Class- VIII

Quantum Numbers

Teaching Task

JEE Main Level

Q1) Ans:- B

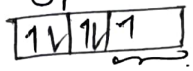
Solution:- Principal quantum Number → Size

Azimunthal quantum Number → Shape.

Magnetic quantum Number → Orientation.

Q2) Ans:- C.

Solution:- $Cl = 17 \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^5$



$n = 3$,

for p, $l = 1$.

$m = 1$.

Q3) Ans:- A, B.

Solution:- A) $Cr = 24 = [Ar]\, 3d^5 4s^1$.

For extra stability chromium filled 3d

B). Magnetic quantum number ranges from $-l$ to $+l$. So +ve values present

C). [Ag] = 47.

24 electron with spin $+\frac{1}{2}$

23 electron with spin $-\frac{1}{2}$

Q4) Ans:- A, D.

Solution:- Just like the earth rotates around its axis, the electron spins about its axis either clockwise & anti-clockwise manner. The two type of rotation are $+\frac{1}{2}$ and $-\frac{1}{2}$. These two quantum mechanical spin state which have no classical analogue

Q5) Ans:- A, B, C.

Solution:- $n=4$, $m=2$

Value of $l = 0$ to $(n-1)$ but $m=2$

$\therefore l = 2$ & 3 only.

Value of s may be $+\frac{1}{2}$ & $-\frac{1}{2}$

Q6) Ans:- A, C.

Solution:- Electronic Configuration of $Zn^{2+} = [Ar]\,3d^{10}$

$Cu^{+} = [Ar]\,3d^{10}$.

Zn^{+2} & Cu^{+} have a $3d^{10}$ Configuration, with '0' unpaired electrons. Hence their magnetic property same.

→ $Mn^{4+} = [Ar]\,3d^{3}$ $\quad Co^{2+} = [Ar]\,3d^{7}$

Mn^{4+} has $3d^3$ an Co^{2+} has $3d^7$, both have 3 unpaired electrons. Hence, they have same magnetic property.

Q7) Ans:- A, C.

Solution:- The magnitude of spin angular momentum of an electron is given by

$$\sqrt{S(S+1)}\frac{h}{2\pi}.$$

For a single electron $S=\pm\frac{1}{2}$ but for calculating spin angular momentum of an electron on positive value of s is taken

$$\sqrt{\frac{1}{2}\left(\frac{1}{2}+1\right)}\frac{h}{2\pi} = \frac{\sqrt{3}}{2}\times\left(\frac{h}{2\pi}\right)$$

Q8) Ans:- A.

Solution:- Orbital angular momentum of an electron $= \sqrt{l(l+1)}h$

1S & 3S $\rightarrow l=0$, so O.A.M of 1S & 3S = 0.

3d $\rightarrow l=2$.

O.A.M $= \sqrt{2(2+1)}\,h = \sqrt{6}\,h$

2P $\rightarrow l=1$, $\Rightarrow \sqrt{1(1+1)}\,h = \sqrt{2}\,h$.

Q9) Ans:- A.

Solution:- Rb (Z=37) = [Kr] $5s^1$.

$n=5$

$l=0$

$m=0$

$s=+\frac{1}{2}$

Q10) Ans:- B.

Solution:- $Zn^{+2} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$.

Zn^{+2} lost 2 electrons from 4s.

So there is no electrons in the 4th shell.

The number of electrons having the quantum numbers is zero

JEE ADVANCED LEVEL

Q11) Ans:- A, B, C.

Solution:- Magnetic quantum number 'm' signifies the no. of orientations of subshells.

→ It tells about the zeeman effect

Q12) Ans:- D.

Solution:- For $n=3$, $l = 0, 1, 2$.

'3' is not possible.

Q13) Ans:- A.

Solution:- l values are ranging from 0 to $(n-1)$

For $n=3$, l values 0, 1, 2.

Q14) Ans:- B.

Solution:- Magnetic quantum number gives orientation and it is denoted by 'm'.

Q15) Ans:- A.

Solution:- $Rb(Z=37) = [Kr]5s^1$.

