Date:________ M T W T F S

Atomic structure

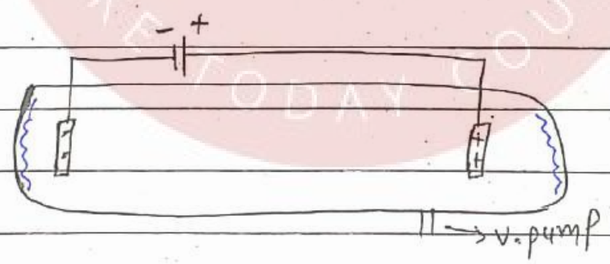
① Iso-electronic specie:

* Same electrons
* Same E.C
* (es in shell) Same electronic structure
* Same valence es
* Chemical properties different.

⇒ $_{11}Na^{+1}$ → 10 es, $_{10}Ne$ → 10 es, $_8O^{-2}$ → 10 es, $_9F^{-1}$ → 10 es

* Discharge Tube experiment

Apparatus:



* Glass tube
* electrodes → cathode, → Anode
* Vaccum pump = Reduced pressure.
* D.C source → $\boxed{\text{ionization, create P.D, acceleration}}$
* Flourosence screen (ZnS)

Detect cathode rays/ es

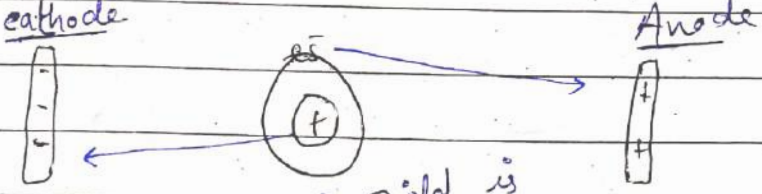
pressure → means No. molecules.
$P\uparrow R\uparrow$

Date:________ M T W T F S

Condition:

High voltage & low pressure.

Voltage:



when $V\uparrow$ → electric field is produced around both electrodes & cathode repels the e^-s & attract the nucleus.

* ionize gas
* accelerate the e^-s → to enhance penetration of e^-s in electrode

Depend:

$\boxed{\text{voltage} \propto \text{length of tube}}$

$\boxed{\text{Voltage} \propto \text{pressure inside}}$

$\boxed{\text{voltage} \propto Z}$

$\boxed{\text{Voltage} \rightarrow \text{depend on Nature of gas.}}$

(#) Pressure:

↳ * Low pressure (To enhance the flow of e^-s)

means ↳ * No. gas molecules.

Mechanism:

$H_2 \xrightarrow{\text{atomization}}$ energy require ΔH_{atm} ↳ enthalphy of atomization.

$H \{ H \xrightarrow{\text{atomization}} 2H$ → atom

enthalpy of ionization ← $H \longrightarrow H^+ + \bar{e}$

Result	pressure	Voltage
NiL	Normal pressure	5000 V
glow produced	0.1 atm	10,000 V
No glow / Rays are produced + Flourosence on P. film	~~0.1~~ 0.01 atm	10,000 above

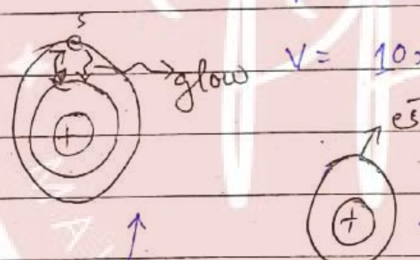
Working:

① **Step = 1**

- P = 1 atm
- V = 5000 V
  - → Nothing happens
  - → R ⇑
  - → Air is bad conductor.
  - → No ionization &
  - → No Flourosence.

② **Step #2:**

- P = 0.1 mm Hg
- V = 10,000 V



$\oplus \longrightarrow \oplus + e^-$

→ Excitation > ionization

Excitation ↓ glow

ionization ↓ Flourosence is produced

- * glow > Flourosense
- * color of glow → depend on gas.
- * plasma is created
- * electrical conductivity ⇑
- * electrical Resistance ⇓

- * Neutral atom,
- * cation,
- * e^-

Date:

(M)(T)(W)(T)(F)(S)

Step # 3:

$P = 0.01\ mmHg$

$V = 10{,}000$

→ * ionization > excitation.

* Flourosence > glow.

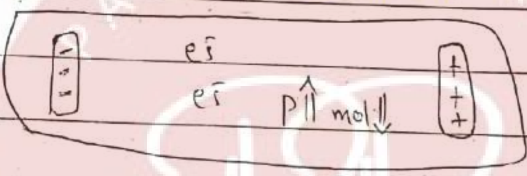
* tube become dark called

⇓

$\boxed{\text{Crook's dark spaces}}$

* invisibe rays are produced.

