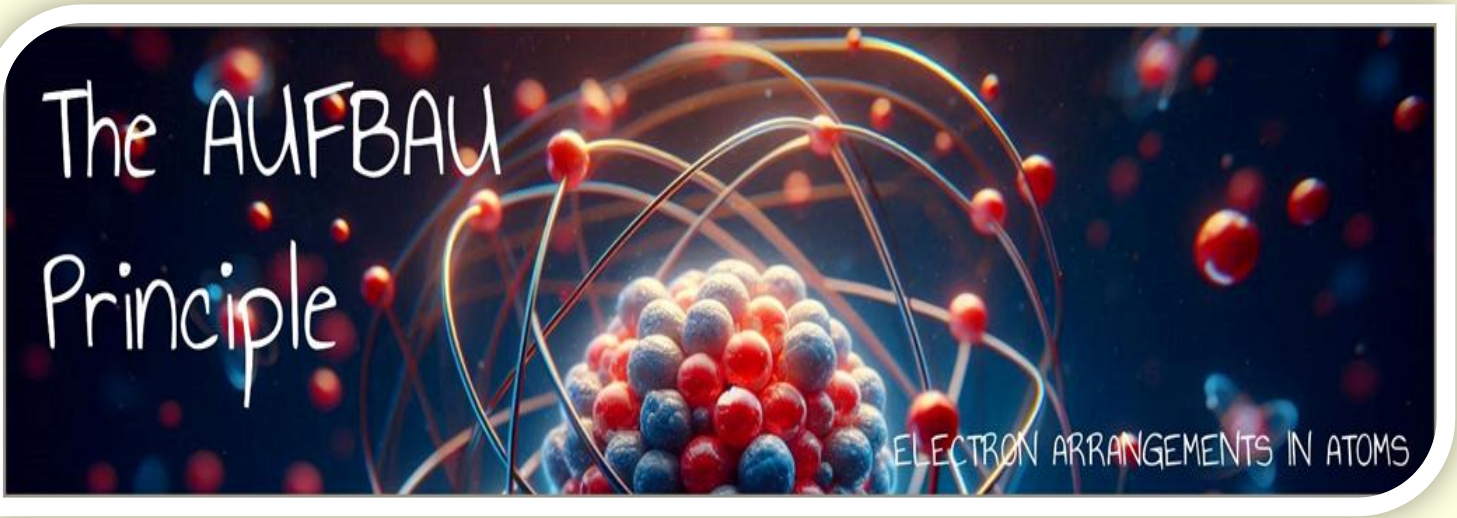


Answer all the questions below as fully as you can then check your answers

1. Which of the following statements correctly describes the Aufbau principle?

a) Electrons occupy the lowest energy orbitals first.

b) Electrons occupy orbitals of the same energy in opposite spins.

c) Electrons pair up in orbitals only after each orbital in a sublevel is singly occupied.

d) Electrons in the same orbital have the same spin.

2. Which of the following elements has the electron configuration [Ne] $3s^2$ $3p^3$?

a) Sulfur (S) b) Phosphorus (P) c) Silicon (Si) d) Chlorine (Cl)

3. In which part of the periodic table are the d-block elements located?

a) Groups 1 and 2 b) Groups 5 to 8

c) Middle block of the periodic table d) The lanthanides and actinides

4. Fill in the gaps below to complete the sentences.

a. In the Aufbau principle, electrons fill orbitals starting from the _____ energy level first.

b. The electron configuration of Copper (Cu) is _____ instead of the expected [Ar] $4s^2$ $3d^9$ due to increased stability associated with full and half-full d orbitals.

c. The noble gas notation for the electron configuration of Chlorine (Cl) is _____.

