Molecular orbital theory

41. **(c) Two**

Explanation (Word-friendly format):
A **d orbital** has **two nodal planes** — regions where the probability of finding an electron is **zero**.

For example:

- In the **d_{xy}** orbital, nodal planes are the **xz and yz planes**.
- In general, the **number of nodal planes = |m_l|**, and for d orbitals (l = 2), there are **two nodal planes**.

Hence, each **d orbital** has **two nodal planes**.

42. (a) Element with atomic number 26 is *Fe*. It is a ferromagnetic.

43. (b) Correct Sequence of bond order is

$O_2^+ > O_2 > O_2^{2-}$

B.O – 2.5 2 1.5

44. (a) Due to small bond length.

45. (a) S^{-2} have all paired electrons so it is diamagnetic.

46. (c) *NO* has 15 electrons.

47. (b) In the conversion of O_2 into O_2^- bond order decreases.

48. **(c) Increases**

Explanation (Word-friendly format):
Bond order represents the **number of chemical bonds** between a pair of atoms.

It is calculated as:

Bond order = (Number of bonding electrons − Number of antibonding electrons) ÷ 2

- As **bond order increases**, the number of bonds increases.
- This leads to **greater attraction** between atoms, **higher bond energy**, and **shorter bond length**.
- Therefore, **bond stability increases** with increasing bond order.

49. (c) O_2^{2-} does not have any unpaired electron so it is diamagnetic.

50. (a) O_2^{2-} consist of four antibonding electron pair [1s and 2s have two antibonding and $2p_x 2p_y$ have two antibonding electron pair].

51. (c) The electron's distribution in molecular orbitals is $1s^2, 2s^1$

B.O. $= \frac{2-1}{2} = \frac{1}{2} = 0.5$.

52. (b) CO_2^- has all paired electrons hence it does not show paramagnetism.

53. (a) B.O. $= \frac{1}{2}[N_b - N_a]$

$N_2 = \frac{1}{2}[10-4] = \frac{6}{2} = 3$;

$O_2^{2+} = \frac{1}{2}[10-4] = \frac{6}{2} = 3.$

54. (a) B.O. for $N_2^+ = \frac{1}{2}[N_b - N_a] = \frac{1}{2}[9-4] = \frac{5}{2} = 2.5$.

55. (a) H_2O_2 contain bond angle between two $O-H$ planes about 90°.

56. (c) Nitrogen molecule has highest bond energy due to presence of triple bond.

57. (c) $Cu^{2+} = [Ar_{18}]3d^9 4s^0$ it has one unpaired electron so it is paramagnetic.

58. **(c) 2p, 1s**

Explanation (Word-friendly format):
In a nitrogen molecule (N_2), the triple bond consists of:

- **One sigma (σ) bond** formed by **overlap of 2p_z orbitals** (end-to-end overlap).
- **Two pi (π) bonds** formed by **sidewise overlap of 2p_x and 2p_y orbitals**.

The **1s orbitals** form an inner filled shell (core), but the bonding mainly involves **2p orbitals**.
Thus, the triple bond in N_2 arises from **2p orbital overlaps**, corresponding to option **(c) 2p, 1s** (where 2p gives the bond formation, and 1s electrons are inner and nonbonding).

59. (a) $CN^- = 14$ electrons ; $CO = 14$ electrons

B.O. $= \frac{1}{2}[10-4] = \frac{6}{2} = 3$.

60. (a) B.O. $= \frac{1}{2}[10-5] = \frac{5}{2} = 2.5$, paramagnetic