

## Questions with Answer Keys

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## Q1 - 2024 (01 Feb Shift 1)

Given below are two statements; one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :  $\text{PH}_3$  has lower boiling point than  $\text{NH}_3$ . Reason (R) : In liquid state  $\text{NH}_3$  molecules are associated through vander waal's forces, but  $\text{PH}_3$  molecules are associated through hydrogen bonding. In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both (A) and (R) are correct and (R) is not the correct explanation of (A)
- (2) (A) is not correct but (R) is correct
- (3) Both (A) and (R) are correct but (R) is the correct explanation of (A)
- (4) (A) is correct but (R) is not correct

## Q2 - 2024 (01 Feb Shift 1)

Arrange the bonds in order of increasing ionic character in the molecules.  $\text{LiF}$ ,  $\text{K}_2\text{O}$ ,  $\text{N}_2$ ,  $\text{SO}_2$  and  $\text{ClF}_3$ .

- (1)  $\text{ClF}_3 < \text{N}_2 < \text{SO}_2 < \text{K}_2\text{O} < \text{LiF}$
- (2)  $\text{LiF} < \text{K}_2\text{O} < \text{ClF}_3 < \text{SO}_2 < \text{N}_2$
- (3)  $\text{N}_2 < \text{SO}_2 < \text{ClF}_3 < \text{K}_2\text{O} < \text{LiF}$
- (4)  $\text{N}_2 < \text{ClF}_3 < \text{SO}_2 < \text{K}_2\text{O} < \text{LiF}$

## Q3 - 2024 (01 Feb Shift 1)

The number of molecules/ion/s having trigonal bipyramidal shape is .....

$\text{PF}_5$ ,  $\text{BrF}_5$ ,  $\text{PCl}_5$ ,  $[\text{PtCl}_4]^{2-}$ ,  $\text{BF}_3$ ,  $\text{Fe}(\text{CO})_5$

## Q4 - 2024 (01 Feb Shift 2)

Given below are two statements :

Statement (I) : A  $\pi$  bonding MO has lower electron density above and below the inter-nuclear axis.

Statement (II) : The  $\pi^*$  antibonding MO has a node between the nuclei.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both Statement I and Statement II are false

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(2) Both Statement I and Statement II are true

(3) Statement I is false but Statement II is true

(4) Statement I is true but Statement II is false

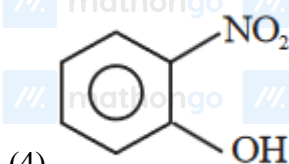
## Q5 - 2024 (01 Feb Shift 2)

Select the compound from the following that will show intramolecular hydrogen bonding.

(1)  $\text{H}_2\text{O}$

(2)  $\text{NH}_3$

(3)  $\text{C}_2\text{H}_5\text{OH}$



## Q6 - 2024 (27 Jan Shift 1)

Choose the polar molecule from the following :

(1)  $\text{CCl}_4$

(2)  $\text{CO}_2$

(3)  $\text{CH}_2 = \text{CH}_2$

(4)  $\text{CHCl}_3$

## Q7 - 2024 (27 Jan Shift 1)

Sum of bond order of  $\text{CO}$  and  $\text{NO}^+$  is

## Q8 - 2024 (27 Jan Shift 2)

The number of non-polar molecules from the following \_\_\_\_\_

## Q9 - 2024 (29 Jan Shift 1)

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Number of compounds with one lone pair of electrons on central atom amongst following is \_\_\_\_\_

$O_3, H_2O, SF_4, ClF_3, NH_3, BrF_5, XeF_4$

Q10 - 2024 (29 Jan Shift 1)

The number of species from the following which are paramagnetic and with bond order equal to one is \_\_\_\_\_

$H_2, He_2^+, O_2^+, N_2^{2-}, O_2^{2-}, F_2, Ne_2^+, B_2$

Q11 - 2024 (29 Jan Shift 2)

The total number of anti bonding molecular orbitals, formed from 2 s and 2p atomic orbitals in a diatomic molecule is \_\_\_\_\_

Q12 - 2024 (29 Jan Shift 2)

The total number of 'Sigma' and Pi bonds in 2formylhex-4-enoic acid is \_\_\_\_\_

Q13 - 2024 (29 Jan Shift 2)