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

Q16) Ans:- A.

Solution:- $Li(Z=3) = 1s^2 2s^1$

[1]

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

Integer Type

Q17) Ans:- 16.

Solution:- For $n=4$, 16 orbitals present

Total Electrons $= 2n^2 = 2(4)^2 = 32$

16 electron with spin $+\frac{1}{2}$

16 electron with spin $-\frac{1}{2}$

Q18) Ans:- $n=4,\ l=0,\ m=0,\ s=+\frac{1}{2}$ & $-\frac{1}{2}$

Solution:- $Co(Z=27) = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

[11]

$n=4,\ l=0,\ m=0,\ s=+\frac{1}{2}$ & $-\frac{1}{2}$

Matrix Matching

III. Ans:- a) B b) A c) C d). D.

Solution:-

a) Principal Quantum number → B) $2n^2$

b) Azimunthal Quantum number → A) Shape of orbitals.

c) Magnetic Quantum number. → c) m-Space Orientation.

d) Spin Quantum number → D) Spin of an electron.

Learners Task.

Q1) Ans:- D.

Solution:- Spin quantum number only tells about the spin of the electron, no the orbital itself.

Q2) Ans:- C

Solution:- For $n = 3$ $l = 0, 1, 2$.

If $l = 2$, $m = -2, -1, 0, +1, +2$

$m = -3$ not possible.

Q3) Ans:- D.

Solution:- Spin of electron is represented by spin quantum number.

Q4) Ans:- D

Solution:- The electrons occupying the same orbital have the same value for all quantum number except for Spin quantum number $\rightarrow +\frac{1}{2}$ and $-\frac{1}{2}$

Q5) Ans:- B.

Solution:- Na $(Z=11) = 1s^2\ 2s^2\ 2p^6\ 3s^1$ [1.]

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

Q6) Ans:- A

Solution:- $Z=17 \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^5$

$\boxed{\uparrow\downarrow\uparrow\downarrow\uparrow}$

$n=3$, $l=1$.

Q7) Ans:- B.

Solution:- $Na = 1s^2 2s^2 2p^6 3s^1$

$n=3$, $l=0$, $m=0$, $S=+\frac{1}{2}$

$AL = 1s^2 2s^2 2p^6 3s^2 3p^1 \rightarrow n=3, l=1, m=\pm1, S=+\frac{1}{2}$

$\boxed{\uparrow\ \ \ }$

$F[Z=9] = 1s^2 2s^2 2p^5 \rightarrow n=2, l=1, m=+1, S=+\frac{1}{2}$

$\boxed{\uparrow\downarrow\uparrow\downarrow\uparrow}$

$K[Z=19] = [Ar]\ 4s^1 \rightarrow n=4, l=0, m=0, S=+\frac{1}{2}$

Q8) Ans:- C

Solution:- Three quantum numbers (n, l, m) are required to define an orbital.

Q9) Ans:- +2

Solution:- For an orbital with $l \rightarrow m$ values ranging from $-l$ to $+l$

For $l=2$ & $S=+\frac{1}{2}$, $m \rightarrow \underline{+2}$

Q10) Ans:- C.

Solution:- Magnetic quantum number (m) determine orientation.

JEE Main level Questions

Q1) Ans:- D.

Solution:- $Na(Z=11) = 1s^2 2s^2 2p^6 3s^1$

l value for $s = 0$, S value $= \pm\frac{1}{2}$

Angular momentum $= \sqrt{S(S+1)}\,\frac{h}{2\pi}$

$= \sqrt{\frac{1}{2}\left(\frac{1}{2}+1\right)}\,\frac{h}{2\pi}$

$= \sqrt{\frac{1}{2}\left(\frac{3}{2}\right)}\,\frac{h}{2\pi}$

$= \frac{\sqrt{3}\,h}{4\pi}$

Q2) Ans:- C

Solution:- For $4f \longrightarrow n = 4$

$l = 0, 1, 2, 3$.

$m = -3, -2, -1, 0, +1, +2, +3$.

$s = \pm\frac{1}{2}$

So option 'c' has chance.