5. Match the following sublevels with the correct number of orbitals:

Sub-level
s
p
d
f

Number of orbitals

6. Match the element with its electron configuration:

element
Argon (Ar)
Tin (Sn)
Tellurium (Te)
Chromium (Cr)

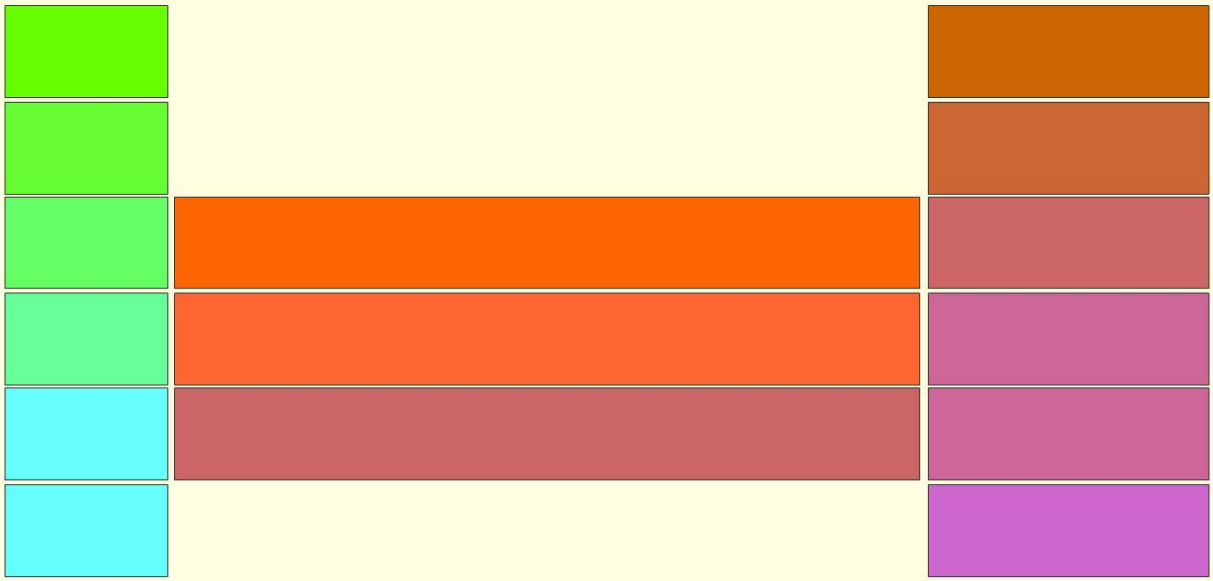
Electron configuration
[Ar] $4s^2$ $3d^5$
[Kr] $5s^2$ $4d^{10}$ $5p^4$
[Xe] $6s^2$ $4f^{14}$ $5d^{10}$ $6p^2$
[Ne] $3s^2$ $3p^6$

7. Explain the anomaly in the electron configurations of Chromium (Cr) and Copper (Cu) as compared to the expected configurations.

8. Draw the electron energy level diagram for the first 20 electrons in an atom, showing the order in which the levels and sub-levels fill according to the Aufbau principle.

9. Using the Aufbau principle, write the full electron configuration for the element Vanadium (V).

10. Complete the outline of the periodic table to show the location of the s, p and d blocks in the periodic table. Indicate on the diagram the sub-level in which the outer electrons are found for each row in the s, p and d blocks.



11. Explain the significance of the noble gas shorthand notation in electron configurations and provide examples with Sodium (Na) and Iron (Fe).

12. Which of the following statements correctly describes Hund's rule?

a) Electrons fill orbitals starting from the lowest energy level.

b) Electrons occupy degenerate orbitals singly before pairing up.

c) No two electrons in the same atom can have the same set of four quantum numbers.

d) The 4s orbital fills before the 3d orbital.

13. The Pauli Exclusion Principle states that:

a) Electrons in the same orbital must have opposite spins.

b) Electrons in the same subshell occupy different orbitals before pairing.

c) Electrons always occupy the lowest energy orbitals first.

d) Electrons pair up in orbitals of equal energy.

14. Fill in the Gaps to complete the sentences below:

a. According to Hund's rule, electrons in degenerate orbitals will occupy _____ orbitals before _____ up.

b. The Pauli exclusion principle states that no two electrons in the same atom can have the same set of four _____ numbers.

c. In a p subshell, the three p orbitals will each receive one electron before any of them receive a second electron. This is an application of _____ rule.