The total number of molecules with zero dipole moment among  $CH_4, BF_3, H_2O, HF, NH_3, CO_2$  and  $SO_2$  is \_\_\_\_\_

Q14 - 2024 (30 Jan Shift 1)

Match List-I with List-II

List-I

List-II

Molecule

Shape

(A)  $BrF_5$

(I) T-shape

(B)  $H_2O$

(II) See saw

(C)  $ClF_3$

(III) Bent

(D)  $SF_4$

(IV) Square pyramidal

(1) (A)-I, (B)-II, (C)-IV, (D)-III

(2) (A) -II, (B)-I, (C)-III, (D)-IV

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(3) (A)-III, (B)-IV, (C)-I, (D)-II

(4) (A)-IV, (B)-III, (C)-I, (D)-II

## Q15 - 2024 (30 Jan Shift 1)

The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule

## Q16 - 2024 (30 Jan Shift 2)

Given below are two statements:

Statement-I: Since fluorine is more electronegative than nitrogen, the net dipole moment of  $\text{NF}_3$  is greater than  $\text{NH}_3$ .

Statement-II: In  $\text{NH}_3$ , the orbital dipole due to lone pair and the dipole moment of NH bonds are in opposite direction, but in  $\text{NF}_3$  the orbital dipole due to lone pair and dipole moments of N-F bonds are in same direction.

In the light of the above statements. Choose the most appropriate from the options given below.

(1) Statement I is true but Statement II is false.

(2) Both Statement I and Statement II are false.

(3) Both statement I and Statement II is are true.

(4) Statement I is false but Statement II is are true.

## Q17 - 2024 (31 Jan Shift 1)

The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals

A. have the same energy

B. have the minimum overlap

C. have same symmetry about the molecular axis

D. have different symmetry about the molecular axis

Choose the most appropriate from the options given below:

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## Questions with Answer Keys

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(1) A, B, C only

(2) A and C only

(3) B, C, D only

(4) B and D only

## Q18 - 2024 (31 Jan Shift 1)

The number of species from the following in which the central atom uses  $sp^3$  hybrid orbitals in its bonding is

$NH_3$ ,  $SO_2$ ,  $SiO_2$ ,  $BeCl_2$ ,  $CO_2$ ,  $H_2O$ ,  $CH_4$ ,  $BF_3$

## Q19 - 2024 (31 Jan Shift 2)

Which of the following is least ionic?

(1)  $BaCl_2$ (2)  $AgCl$ (3)  $KCl$ (4)  $CoCl_2$ 

## Q20 - 2024 (31 Jan Shift 2)

A diatomic molecule has a dipole moment of  $1.2D$ . If the bond distance is  $1\text{\AA}$ , then fractional charge on each atom is \_\_\_\_\_  $\times 10^{-1}$  esu .

(Given  $1D = 10^{-18}$  esu cm)

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## Questions with Answer Keys

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**Answer Key**

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**Q1** (4) mathongo /// ma **Q2** (3) mathongo **Q3** (3) mathongo /// ma **Q4** (3) mathongo

**Q5** (4) mathongo /// ma **Q6** (4) mathongo **Q7** (6) mathongo /// ma **Q8** (4) mathongo

**Q9** (4) mathongo /// ma **Q10** (1) mathongo **Q11** (4) mathongo /// ma **Q12** (22) mathongo

**Q13** (3) mathongo /// ma **Q14** (4) mathongo **Q15** (8) mathongo /// ma **Q16** (2) mathongo

**Q17** (2) mathongo /// ma **Q18** (4) mathongo **Q19** (2) mathongo /// ma **Q20** (0) mathongo

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## Solutions

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Q1

Unlike  $\text{NH}_3$ ,  $\text{PH}_3$  molecules are not associated through hydrogen bonding in liquid state. That is why the boiling point of  $\text{PH}_3$  is lower than  $\text{NH}_3$ .

Q2

Increasing order of ionic character  $\text{N}_2 < \text{SO}_2 < \text{ClF}_3 < \text{K}_2\text{O} < \text{LiF}$

Ionic character depends upon difference of electronegativity (bond polarity).