Q3) Ans:- B.

Solution:- $Cr(Z=24) = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 \underline{3d^5}$.

$l = 1$ means $p \rightarrow 12$ electron.

$l = 2$ mean $d \rightarrow 5$ electron

Q4) Ans:- A.

Solution:- iv) $n=3$, $l=2$, $m=1$ & v) $n=3$, $l=2$, $m=0$ described by the three quantum numbers will have the same energy in the absence of magnetic and electric field.

Q5) Ans:- C.

Solution:- n+l value high means it has higher energy level.

c) n=3, l=2, m=1, s=+1/2

n+l = 3+2 = 5 [High energy].

Q6) Ans:- B.

Solution:- A) n=4, l=1 → n+l=5.

B) n=4, l=0 → n+l=4.

c) n=3, l=2 → 3+2=5

D) n=3, l=1 → n+l=4.

D < B < C < A.

Q7) Ans:- C.

Solution:- Rb[Z=37] = [Kr]5s¹

n=5, l=0, m=0, s=+1/2

Q8) Ans:- A.

Solution:- Principal quantum number tells about size of the orbital.

Q9) Ans:- A.

Solution:- Possible values.

A) n=3, l=1, m=1, s=±1/2

Q10) Ans:- D.

Solution:- K = $2e^-$, L = $8e^-$, M = $9e^-$, N = $2e^-$

E.C = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

$l = 1$ means p electrons

Total p electron = 12.

Advanced Level Questions

Q11) Ans:- B, D.

Solution:-

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

For $n = 3$ l values 0, 1, 2

$n \neq l$.

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

For n, l values 0 to $n-1$ } Possible.

For l, m values $-l$ to $+l$ }

c) $n = 3$, $l = 1$, $m = 2$, $s = -\frac{1}{2}$ } not possible

For $l = 1$, m values $-1, 0, +1$ }

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

For $l = 0$, $m = 0$ }

Q12) Ans:- A.

Solution:- I, II, III are false.

Inert gases have a stable electronic structure, they have an extremely high ionization enthalpy. Valency of inert gas zero.

Q13) Ans:- A.

Solution:- The symbol m used to represent the magnetic quantum number that determines orbital orientation.

Q14) Ans:- C.

Solution:- Magnetic quantum number proposed by sommerfeld and introduced by zeeman. The degenerate orbitals in s-subshell is '1'

Q15) Ans:- 4

Solution:- Be = $1s^2$ $2s^2$ (↑↓)

For fourth electron,

$n = 2$

$l = 0$

$m = 0$

$s = -\frac{1}{2}$

Q16) Ans:- D.

Solution:- Quantum Numbers for 4d.

$n=4$, $l=2$, $m=-2,-1,0,+1,+2$ $s=\pm\frac{1}{2}$

D) $n=4$, $l=2$, $m=1$, $s=+1/2$ is possible.

Integer Type

Q17) Ans:- 1

Solution:- $Z=16 \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^4$

1↑↓	1	1

For 16th electron l value is '1'

Q18) Ans:- $\frac{1}{2}$

Solution:- Anticlock wise spin represented with $\frac{-1}{2}$

Matrix Matching

Q19) Ans:- A-A, B-B, C-C, D-D.

Solution:-

A) $n=4$, $l=2$, $m=0$ → A) $4dz^2$

B) $n=3$, $l=1$, $m=\pm1$ → B) $3P_x$ (@1) $3P_y$.

c) $n=4$, $l=0$, $m=0$ → c) 4S

D) $n=3$, $l=2$, $m=\pm2$ → D) $3d_{xy}$.

Q20) Ans:- A-A, B-B, C-C, D-D.

Solution:-

A) No. of values of l for an energy level (n) →

A) 0, 1, 2 - - - - $(n-1)$

B) Values of m for a particular type of orbital.

B) $+l$ to $-l$. through zero.

c) No. of values of m for $l=2$

c) $m = -2, -1, 0, 1, 2 \rightarrow$ total = 5.

D) Values of m for a particular type of orbital.

D) m value depends on 'l'