15. Match the principle with its correct description:

Principle or rule	Description
Hund's Rule	Electrons fill the lowest energy orbitals first.
Pauli Exclusion Principle	Electrons occupy degenerate orbitals singly before pairing.
Aufbau Principle	No two electrons in an atom can have the same four quantum numbers.

Answers

1. Which of the following statements correctly describes the Aufbau principle?

a) Electrons occupy the lowest energy orbitals first.

b) Electrons occupy orbitals of the same energy in opposite spins.

c) Electrons pair up in orbitals only after each orbital in a sublevel is singly occupied.

d) Electrons in the same orbital have the same spin.

Answer: a) Electrons occupy the lowest energy orbitals first.

2. Which of the following elements has the electron configuration [Ne] $3s^2$ $3p^3$?

a) Sulfur (S) b) Phosphorus (P) c) Silicon (Si) d) Chlorine (Cl)

Answer: b) Phosphorus (P)

3. In which part of the periodic table are the d-block elements located?

a) Groups 1 and 2 b) Groups 5 to 8

c) Middle block of the periodic table d) The lanthanides and actinides

Answer: c) Middle block of the periodic table

4. Fill in the gaps below to complete the sentences.

a. In the Aufbau principle, electrons fill orbitals starting from the _____ energy level first.

Answer: lowest

b. The electron configuration of Copper (Cu) is _____ instead of the expected [Ar] $4s^2$ $3d^9$ due to increased stability associated with full and half-full d orbitals.

Answer: [Ar] $4s^1$ $3d^{10}$

c. The noble gas notation for the electron configuration of Chlorine (Cl) is _____.

Answer: [Ne] $3s^2$ $3p^5$

5. Match the following sublevels with the correct number of orbitals:

Sub-level
s
p
d
f

Number of orbitals
1
3
5
7

6. Match the element with its electron configuration:

element	Electron configuration
Argon (Ar)	[Ar] $4s^2$ $3d^5$
Tin (Sn)	[Kr] $5s^2$ $4d^{10}$ $5p^2$
Tellurium (Te)	[Kr] $5s^2$ $4d^{10}$ $5p^4$
Chromium (Cr)	[Ne] $3s^2$ $3p^6$

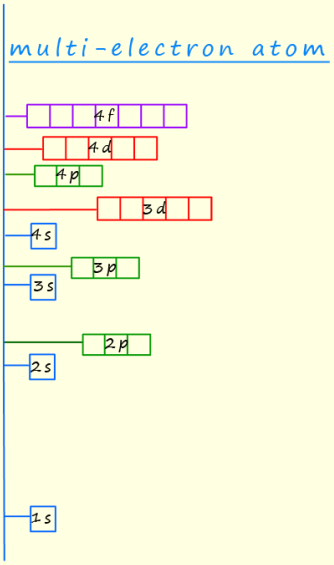
7. Explain the anomaly in the electron configurations of Chromium (Cr) and Copper (Cu) as compared to the expected configurations.

Answer:
The electron configurations of Chromium and Copper are anomalies because they do not follow the expected filling order according to the Aufbau principle. Chromium, expected to be [Ar] $4s^2$ $3d^4$, instead has the configuration [Ar] $4s^1$ $3d^5$. This occurs because a half-filled d subshell ($3d^5$) provides extra stability. Similarly, Copper,

expected to be [Ar] $4s^2$ $3d^9$, actually has the configuration [Ar] $4s^1$ $3d^{10}$. The fully filled d subshell ($3d^{10}$) is more stable, leading to this anomaly.

8. Draw the electron energy level diagram for the first 20 electrons in an atom, showing the order in which the levels and sub-levels fill according to the Aufbau principle.

