Quantum Numbers

- **Principal Quantum number (n):** It denotes the orbital number or shell number of electron.
- **Azimuthal Quantum numbers (*l*):** It denotes the orbital (sub-orbit) of the electron.
- **Magnetic Quantum number: (*ml*)** It denotes the number of energy states in each orbit.
- **Spin Quantum number(s):** It denotes the direction of spin, S = -½ = Anticlockwise and ½ = Clockwise.

Electronic Configuration of an Atom

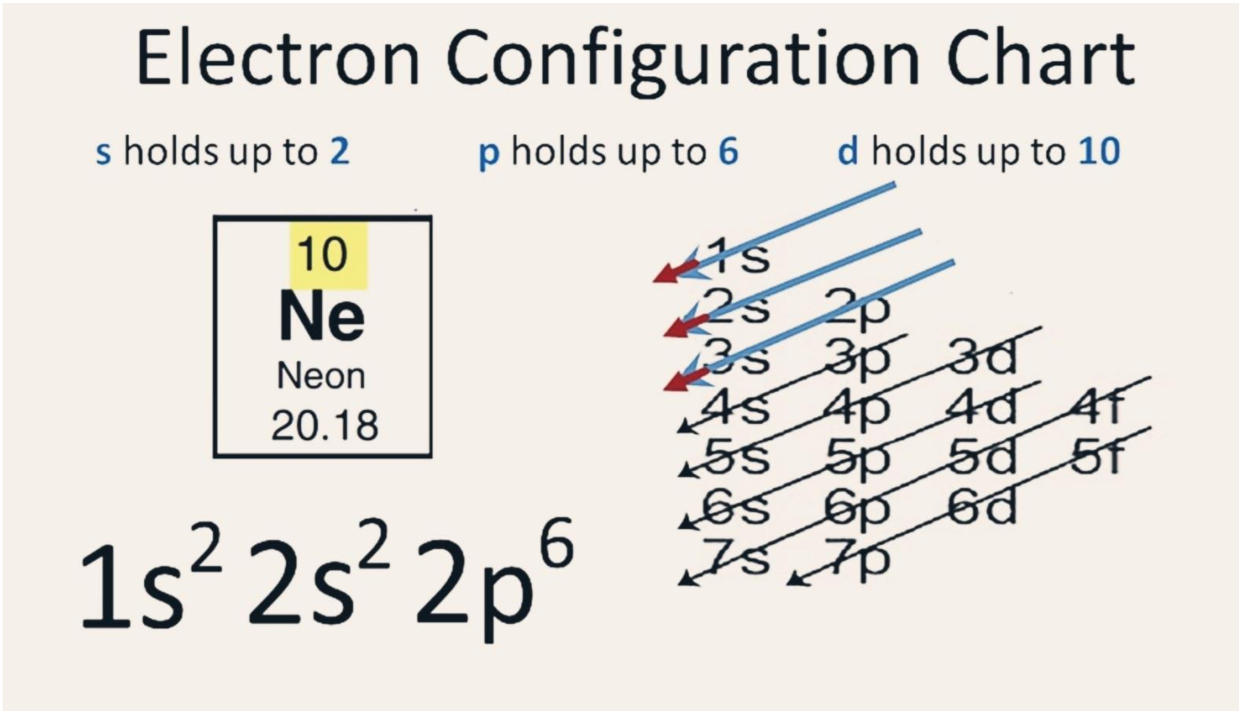
The electrons have to be filled in the s, p, d, f in accordance with the following rule.

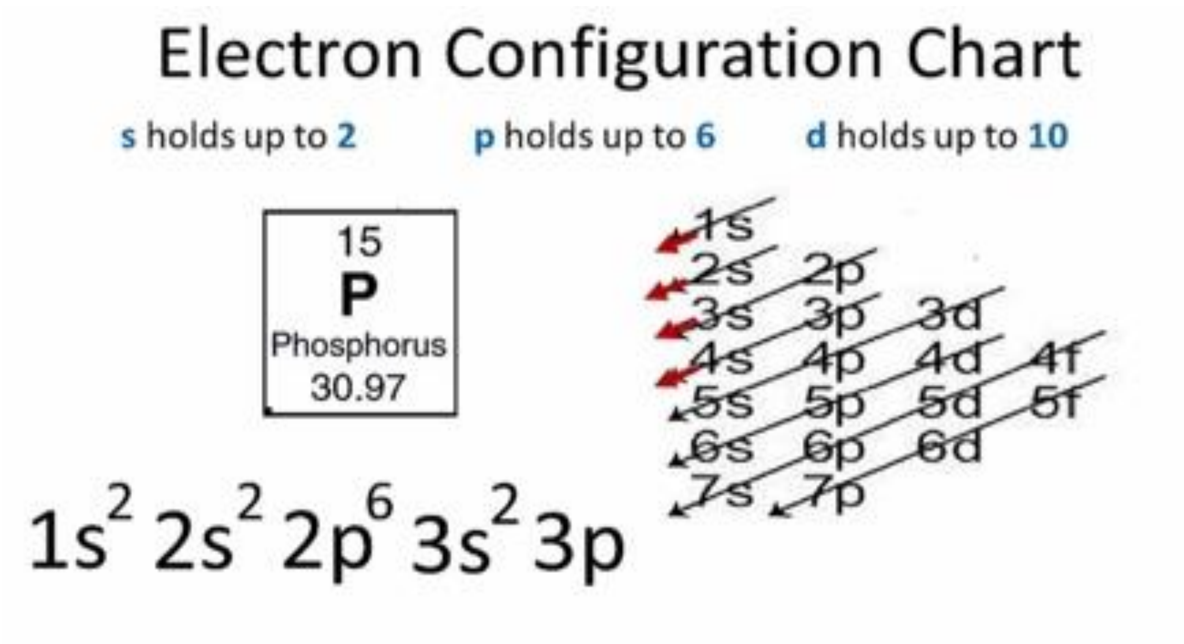
1. Aufbau's principle: The filling of electrons should take place in accordance with the ascending order of energy of orbitals:

