# Aufbau Principle Chemistry Questions with Solutions

**Q1.** Which of the following orbital will have the lowest energy?
(a) 1s
(b) 2s
(c ) 3s
(d) None of the above
**Answer:** (a) 1s will have the lowest energy as per the Aufbau principle.

**Q2.** Which of the following will have the highest energy?
(a) 3s
(b) 3d
(c) 4s
(d) None of the above
**Answer:** (b) 3d will have the highest energy as per the Aufbau principle.

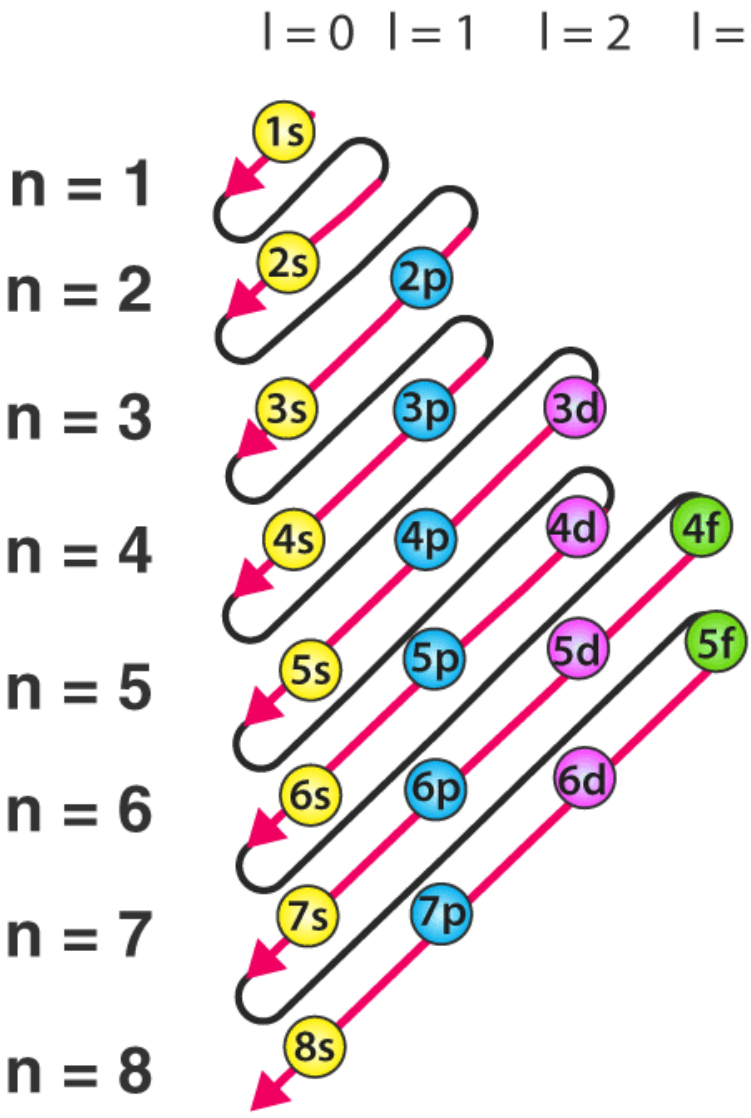
**Q3.** Electrons revolving in orbit have a fixed
(a) Angular momentum
(b) Shape
(c ) Thickness
(d) None of the above
**Answer:** (a) Electrons revolving in orbit have a fixed angular momentum.

**Q4.** The Aufbau principle does not give the correct arrangement of filling up of atomic orbitals in
(a) Copper and Zinc
(b) Chromium and Zinc
(c ) Copper and Chromium
(d) None of the above
**Answer:** (c) The Aufbau principle does not give the correct arrangement of filling up of atomic orbitals in copper and chromium.

**Q5.** According to the Aufbau principle, the electron occupies that sub-shell with the
(a) Lowest energy
(b) Highest energy
(c ) Zero Energy
(d) None of the above
**Answer:** (a) According to the Aufbau principle, the electron occupies that sub-shell with the lowest energy.

**Q6.** What is the Aufbau principle?
**Answer:** The Aufbau principle states that the electrons are filled in an atom in increasing order of energy. The atomic orbital with less energy is filled before the atomic orbital with high energy. It is used to specify the location of an electron in different energy levels.

**Q7.** How are electrons filled in an atom? Explain with the help of a neat and clean diagram.
**Answer:** Electrons are filled in an atom in increasing order of energy. The atomic orbital with less energy is filled before the atomic orbital with high energy.
Diagram:



**Q8.** An atom of an element contains 29 electrons and 35 neutrons.
Deduce:
(a) The number of protons
(b) The electronic configuration of the element.
(c ) The name of the element.
**Answer:** (a) The number of protons is equivalent to the number of electrons. Thus, it will have 29 protons.
(b) The electronic configuration of the element will be $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$.
(c ) The atomic number of copper is 29. Hence, it is copper.

**Q9.** The electronic configuration of an element A is

| K | L | M |
|---|---|---|
| 2 | 8 | 6 |

(a) What is the group number of element A?
(b) What is the period number of element A?
(c) How many valence electrons are there in element A?
(d) What is the valency of element A?
(e) Is element A, a metal or a non-metal?
**Answer:** (a) As element A has six valence electrons, it belongs to group 16 of the periodic table.
(b) As element A has three valence shells, it belongs to period 3 of the periodic table.
(c ) There are six valence electrons in element A.
(d) The valency of element A would be equal to 8 - the number of valence electrons, i.e. 8 - 6 = 2.
(e) Element A is a non-metal.

