Quantum number, Electronic configuration and Shape of orbitals

1. **Be's 4th electron quantum numbers**

Beryllium (Be) has atomic number 4 → 4 electrons.
Electron configuration: **$1s^2\ 2s^2$**
1st electron → 1s
2nd electron → 1s
3rd electron → 2s
4th electron → 2s
For the 4th electron:
n (principal quantum number) = 2 (since it's in 2s)
l (azimuthal quantum number) = 0 (s-orbital)
m_l (magnetic quantum number) = 0 (s-orbital has only one orientation)
s (spin quantum number) = –1/2 (since the first electron in 2s is +1/2, the second must be –1/2 by Pauli exclusion)
So, correct option: **(c) 2, 0, 0, –1/2**

2. **(a) Principal quantum number**
Quantum number specifying location and energy of an electron
n (principal quantum number) → determines **energy level and approximate distance from nucleus**
l (azimuthal quantum number) → determines **shape of orbital**
m_l (magnetic quantum number) → determines **orientation of orbital**
s (spin quantum number) → determines **spin orientation**
So, the quantum number that specifies **location and energy**:

3. (b) The shape of an orbital is given by azimuthal quantum number $'l'$.

4. **(d) Pauli's exclusion principle**

Explanation:

Each electron in an atom is uniquely described by four quantum numbers: **n, l, m_l, s**.
No two electrons can have the exact same set of all four quantum numbers.
Other options for clarity:
Hund's rule → electrons fill degenerate orbitals singly first, with parallel spins.
Aufbau principle → electrons fill orbitals starting from lowest energy.
Uncertainty principle → we cannot simultaneously know exact position and momentum of a particle.

5. (c) Hund's rule states that pairing of electrons in the orbitals of a subshell (orbitals of equal energy) starts when each of them is singly filled.

6. (c) $1s^2, 2s^2, 2p^6$ represents a noble gas electronic configuration.

7. (c) The electronic configuration of *Ag* in ground state is $[Kr]4d^{10}5s^1$.

8. (a) *n*, *l* and *m* are related to size, shape and orientation respectively.

9. (a) Electronic configuration of $Rb_{(37)}$ is
$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$
So for the valence shell electron $(5s^1)$

$n = 5, l = 0, m = 0, s = +\frac{1}{2}$

10. (a) 3*d* subshell filled with 5 electrons (half-filled) is more stable than that filled with 4 electrons. $1{,}4s$ electrons jumps into $3d$ subshell for more sability.

11. (c) In 2*p* – orbital, 2 denotes principal quantum number (n) and p denotes azimuthal quantum number $(l = 1)$.

12. (c) Electronic configuration of H^- is $1s^2$. It has 2 electrons in extra nuclear space.

13. (a) The electronic configuration must be $1s^2 2s^1$. Hence, the element is lithium $(z = 3)$.

14. (a) Principal quantum no. tells about the size of the orbital.

15. (d) An element has the electronic configuration $1s^2, 2s^2 2p^6, 3s^2 3p^2, (Si)$. It's valency electrons are four.

16. (c) The magnetic quantum number specifies orientation of orbitals.

17. (c) If $l = 2, m \neq -3. = (-e$ to $+e)$.

18. (d) If $n = 3$ then $l = 0,1,2$ but not 3.

20. (c) Atomic number of *Cu* is $29 = (Ar)4s^1 3d^{10}$.

21. (c) The shape of $2p$orbital is dumb-bell.

22. (a) When the value of $n = 2$, then $l = 1$ and the value of $m = -1, 0, +1$ *i.e.* 3 values.

23. (c) $Cr_{24} = (Ar)3d^5 4s^1$ electronic configuration because half filled orbital are more stable than other orbitals.

24. (d) *Kr* has zero valency because it contains 8 electrons in outermost shell.

25. (c) 2 electron in the valence shell of calcium $Ca_{20} = (2,8,8,2)$.

26. **(c) 4**

Carbon (C) has atomic number 6 → 6 electrons.

Electron configuration: **$1s^2\ 2s^2\ 2p^2$**
Valence electrons are the electrons in the **outermost shell** (highest principal quantum number, n).

For carbon, the outermost shell is **n = 2**, which contains **2 electrons in 2s + 2 electrons in 2p = 4 electrons**.

27. (b) Value of $l = 1$ means the orbital is *p* (dumb-bell shape).

28. (d) Cr has $[Ar]4s^1 3d^5$ electronic configuration because half filled orbital are more stable than other orbitals.

29. : **(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$**

Electronic configuration of calcium ion (Ca^{2+})

Calcium (Ca) has atomic number **20** → 20 electrons
Neutral Ca electron configuration: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$**
Ca^{2+} → loses **2 electrons** → these come from the outermost shell ($4s^2$)
So, **Ca^{2+} configuration:**
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$

30. **(b) $s^2\ p^6$**
Structure of external most shell of inert gases
Inert gases (noble gases) have a **completely filled outermost shell**.
For **main group inert gases**, the outermost shell is:
$s^2\ p^6$ (except helium, which is s^2)
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