C. 3

Explanation:  $\text{I}_3^-$  has total 10 electrons  $\rightarrow$  2 bond pairs, 3 lone pairs  $\rightarrow$  linear shape.

Q31. The geometry and hybridisation of  $\text{SF}_4$  are:

- A. Tetrahedral,  $\text{sp}^3$
- B. See-saw,  $\text{sp}^3\text{d}$
- C. Trigonal bipyramidal,  $\text{sp}^3\text{d}^2$
- D. Square planar,  $\text{dsp}^2$

Answer: B. See-saw,  $\text{sp}^3\text{d}$

Explanation:  $\text{SF}_4$  has 4 bond pairs and 1 lone pair  $\rightarrow \text{sp}^3\text{d} \rightarrow$  see-saw geometry.

Q32. Which of the following is isoelectronic with  $\text{N}_2$ ?

- A.  $\text{O}_2^-$
- B. CO
- C.  $\text{NO}^+$
- D.  $\text{CN}^-$

Answer: B. CO

Explanation: CO,  $\text{N}_2$ , and  $\text{CN}^-$  have 14 electrons  $\rightarrow$  same electronic configuration  $\rightarrow$  isoelectronic.

Q33. Which of the following is not correctly matched?

- A.  $\text{NO}_3^-$  –  $\text{sp}^2$
- B.  $\text{NH}_4^+$  –  $\text{sp}^3$
- C.  $\text{SF}_6$  –  $\text{sp}^3\text{d}^2$
- D.  $\text{XeF}_4$  –  $\text{sp}^3\text{d}$

Answer: D.  $\text{XeF}_4$  –  $\text{sp}^3\text{d}$

Explanation:  $\text{XeF}_4$  has 6 electron pairs  $\rightarrow \text{sp}^3\text{d}^2$ , not  $\text{sp}^3\text{d}$ .

Q34. The bond order in  $\text{N}_2$  molecule is:

- A. 2
- B. 3
- C. 2.5
- D. 3.5

Answer: B. 3

Explanation: Bond order =  $(\text{Bonding} - \text{Antibonding electrons})/2 = (10-4)/2 = 3$ .

Q35. Which of the following has a non-zero dipole moment?

- A.  $\text{BeCl}_2$
- B.  $\text{CO}_2$
- C.  $\text{H}_2\text{O}$
- D.  $\text{BF}_3$

Answer: C.  $\text{H}_2\text{O}$

Explanation: Due to bent shape and polar bonds,  $\text{H}_2\text{O}$  has a net dipole moment.

Q36. Among the following, the molecule with square planar shape is:

- A.  $\text{SF}_4$
- B.  $\text{XeF}_4$
- C.  $\text{IF}_5$
- D.  $\text{PF}_5$

Answer: B.  $\text{XeF}_4$

Explanation:  $\text{XeF}_4$  has  $\text{sp}^3\text{d}^2$  hybridisation with 2 lone pairs  $\rightarrow$  square planar geometry.

Q37. The molecule which is non-polar in nature despite having polar bonds:

- A.  $\text{HCl}$
- B.  $\text{CH}_3\text{Cl}$
- C.  $\text{CHCl}_3$
- D.  $\text{BF}_3$

Answer: D.  $\text{BF}_3$

Explanation: Symmetrical trigonal planar geometry  $\rightarrow$  bond dipoles cancel  $\rightarrow$  net dipole = 0.

Q38. Which molecule has maximum bond angle?

- A.  $\text{NH}_3$
- B.  $\text{CH}_4$
- C.  $\text{H}_2\text{O}$
- D.  $\text{CO}_2$

Answer: D.  $\text{CO}_2$

Explanation:  $\text{CO}_2$  is linear  $\rightarrow$  bond angle =  $180^\circ$ , maximum among the options.

Q39. The correct statement regarding hybrid orbitals is:

- A.  $\text{sp}^3$  hybrid orbitals are 50% s and 50% p

- B.  $sp^2$  orbitals are 33% s and 67% p
- C. sp orbitals have 25% s and 75% p
- D.  $sp^3d$  orbitals have 40% s character

Answer: B.  $sp^2$  orbitals are 33% s and 67% p

Explanation:  $sp^2 = 1 s + 2 p$  orbitals  $\rightarrow$  33.3% s character, 66.7% p.

Q40. Which of the following molecules is linear and contains lone pairs?

- A.  $CO_2$
- B.  $BeCl_2$
- C.  $I_3^-$
- D.  $XeF_2$

Answer: D.  $XeF_2$

Explanation:  $XeF_2$  has 3 lone pairs and 2 bond pairs arranged in trigonal bipyramidal  $\rightarrow$  linear shape.

Q41. In which of the following species is backbonding most effective?

- A.  $BF_3$
- B.  $BCl_3$
- C.  $BBr_3$
- D.  $BI_3$

Answer: A.  $BF_3$

Explanation: Fluorine has high electronegativity and lone pairs  $\rightarrow$  strongest  $p\pi-p\pi$  backbonding with boron.

Q42. The molecule with zero bond order is:

- A.  $He_2$
- B.  $H_2$
- C.  $O_2$
- D.  $H_2^+$

Answer: A.  $He_2$

Explanation:  $He_2$  has 2 bonding and 2 antibonding electrons  $\rightarrow$  bond order = 0  $\rightarrow$  does not exist.

Q43. Which has the shortest bond length?

- A.  $O_2$
- B.  $O_2^+$
- C.  $O_2^-$
- D.  $O_2^{2-}$

Answer: B.  $O_2^+$

Explanation: Highest bond order (2.5)  $\rightarrow$  shortest bond length.

Q44. The bond angle in  $NH_3$  is less than that in  $CH_4$  because:

- A.  $NH_3$  has larger atoms
- B.  $CH_4$  is non-polar
- C.  $NH_3$  has a lone pair causing more repulsion
- D.  $CH_4$  has pi bonds

Answer: C.  $NH_3$  has a lone pair causing more repulsion

Explanation: Lone pair-bond pair repulsion  $>$  bond pair-bond pair  $\rightarrow$  smaller bond angle.

Q45. The molecular orbital configuration of  $O_2$  shows that it is:

- A. Diamagnetic with bond order 2
- B. Paramagnetic with bond order 2
- C. Paramagnetic with bond order 1
- D. Diamagnetic with bond order 3

Answer: B. Paramagnetic with bond order 2

Explanation:  $O_2$  has two unpaired electrons in  $\pi^*$  orbitals and bond order = 2  $\rightarrow$  paramagnetic.