Rules for filling electron:

- on the basis of Aufbau principle (which is a German word meaning build up) filling the electron in increasing order of energy.

- this principle includes following rules.
  → n+l rule
  → Hund's rule
  → Pauli exclusion principle
  → Stability of half and fully filled electron.

(a) n+l rule:

- relative order of energies of various sub-shell in multi-electron atom.

- sub-shell with lower (n+l) value has lower energy and should be filled first.

1s	1+0 = 0	5s	5+0 = 5
2s	2+0 = 2	5p	5+1 = 6
2p	2+1 = 3	5d	5+2 = 7
3s	3+0 = 3	5f	5+3 = 8
3p	3+1 = 4	6s	6+0 = 6
3d	3+2 = 5	6p	6+1 = 7
4s	4+0 = 4		
4p	4+1 = 5		
4d	4+2 = 6		
4f	4+3 = 7		

- 1 = s
- 2 = s, p
- 3 = s, p
- 4 = s, p, d
- 5 = s, f, d, p
- 6 = s, f, d, p
- 7 = "

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d
7s 7p

(b) Hund's rule:

- no electron pairing takes place in orbitals in sub-shell until each orbital is filled with one electron of parallel spin.
- half filled and fully filled are most stable i.e. p^3, p^6, d^5, d^{10}, f^7 and f^{14}.

eg: $_9F \longrightarrow$ [↑↓] [↑↓] [↑↓ ↑↓ ↑] $\qquad$ $_5N \longrightarrow$ [↑↓] [↑↓] [↑] [↑] [↑]

$1s^2$ $2s^2$ $2p^5$ $\qquad$ $1s^2$ $2s^2$ $2p^3$

$_{18}Ar \longrightarrow$ [↑↓] [↑↓] [↑↓ ↑↓ ↑↓] [↑↓] [↑↓ ↑↓ ↑↓]

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

(c) Pauli exclusion:

- no electron in an atom can have same quantum number set.; in case, p, l and m are same s will be different due to $+1/2$ & $-1/2$ spin.

eg: $_1He =$ [↑↓] $\longrightarrow$ p=1 l=0 m=0 s=$+1/2$

$1s^2$ p=1 l=0 m=0 s=$-1/2$

(d) Half filled and fully filled:

- half filled and fully filled orbitals are most stable one comparison to others.
i.e.; s^2 ; p^3 , p^6 , d^5 , d^{10} , f^7 , f^{14} .

eg:- $1s^2$ (He) $2p^3$ (N) $3p^6$ (Ar) $3d^5$ (Mn) $3d^{10}$ (Zn)

Schrodinger wave equation:

- mathematically Schrodinger wave Equation can be written as:

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0$$

here: i) ψ (psi) - (represent wave function.)
(amplitude of wave.)
(describe about orbitals.)

ii) m (mass of microscopic particle).
iii) E (total energy)
iv) V (potential energy)

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} - \frac{8\pi^2 m}{h^2}(V-E)\psi = 0$$

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} = \frac{8\pi^2 m}{h^2}(V-E)\psi$$

→ Ψ (psi) represents the Orbits. ($\Psi_{n,l,m}$)

Q: 39 Identify the valid and invalid wave function.
(a) $\Psi_{1,0,0}$ for 1s
(b) $\Psi_{1,2,1}$ for 1d
(c) $\Psi_{2,0,1}$ for 1s.
(d) $\Psi_{2,1,-1}$ for 2p_x

⟹ (a) n=1 l=0 m=0 (1s)
Valid.

(b) n=1 l=2 m=1 (1d)
l>n (x) invalid.

(c) n=2 l=0 m=1 (1s)
m>l (x) invalid.

(d) n=2 l=1 m=-1 (2p)
-1 0 1.
[ ] [ ] [ ] · 2px valid.

⟹ Representation of different graph:

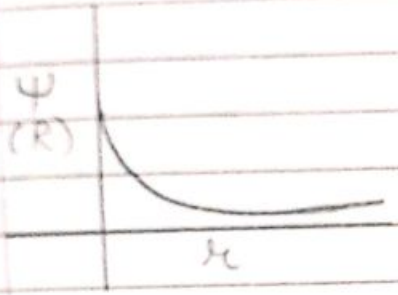
1.) Ψ or R (wave function) vs Radial distance (r).

2.) Ψ^2 or R^2 (probable density of electron) vs Radial distance (r)

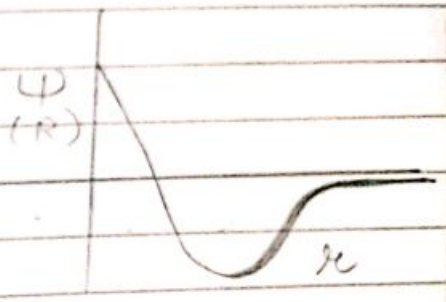
3.) $4\pi r^2 R^2$ (radial probable density) vs Radial distance (r)

(a) Ψ vs r ⟶ It is only negative (-ve).