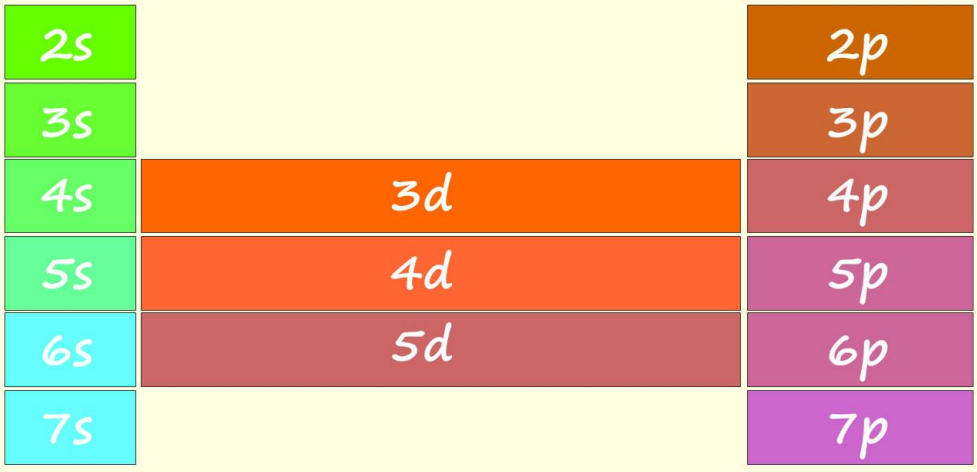
Answer:
An accurate electron energy level diagram should depict the following sequence: 1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p. The diagram should illustrate that the 4s orbital fills before the 3d orbital due to its lower energy. The diagram should be similar to the one shown opposite.



9. Using the Aufbau principle, write the full electron configuration for the element Vanadium (V).

Answer:
The full electron configuration for Vanadium (V) is:
$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$ $3d^3$

10. Complete the outline of the periodic table to show the location of the s, p and d blocks in the periodic table. Indicate on the diagram the sub-level in which the outer electrons are found for each row in the s, p and d blocks.



11. Explain the significance of the noble gas shorthand notation in electron configurations and provide examples with Sodium (Na) and Iron (Fe).

Answer:
The noble gas shorthand notation simplifies electron configurations by using the electron configuration of the nearest noble gas to represent the inner, filled electron shells. For example:

Sodium (Na): Instead of writing $1s^2\ 2s^2\ 2p^6\ 3s^1$, it can be abbreviated as [Ne] $3s^1$, where [Ne] represents the configuration $1s^2\ 2s^2\ 2p^6$.

Iron (Fe): Instead of writing $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$, it is abbreviated as [Ar] $4s^2\ 3d^6$, where [Ar] stands for $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$.

This notation saves space and provides a clearer view of the valence electrons, which are crucial for understanding chemical reactivity.

12. Which of the following statements correctly describes Hund's rule?

a) Electrons fill orbitals starting from the lowest energy level.

b) Electrons occupy degenerate orbitals singly before pairing up.

c) No two electrons in the same atom can have the same set of four quantum numbers.

d) The 4s orbital fills before the 3d orbital.

Answer: b) Electrons occupy degenerate orbitals singly before pairing up.

13. The Pauli exclusion principle states that:

a) Electrons in the same orbital must have opposite spins.

b) Electrons in the same subshell occupy different orbitals before pairing.

c) Electrons always occupy the lowest energy orbitals first.

d) Electrons pair up in orbitals of equal energy.

Answer: a) Electrons in the same orbital must have opposite spins.

14. Fill in the Gaps to complete the sentences below:

a. According to Hund's rule, electrons in degenerate orbitals will occupy _____ orbitals before _____ up.

Answers: separate, pairing

15. The Pauli exclusion principle states that no two electrons in the same atom can have the same set of four _____ numbers.

Answer: quantum

16. In a p subshell, the three p orbitals will each receive one electron before any of them receive a second electron. This is an application of _____ rule.

Answer: Hund's

17. Match the principle with its correct description:

Principle or rule	Description
Hund's Rule	Electrons fill the lowest energy orbitals first.
Pauli Exclusion Principle	Electrons occupy degenerate orbitals singly before pairing.
Aufbau Principle	No two electrons in an atom can have the same four quantum numbers.