- Lower energy orbital should be filled first and higher energy levels.
- Ascending order of energy 1s, 2s, 2p, 3s, 3p, 4s, 3d, . . .

2. Pauli's exclusion principle: No two electrons can have all the four quantum numbers to be the same or, if two electrons have to placed in an energy state they should be placed with opposite spies.

3. Hund's rule of maximum multiplicity: In case of filling degenerate (same energy) orbitals, all the degenerate orbitals have to be singly filled first and then only pairing has to happen.


Electron Configuration Chart
s holds up to 2
p holds up to 6
d holds up to 10
10
Ne
Neon
20.18
1s 2s 2p 3s 3p 3d 4s 4p 4d 4f 5s 5p 5d 5f 6s 6p 6d 7s 7p
$1s^2 2s^2 2p^6$


Electron Configuration Chart
s holds up to 2
p holds up to 6
d holds up to 10
15
P
Phosphorus
30.97
1s 2s 2p 3s 3p 3d 4s 4p 4d 4f 5s 5p 5d 5f 6s 6p 6d 7s 7p
$1s^2 2s^2 2p^6 3s^2 3p$

Test Questions And Answers

1. What atom matches this electron configuration? **1**s^2 **2**s^2 **2**p^6 **3** s^2

- Neon
- **Magnesium**
- Aluminum
- Potassium

2. What atom matches this electron configuration?
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

- **Zinc**
- Copper
- Nickel
- Germanium

3. What is the electron configuration for a Sulfur atom?

- $1s^2$ 2 s^2 $2p^6$ $3p^6$
- $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$
- **$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^4$**
- 3p4

4. What atom matches this electron configuration?
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^9$ [Kr] $4d^{10} 5p^6 6s^2 4f^{14} 5d^9$

Mercury
- **Gold**
- Platinum
- Thallium

5. What electron configuration matches an oxygen atom?

- $1s^22s^22p^63s2, 3p^64s^23d^{10}4p^5$
- **$1s^22s^22p^4$**
- $1s^22s^22p^6$
- $1s^22s^22p^63s^23p^64s^23d^1$

6. Which of the following is the smallest in size?

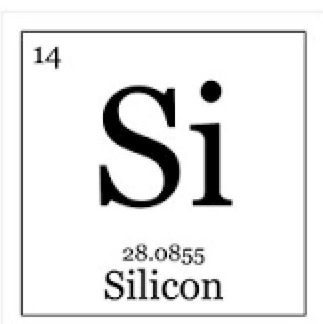
- **N**
- S
- I
- Fr

7. How many electrons does Si contain?

- **14**
- 28
- 2
- 4

8. How many valence electrons does Si contain?

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$



- 14
- 28
- 2
- **4**

9. How many electrons can the first energy level hold?

- 1
- **2**
- 8
- 0

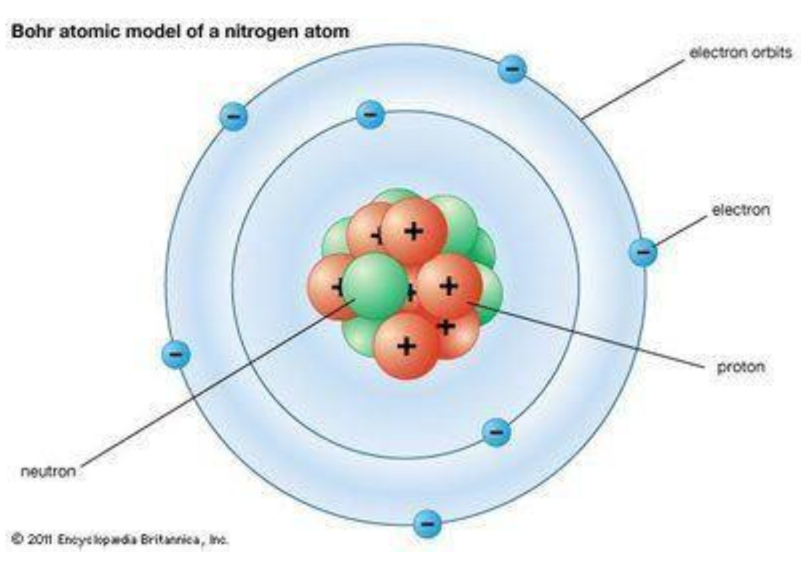
10. An orbital can at most hold how many electrons?