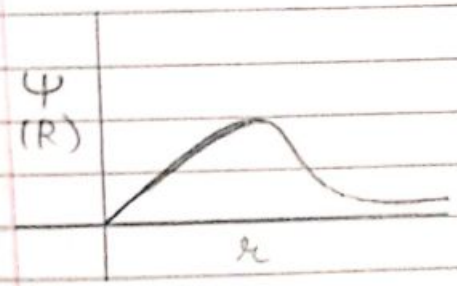
1) 1s (Rad. node = 0)



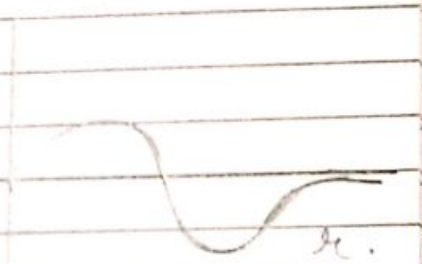
2) 2s (Rad. node = 1)



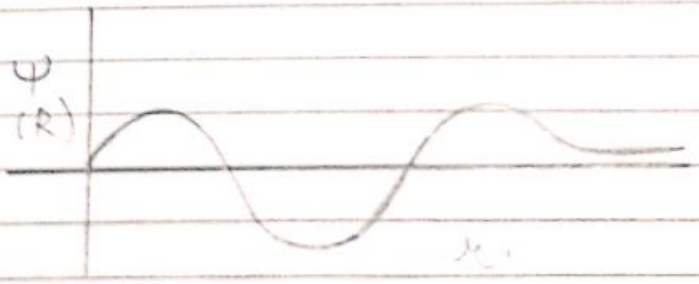
2) 2p (Rad. node = 0)



3) 3p (Rad. nod = 1 (3-1-1))

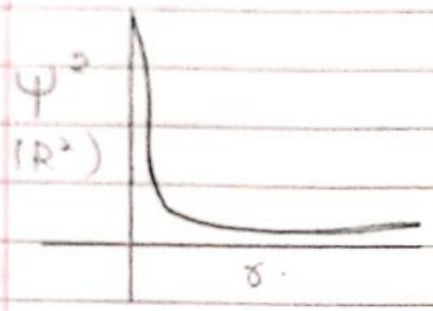


5) 4p (Rad. node = 2 (4-1-1))

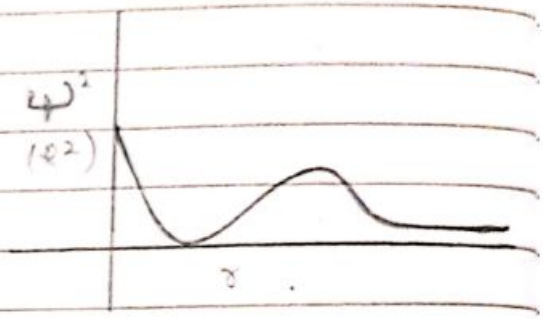


(b) ψ^2 VS r ⟶ always (+ve) positive.

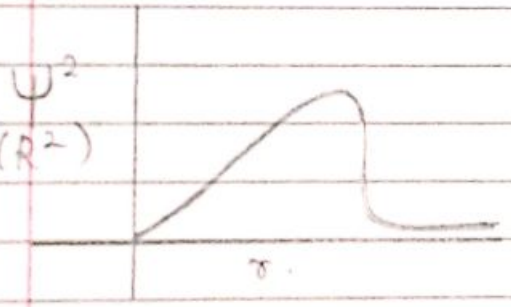
1) 1s



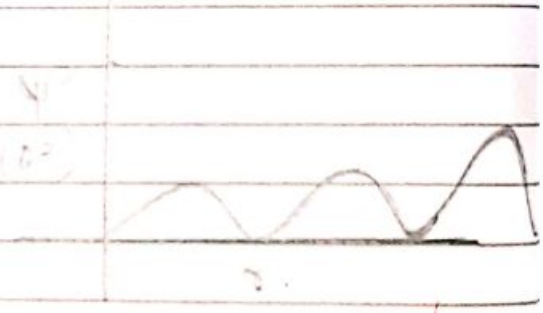
2) 2s.



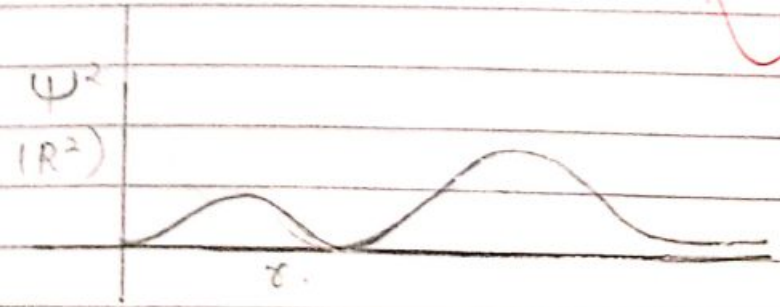
3) 2p



4) 4p

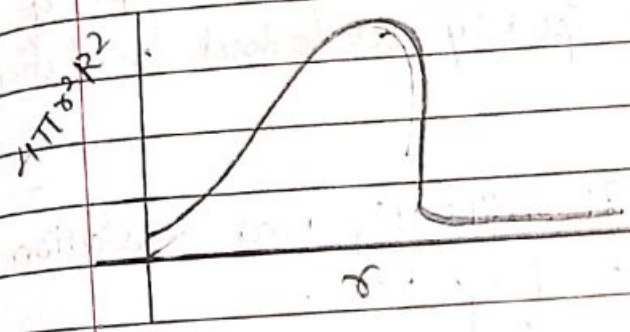


5) 3d.