Q3

$\text{PF}_5$ ,  $\text{PCl}_5$ ,  $\text{Fe}(\text{CO})_5$ ; Trigonal bipyramidal

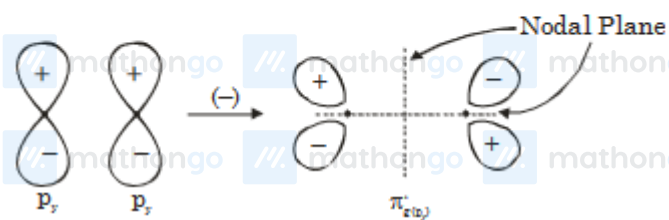
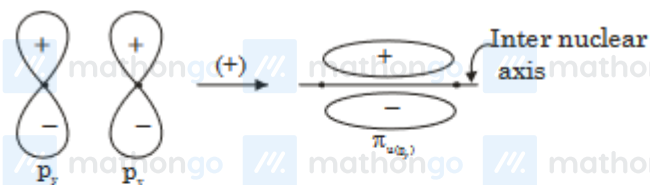
$\text{BrF}_5$ ; square pyramidal

$[\text{PtCl}_4]^{-2}$ ; square planar

$\text{BF}_3$ ; Trigonal planar

Q4

A  $\pi$  bonding molecular orbital has higher electron density above and below inter nuclear axis



Q5

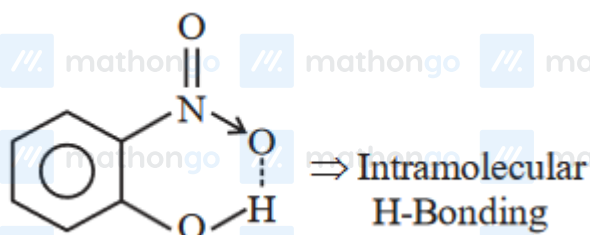
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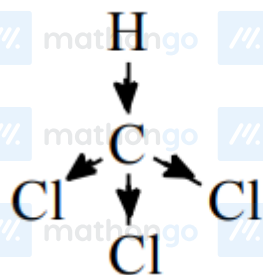
## Solutions

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$\text{H}_2\text{O}, \text{NH}_3, \text{C}_2\text{H}_5\text{OH} \Rightarrow$  Intermolecular H-Bonding

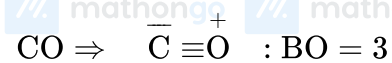


Q6

 $\mu \neq 0$ 

$\text{CHCl}_3$  is polar molecule and rest all molecules are non-polar.

Q7



Q8

The non-polar molecules are  $\text{CO}_2, \text{H}_2, \text{CH}_4$  and  $\text{BF}_3$