* electrical $R \Uparrow$ → b/c



No # molecule ⇓

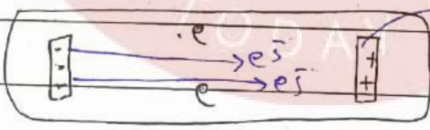
so No # e⁻ ⇓

$I \rightarrow \Downarrow$

Step # 04:

To maintain I

$V \Uparrow$



→ withdraw e⁻ from cathode.

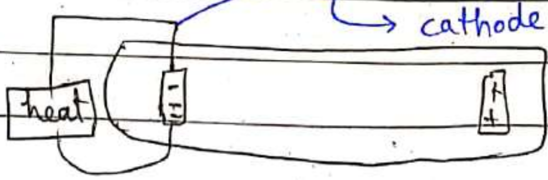
Source of cathode rays

Cold cathode:

→ ionization of gas.

Hot cathode: → ionization of gas.

→ cathode heat (Thermionic emission)



Date: ______

M T W T F S

No # Rays:

* cathode Rays
* Anode Rays
* X-rays

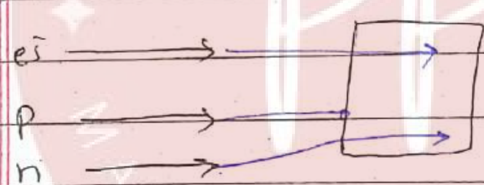
Velocity of ~~canal~~ rays:

$\boxed{\text{velocity} \propto \text{voltage}}$

Properties of Cathode Rays

(I) P. Power:

order



$\boxed{n > e^- > p}$

$\boxed{P.P \propto \text{velocity}}$

$\boxed{P.P \propto \frac{1}{\text{charge}}}$

$\boxed{P.P \propto \text{momentum}}$

(*) I.P:

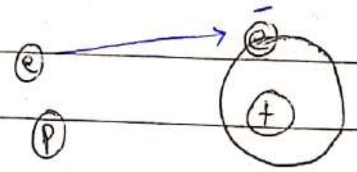
$\boxed{I.P \propto \text{charge}}$

$\boxed{I.P \propto \text{velocity}}$

$\boxed{I.P \propto \text{size}} \rightarrow$ comparable

P not

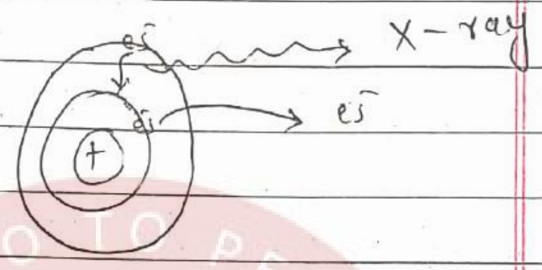
Date: M T W T F S



$\boxed{\alpha > e^- > p \approx N}$

No I.Z

* X-ray production:



Condition:

both by $\boxed{es}$ ← { penetration power, I.P }

* produced by only es

Chemical properties — losing of es

Reducing power:

p.p

$e^- \longrightarrow Na \longrightarrow Na^+ + e^-$

penl

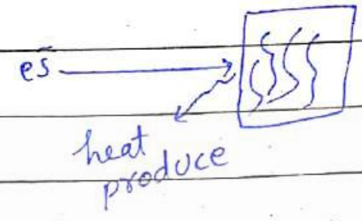
Oxidizing Power — penetrat

$e^- \longrightarrow Na \longrightarrow Na$

Date:

M T W T F S

Heating effect:



K.E → Thermal energy.

Straight Line:

straight line b/c it produce shadow of opaque particle.

Particle nature:

b/c it rotates the pin wheel.

charge in Nature:

helical motion in magnetic field.

* They have −ve charge
  ⇓
  deflect toward +ve plate in electric field.

* Mass:

$1P = 1836\ e^-$

$\boxed{nP = n \times 1836\ e^-}$

$1N = 1842\ e^-$

$\boxed{nN = n \times 1842\ e^-}$

Date:

M T W T F S

e/m of Cathode rays:

b/c e^- is universal particle of all atom.

- ★ independant of Nature of gas.
- ★ " " " voltage.
- ★ " " " length of tube.

$\boxed{e/m = 1.7588 \times 10^{11} \ C/kg}$ → for one e^-

$\boxed{1 \text{Kg of } e^- = 1.7588 \times 10^{11} \ C}$

$\boxed{1 \text{g of } e^- = 1.7588 \times 10^{8} \ C}$

$mg = 10^{-3}$

$\boxed{1 \text{mg of } e^- = 1.7588 \times 10^{5} \ C}$

~~mass = no e^-~~

$\boxed{\text{Charge} = \text{mass(Kg)} \times 1.7588 \times 10^{11} \ C}$

$\boxed{\text{charge} = \text{mass(g)} \times 1.7588 \times 10^{8} \ C}$

$\boxed{\text{mass(Kg)} = \frac{\text{charge given}}{1.7588 \times 10^{11}}}$

$\boxed{\text{mass(g)} = \frac{\text{Charge given}}{1.7588 \times 10^{8}}}$

Date:

M T W T F S

$\boxed{e/m \text{ of } n\bar{e}s = \frac{No \# of}{\bar{es}} \times 1.7588 \times 10^{11} \ C/kg}$

Q# e/m of 10 $\bar{es}$ is equal to:

$\boxed{e/m = 1.7588 \times 10^{12} \ C/Kg}$

Charge on Electron

* Millikan ⟶ in oil drop experiment.