**Q10.** Answer the following questions.
(a) Write the electronic configurations of the following ions.
(i) $H^-$
(ii) $Na^+$
(iii) $O^{2-}$
(iv) $F^-$
(b) What are the atomic numbers of elements whose outermost electrons are represented by the following.
(i) 3 $s^1$
(ii) 2 $p^3$
(iii) 3 $d^1$
**Answer:** The electronic configuration of following ions are listed below.

| S. No. | Ions | Electronic Configuration |
|---|---|---|
| 1. | $H^-$ | $1s^2$ |
| 2. | $Na^+$ | $1s^2\ 2s^2\ p^6$ |
| 3. | $O^{2-}$ | $1s^2\ 2s^2\ p^6$ |
| 4. | $F^-$ | $1s^2\ 2s^2\ p^6$ |

The atomic number of elements with the given outermost electrons are.

| S. No. | Outermost electrons | Atomic Number |
|---|---|---|
| 1. | $3\ s^1$ | 11 |
| 2. | $2\ p^3$ | 7 |
| 3. | $3\ d^1$ | 21 |

**Q11.** Name the atom indicated by the following configuration.
(a) [He] $2s^1$
(b) [Ne] $3s^2\ 3p^3$
(c) [Ar] $4s^2\ 3d^1$
**Answer:** The atom indicated by the following configuration is mentioned below.

| S. No. | Electronic Configuration | Name of the atom |
|---|---|---|
| 1. | [He] $2s^1$ | Lithium |
| 2. | [Ne] $3s^2\ 3p^3$ | Phosphorous |
| 3. | [Ar] $4s^2\ 3d^1$ | Scandium |

**Q12.** Why are half-filled or fully filled orbitals more stable?
**Answer:** The half-filled or fully filled orbitals are more stable for two reasons.
1. Symmetry: The half-filled or fully filled orbitals are more stable because it has a symmetrical distribution of electrons.
2. Exchange Energy: The half-filled or fully filled orbitals are more stable because electrons in degenerate orbitals have parallel spins, and they exchange their positions. When the orbitals are

half-filled or completely filled, the number of exchanges is maximum. Therefore, it acquires greater stability.

**Q13.** Why is the electronic configuration of potassium 2,8,8,1 and not 2,8,9?
**Answer:** The electronic configuration of potassium 2,8,8,1 and not 2,8,9 because according to the octet rule, the outermost shell of an atom can accommodate 8 electrons (except the K shell, which can accommodate 2 electrons). Hence, the electronic configuration of potassium is 2,8,8,1 and not 2,8,9.

**Q14.** Write calcium and rubidium's ground state electronic configuration using the Aufbau principle.
**Answer:** Calcium and rubidium's ground state electronic configuration will be

| S. No. | Element | Electronic Configuration |
|---|---|---|
| 1. | Calcium | $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ |
| 2. | Rubidium | $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^1$ |

**Q15.** Match the following

| Column A | Column B |
|---|---|
| Hund's Rule | No two electrons in an atom can have the same set of four quantum numbers. |
| Aufbau Principle | In the ground state of atoms, orbitals are filled in the order of their increasing energies. |
| Pauli Exclusion Principle | Pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital is singly occupied. |
| Heisenberg's Uncertainty Principle: | It is impossible to determine a subatomic particle's exact position and momentum simultaneously. |

**Answer:**

| Column A | Column B |
|---|---|
| Hund's Rule | Pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital is singly occupied. |

| | |
|---|---|
| **Aufbau Principle** | **In the ground state of atoms, orbitals are filled in the order of their increasing energies.** |
| **Pauli Exclusion Principle** | **No two electrons in an atom can have the same set of four quantum numbers.** |
| **Heisenberg's Uncertainty Principle:** | **It is impossible to determine a subatomic particle's exact position and momentum simultaneously.** |

## Practise Questions on Aufbau Principle

**Q1.** Arrange them in the order in which electrons are filled in the orbitals.
3s, 2p, 3p, 2s, 3d, 4s.
**Answer:** According to the Aufbau principle, the given orbitals will be filled as 2s, 2p, 3s, 3p, 4s, and 3d.

**Q2.** In an atom, what is the order of increasing energy of electrons with quantum numbers?
i) n = 4, l = 1 ii) n = 3, l = 2 iii) n = 3, l = 1 iv) n = 4, l = 0
**Answer:** The order of increasing energy of electrons with quantum numbers:
i) n = 4, l = 1 ii) n = 3, l = 2 iii) n = 3, l = 1 iv) n = 4, l = 0
Are as (iii) < (iv) < (i) < (ii)

**Q3.** What is the maximum number of electrons that can be filled into all the orbitals corresponding to the azimuthal quantum number l = 3?
**Answer:** For l = 3, the possible values of m = 2l + 1 = 7. For each m, there can be 2 electrons filled.

Hence, the maximum number of electrons that can be filled into all the orbitals corresponding to the azimuthal quantum number l = 3 is equivalent to 2 X 7 = 14.

**Q4.** What is an azimuthal quantum number?
**Answer:** An azimuthal quantum number is a quantum number for an atomic orbital that determines its orbital angular momentum and describes the shape of the orbital. The azimuthal quantum number is the second of a set of quantum numbers representing an electron's unique quantum state. It is also known as the orbital angular momentum quantum number, orbital quantum number or second quantum number and is symbolised as l.

**Q5.** What are the azimuthal quantum number and the principal quantum number of the 17th electron?
**Answer:** For an atom with 17 electrons, the configuration is, $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$. Therefore the 17th electron is in the p orbital with n = 3 and l = 1.