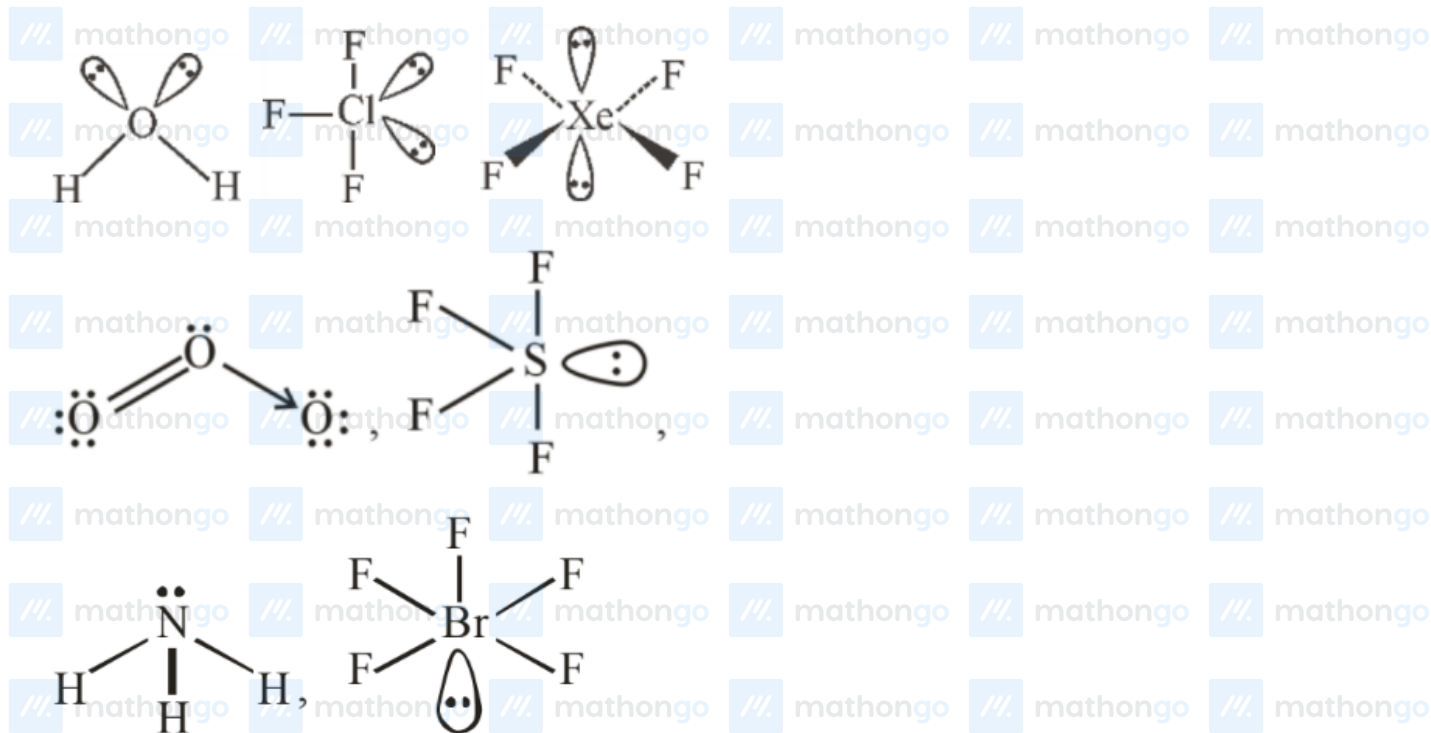
Q9

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## Solutions

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## Q10

	Magnetic behaviour	Bond order
H <sub>2</sub>	Diamagnetic	1
He <sub>2</sub> <sup>+</sup>	Paramagnetic	0.5
O <sub>2</sub> <sup>+</sup>	Paramagnetic	2.5
N <sub>2</sub> <sup>2-</sup>	Paramagnetic	2
O <sub>2</sub> <sup>2-</sup>	Diamagnetic	1
F <sub>2</sub>	Diamagnetic	1
Ne <sub>2</sub> <sup>+</sup>	Paramagnetic	0.5
B <sub>2</sub>	Paramagnetic	1

## Q11

Antibonding molecular orbital from 2s = 1

Antibonding molecular orbital from 2p = 3

Total = 4

## Q12

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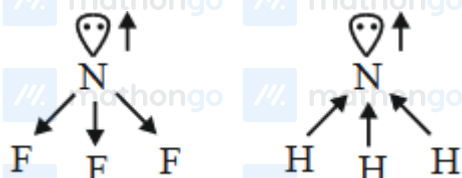
## Solutions

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Q15

Two molecular orbitals  $\sigma 2s$  and  $\sigma^* 2s$ .Six molecular orbitals  $\sigma 2p_z$  and  $\sigma^* 2p_z$ ,  $\pi 2p_x$ ,  $\pi 2p_y$  and  $\pi^* 2p_x$ ,  $\pi^* 2p_y$ 

Q16

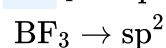
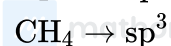
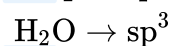
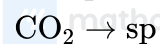
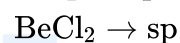
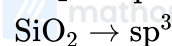
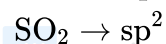
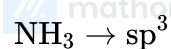


Q17

\*Molecular orbital should have maximum overlap

\* Symmetry about the molecular axis should be similar

Q18



Q19

$$\text{AgCl} < \text{CoCl}_2 < \text{BaCl}_2 < \text{KCl} \text{ (ionic character)}$$
Reason :  $\text{Ag}^+$  has pseudo inert gas configuration.

Q20

$$\mu = 1.2D = q \times d$$

$$\Rightarrow 1.2 \times 10^{-10} \text{esu}\text{\AA} = q \times 1\text{\AA}$$

$$\therefore q = 1.2 \times 10^{-10} \text{esu}$$

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