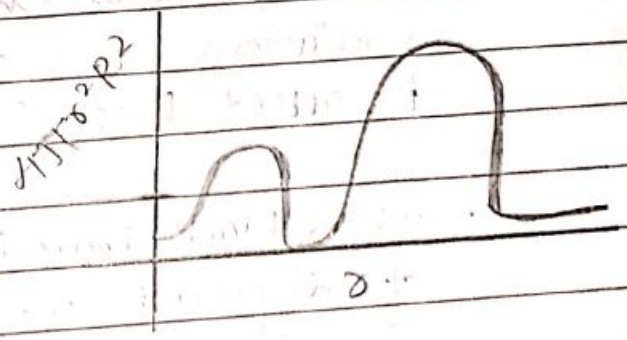


c) $4\pi r^2 R^2$ Vs r (here s, starts from bottom)

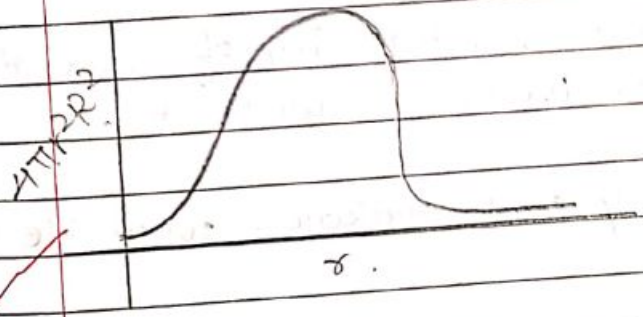
1) 1s



2) 2s.



3) 2p



4) 4p.

Q40 what is the ratio of De Broglie wavelength for electron accelerated through 200 volts and 50 volts.

$$\Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{\frac{h}{\sqrt{2me(200)}}}{\frac{h}{\sqrt{2me(50)}}}$$

$$\sqrt{\frac{200}{50}} \quad \sqrt{\frac{1}{4}}$$

$$\sqrt{4} \quad \sqrt{\frac{1}{4}}$$

$$\boxed{1:2}$$

Q40

PAGE NO.:

Black Body Radiation:

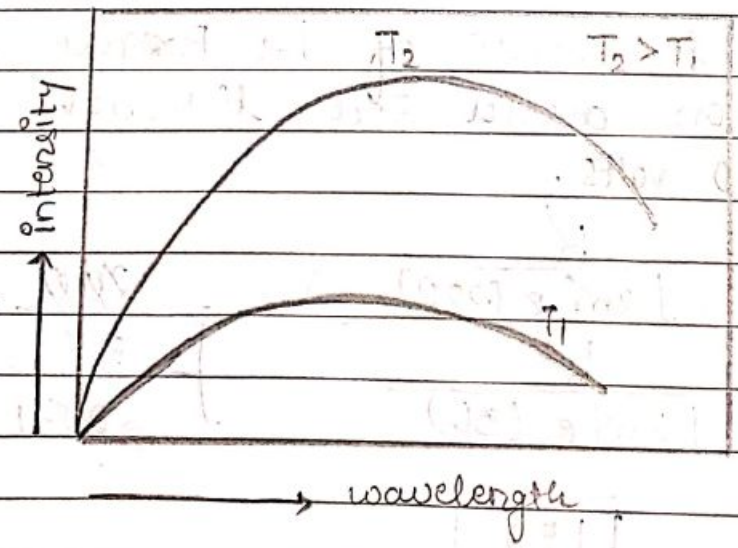
- a body that is capable of absorbing all types of radiations and emits completely absorbed radiation. is called black body.

- when black body heated, it emits thermal radiation of different wavelength or frequencies.

- at given temperature, intensity of radiation increases with wavelength reaches maximum and then decrease

- when temperature increases, intensity of radiation will be more towards lower wavelengths.

- when solids heated, they emit radiation over wide range of wavelength.



* Millikan Oil drop:

- Millikan determined charge of electron by an oil drop experiment.

→ concluded that magnitude of electrical charge, q, on droplets is always an integral multiple of electrical charge, e, that $q = ne$, where $n = 1, 2, 3, \ldots$

charge on oil drops always an integral multiple of $1.6 \times 10^{-19} C$.

$$me = \frac{e}{e/me} = \frac{1.6 \times 10^{-19}}{1.7588.20 \times 10^{11}\ Ckg^{-1}} \longrightarrow 9.1094 \times 10^{-31} kg$$

$$\left[Q.E = m.g \implies Q = \frac{m.g}{E} \right]$$