Quantum number, Electronic configuration and Shape of orbitals

91. (d) $l = 3$ means *f* subshell maximum number of e^- in *f* subshell = 14.

92. **(a) Cu^+** → Cu (Z = 29) → Cu^+ has 28 electrons

93. (b) As per Aufbau principle.

94. (b) $l = 0$ is *s*, *l* = 1is *p* and $l = 2$ is *d* and so on hence spd may be used in state of no..

95. (d) For $4d, n = 4, l = 2, m = -2, -1, 0, +1, +2,\ s = +\frac{1}{2}$.

96. (d) *m* cannot be greater than $l(= 0,1)$.

97. (a) For $n = 1, l = 0$.

98 **(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$**

Iron (Fe) atomic number = 26

Neutral Fe configuration: **[Ar] $4s^2\ 3d^6$** → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

Fe^{3+} ion:

Fe^{3+} → loses **3 electrons**

Electrons are removed first from 4s, then from 3d if needed:

Remove 2 from 4s → $4s^0$, $3d^6$

Remove 1 from 3d → $3d^5$

So, Fe^{3+} configuration:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

99. (d) $Na_{11} = 1s^2 2s^2 p^6 3s^2$

$n = 3, l = 0, m = 0$ and $s = +\frac{1}{2}$.

100. (c) Recall about orbitals and nodes:

Total number of nodes = n−1n - 1n−1
Number of angular (non-spherical) nodes = l
Number of radial (spherical) nodes = n−l−1n - l - 1n−l−1
Given: 3p orbital
n = 3, l = 1 (p-orbital)
Total nodes = n - 1 = 3 - 1 = 2
Angular nodes = l = 1 → non-spherical node
Radial nodes = n - l - 1 = 3 - 1 - 1 = 1 → spherical node
So, 3p orbital has **1 spherical node and 1 non-spherical node**

101. (b) l = 1

4p sub-shell → n = 4, l = 1 (p-orbital)

Each electron in this sub-shell can have:
- **n = 4** → principal quantum number
- **l = 1** → azimuthal quantum number (p-orbital)
- **m_l = –1, 0, +1** → magnetic quantum number (orientation)
- **s = ±1/2** → spin

The question asks: **All electrons in 4p must be characterized by the quantum number(s)**

The **common quantum numbers for all electrons in 4p** are:
n = 4 and **l = 1** (m_l and s can vary)
Looking at options:
- n = 4, m = 0, s = ±1/2 → only one orbital, not all electrons
- l = 1 → correct, common for all electrons in p-sub-shell
- l = 0 → wrong, s-orbital
- s = ±1/2 → varies among electrons

102. (d) According to Aufbau's rule.

103. (a)

Permitted values of l and m for n = 3

Principal quantum number: n = 3
Azimuthal quantum number (l): 0 ≤ l ≤ n – 1 → l = 0, 1, 2
Magnetic quantum number (m_l): –l ≤ m_l ≤ +l

So:

l	**m_l values**
0	0
1	–1, 0, +1
2	–2, –1, 0, +1, +2

104 **(c) Number of possible spatial orientations**

Spatial orientation of an orbital is given by the **magnetic quantum number (m_l)**
Each m_l corresponds to one possible orientation in space.
Magnetic quantum number

105. (d) $2p_x, 2p_y, 2p_z$ sets of orbital is degenerate.

106. (a) Mg_{12} have $1s^2 2s^2 2p^6 3s^2$ electronic configuration

$n = 3, l = 0, m = 0, s = -\frac{1}{2}$.

107. (c) The principle quantum number $n = 3$. Then azimuthal quantum number $l = 3$ and number of orbitals $= n^2 = 3^2 = 9$. 3 and 9

108. (d) $\mathbf{29Cu = [Ar]3d^{10}4s^1, Cu^{2+} = [Ar]3d^9.4s^0}$.
Ground state of $Cu^{29} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ $Cu^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^9$.

109. **(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$**

Titanium (Ti) atomic number = 22

Neutral Ti has **22 electrons**

Fill orbitals according to **Aufbau principle**:

$1s^2$ → 2 electrons (total 2)
$2s^2$ → 2 electrons (total 4)
$2p^6$ → 6 electrons (total 10)
$3s^2$ → 2 electrons (total 12)
$3p^6$ → 6 electrons (total 18)
$4s^2$ → 2 electrons (total 20)
$3d^2$ → 2 electrons (total 22)

So, configuration: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$**

110. (d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ it shows electronic configuration of Iron.

111. (d) Orbitals are $4s, 3s, 3p$ and $3d.$ Out of these 3*d* has highest energy.

112. **(b) Azimuthal quantum number**

Shape of a subshell (s, p, d, f) is determined by the **azimuthal quantum number (l)**.

l = 0 → s (spherical)
l = 1 → p (dumb-bell)
l = 2 → d (cloverleaf)
l = 3 → f (complex shapes)

113. (c) For the $n = 2$ energy level orbitals of all kinds are possible $2^n, 2^2 = 4$.

114. (b) $n = 2$ than no. of orbitals $= n^2$, $2^2 = 4$

115. **(b) 0, 1, 2**

Possible values of azimuthal quantum number (l) for n = 3

Principal quantum number: n = 3
Azimuthal quantum number: l = 0, 1, 2, …, n–1
So, l = 0, 1, 2

116. **(b) l = 0,1,3; s = +1/2, (d) all are not correct**

l = 4 → allowed for n = 5 →correct

l = 0, 1, 3; s = +1/2 → **m_l = 3 not allowed for l = 0 or 1** →not correct

l = 3 → allowed for m_l = 3 →correct

All are correct → not correct

117. (c) Mg^+ → Mg^+ has 11 electrons → configuration $1s^2\ 2s^2\ 2p^6\ 3s^1$

118. (b) For both *A* & *B* electrons $s = -1/2$ & $+1/2$ respectively, $n = 3, l = 0, m = 0$

119. (a) According to Aufbau's rule.

120. (a) Possible number of subshells would be (6*s*, 5*p*, 4*d*).