

Class - VIII

Quantum Numbers

Teaching Task

JEE Main Level

Q1) Ans:- B

Solution:- Principal quantum Number $\rightarrow$ Size
Azimuthal quantum Number $\rightarrow$ Shape.
Magnetic quantum Number $\rightarrow$ Orientation.

Q2) Ans:- C.

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

1	↓	↑	↓	↑
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$n = 3,$
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 or anti-clockwise manner. The two types of rotation are $+\frac{1}{2}$ and $-\frac{1}{2}$. These two quantum mechanical spin states which have no classical analogue.

Q5) Ans:- A, B, C.

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

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

$\therefore l=2$ or 3 only.

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

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.

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

Mn^{4+} has $3d^3$ and 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 a 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 $\rightarrow l=2$.

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

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

Q9) Ans:- A

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

$$n=5$$

$$l=0$$

$$m=0$$

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

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 electron 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:- $Li(z=3) = 1s^2 2s^1$

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

Integer Type

Q17) Ans:- 16.

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

$$\text{Total Electrons} = 2n^2 = 2(4)^2 = 32$$

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

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

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

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

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

Matrix Matching

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

Q19) Solution:-

a) Principal Quantum number $\rightarrow$ B) $2n^2$

b) Azimuthal Quantum number $\rightarrow$ A) Shape of orbitals.

c) Magnetic Quantum number $\rightarrow$ C) m-Space Orientation.

d) Spin Quantum number $\rightarrow$ D) Spin of an electron.

Learners Task.

Q1) Ans:- D.

Solution:- Spin quantum number only tells about the spin of the electron, not 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 values for all quantum numbers except for spin quantum number $\rightarrow +\frac{1}{2}$ and $-\frac{1}{2}$

Q5) Ans:- B.

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

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

$Al = 1s^2 2s^2 2p^6 3s^2 3p^1 \rightarrow n=3, l=1, m=\pm 1, s=+\frac{1}{2}$
 $\boxed{\uparrow\downarrow\downarrow}$

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

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

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 $+l$

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

Q10) Ans:- C.

Solution:- Magnetic quantum number (m) determines orientation

JEE Main Level Questions

Q1) Ans:- B.

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

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

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

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

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

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

Q2) Ans:- C

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

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

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

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

So option 'c' has chance.

Q3) Ans:- B.

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

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

$l=2$ means $d \rightarrow 5$ electrons

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

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

Q6) Ans:- B.

Solution:- A) $n=4$, $l=1 \rightarrow n+l=5$.

B) $n=4$, $l=0 \rightarrow n+l=4$.

C) $n=3$, $l=2 \rightarrow 3+2=5$

D) $n=3$, $l=1 \rightarrow n+l=4$.

$D < B < C < A$.

Q7) Ans:- C.

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

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

Q8) Ans:- A.

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

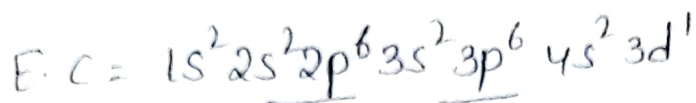
Q9) Ans:- A.

Solution:- Possible values.

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

Q10) Ans:- D.

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



$l=1$ 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 $n-1$

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

} Possible.

C) $n=3$, $l=1$, $m=2$, $s=\frac{1}{2}$

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

} not possible

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

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

} possible.

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:- B

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:- $\text{Be} = 1s^2 \underset{\boxed{\uparrow\downarrow}}{2s^2}$

For fourth electron,

$$n = 2$$

$$l = 0$$

$$m = 0$$

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

Q16) Ans:- D.

Solution:- Quantum Numbers for 4d

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

D) $n=4, l=2, m=1, s=+\frac{1}{2}$ is possible.

Integer Type

Q17) Ans:- 1

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

1	1	1
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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-1, B-2, C-3, D-4.

Solution:-

A) $n=4, l=2, m=0 \rightarrow 1) 4dz^2$

B) $n=3, l=1, m=\pm 1 \rightarrow 2) 3p_x \text{ (or) } 3p_y$

C) $n=4, l=0, m=0 \rightarrow 3) 4s$

D) $n=3, l=2, m=\pm 2 \rightarrow 4) 3dx^2y^2$

Q20) Ans:- A-1, B-2, C-3, D-4.

Solution:-

A) No. of values of l for an energy level (n) $\rightarrow$

$$1) 0, 1, 2, \dots, (n-1)$$

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

$$2) +l \text{ to } -l \text{ through zero.}$$

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

$$3) m = -2, -1, 0, 1, 2 \rightarrow \text{total} = 5.$$

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

$$4) m \text{ value depends on 'l'}$$

KEY

TEACHING TASK									
JEE MAINS LEVEL QUESTIONS									
1	2	3	4	5	6	7	8	9	10
B	C	A,B	A,D	A,B,C	A,C	A,C	A	A	B
JEE ADVANCED LEVEL QUESTIONS									
11	12	13	14	15	16	17	18		
A,B,C	D	A	B	A	A	16 $n=4, l=0, m=0, s=+1/2$ or $-1/2$			
19									
a-B, b-A, c-C, d-D									
LEARNERS TASK									
CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's									
1	2	3	4	5	6	7	8	9	10
D	C	D	B	A	B	C		2 C	
JEE MAINS LEVEL QUESTIONS									
1	2	3	4	5	6	7	8	9	10
B	C	B	A	C	B	C	A	A	D
JEE ADVANCED LEVEL QUESTIONS									
11	12	13	14	15	16	17	18	19	
B,D	A	B	C	4 D		1 ONE/TWCA-1,B-2,C-3,D-4			
20									
A-1,B-2,C-3,D-4									