- 1 electron
- **2 electrons**
- 3 electrons
- 4 electrons

11. The electron configuration of an atom is $1s^2\,\mathbf{2}s^2\,\mathbf{2}p^6$. The number of valence electrons in the atom is

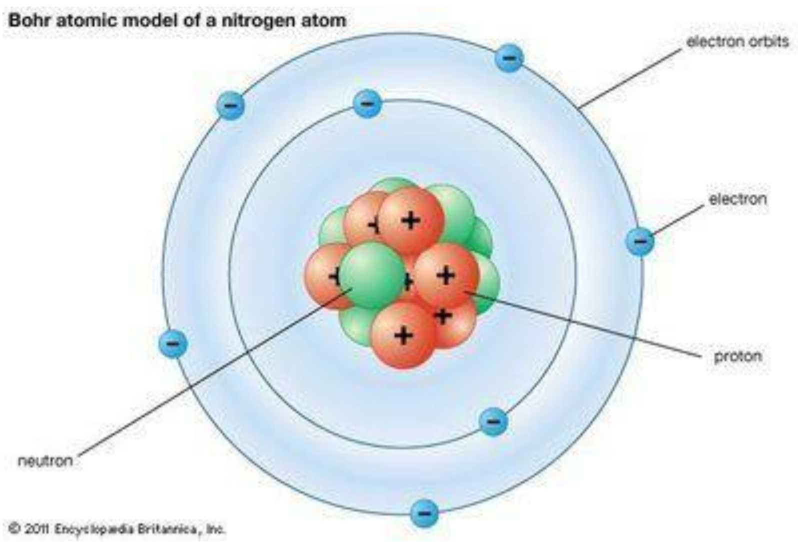
- 3
- 6
- **8**
- 10

12. What atom is represented here?

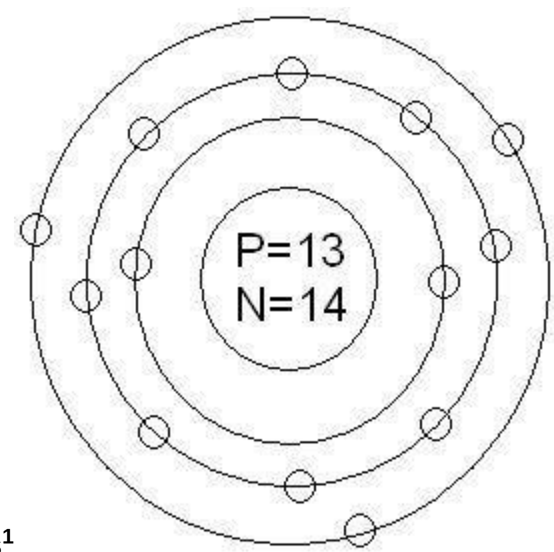


- Carbon
- **Nitrogen**
- Oxygen
- Fluorine

13. How many valence electrons are represented here?



14. What is the highest occupied energy level?



^{11}Na $1s^2$ $2s^2$ $2p^6$ $3s^1$

$^{10}Na^{+}$: $1s^2\ 2s^2\ 2p^6$

^{17}Cl : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

$^{18}Cl^{-1}$: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Quantum Numbers

Name	Symbol	Orbital meaning	Range of values	Value examples
Principal quantum number	n	shell	1 ≤ n	n = 1, 2, 3, …
Azimuthal quantum number (angular momen ...	ℓ	subshell (s orbital is listed as 0, p or ...	0 ≤ ℓ ≤ n − 1	for n = 3: ℓ = 0, 1, 2 (s, p, d)
Magnetic quantum number (projection of a ...	mℓ	energy shift (orientation of the subshel ...	−ℓ ≤ mℓ ≤ ℓ	for ℓ = 2: mℓ = −2, −1, 0, 1, 2
Spin quantum number	ms	spin of the electron (− 1 / 2 = "spin do ...	−s ≤ ms ≤ s	for an electron s = 1 / 2, so ms = − 1 / ...

Examples

1- What are the quantum numbers of latest electron in Carbon (^{6}C).

Answer:

^{6}C: $1s^2\ 2s^2\ 2p^2$

n=2, l= 1, ml= 0, ms=+1/2 Px^1 Py^1 pz

-1 0 +1

2. What is the maximum number of orbitals with:

Answer

n = 4, l = 1 4P

n = 2, l = 2 (No energy level in orbital 2d)

n = 3, l = 2 3d

n = 5, l = 1, ml = -1 $5p(^{1or4)}$

n = 5, l = 1, ml = -1, ms=1/2 $5p^1$

4- Which orbitals cannot exist?

2p , 3p, 4d, 3f, 6s, 2d

Answer: **3f, 2d**

5- Write the quantum numbers of latest electron in ^{30}Zn

^{30}Zn : $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$ $\mathbf{3d}^{10}$

n=3, l= 2, ml=+2, ms=-1/2 -2^{11} -1^{11} 0^{11} 1^{11} 2^{11}