$\boxed{\text{charge on } \bar{es} = \text{Smallest charge on oil drops}}$

$Q = ne$ (Q = charge on oil drop)

Q# oil drops has charge -2, -4, -6, -8C then charge on $\bar{es}$

$\underbrace{-2, -4, -6, -8C}$ ⟶ all are integral multiple of first.

$Q = ne$

$Q = 2 \times -2 = -4C$

$Q = 3 \times -2 = -6C$

$Q = 4 \times -2 = -8C$

Charge:

* $1\bar{es} = 1.602 \times 10^{-19}C$ (columbic charge)

$1es = -4.8 \times 10^{-10} esu$

Not actual charge

* $1\bar{es} = -4.8 \times 10^{-10} esu$ (elctrostatic charge)

* $1\bar{es} = -1$ (unit charge)

Date: M T W T F S

* 1 mole e^- = 96500 C

* ~~1 mole e^- = 1 Faraday~~

$$\boxed{O^{-1} = \overset{-1.602 \times 10^{-19} C}{O}}$$

$$\boxed{\begin{aligned} \text{Charge} &= \text{No \# } e^- \times 1.602 \times 10^{-19} C \\ &= 4.8 \times 10^{-10} esu \end{aligned}}$$

Columb & No # e^-:

$1 e^- = 1.602 \times 10^{-19} C$

$1 C = \dfrac{1}{1.602 \times 10^{-19} C}$

$1 C = 6.285 \times 10^{18} es$

$$\boxed{1 C = 625 \times 10^{16} e^-}$$

$$\boxed{\text{No \# } e^- = \text{columb's given} \times 625 \times 10^{16} e^-}$$

esu & columb:

$1.6 \times 10^{-19} C = 4.8 \times 10^{-10}$

$1 es = 1.6 \times 10^{-19} C$

$1 e^- = -4.8 \times 10^{-10} esu$

$$\boxed{1 C = 3 \times 10^{9} esu}$$

$$\boxed{1 esu = 0.33 \times 10^{-19} C}$$

Scanned with CamScanner

Date:

M T W T F S

Moles of e^-:

$1e^- = 1.602 \times 10^{-19} C$

$6.023 \times 10^{23} e^- = x$

$\boxed{1 \text{ mole } e^- = 96500 C}$

$\boxed{\text{charge} = \text{moles} \times 96500C} / 1F$

$\boxed{\text{Charge} = \frac{\text{mass}}{\text{molar mass}} \times 96500 / 1F}$

$\boxed{\text{charge} = \frac{\text{No. molecules}}{N_A} \times 96500 / 1F}$

$\boxed{\text{charge} = \frac{V}{V_m} \times 96500 / 1F}$

Q#: The charge on 0.5g of e^- is equal to

ⓐ $0.5 \times 96500 C$

✓ ⓑ $\frac{0.5 \times 96500}{0.00055}$ → $\boxed{\text{charge} = \frac{\text{mass}}{\text{Molar mass}} \times 96500}$

molar mass of e^-

ⓒ $\frac{0.5 \times 96500}{9.11 \times 10^{-31}}$ ⓓ All

Q# The charge on 10 e^- is:

$\boxed{\text{charge} = \frac{10}{N_A} \times 96500 C}$

Date:

M T W T F S

$$\text{No } \# \, e^- = \frac{\text{charge given}}{1.602 \times 10^{-19} C / -4.8 \times 10^{-19}}$$

Mass of e^-:

$$\boxed{1e^- = 9.11 \times 10^{-31} \, Kg}$$

$$\boxed{1e^- = 9.11 \times 10^{-28} \, Kg}$$

$$\boxed{1e^- = 0.00055 \, amu}$$

$$\boxed{1e^- = 5.5 \times 10^{-04} \, amu}$$

$$\boxed{1e^- = \frac{1}{1840} amu}$$

Molar mass of e^-:

moles of e^-

$$\boxed{1 \text{ mole } e^- = 0.0005 \, g}$$

$$\boxed{1 \text{ mole } e^- = 5.5 \times 10^{-4} \, g} = 5.5 \times 10^{-7} \, kg$$

$$\boxed{1 \text{ mole } e^- = \frac{1}{18400} \, g}$$

moles of e^-

$1e^- = 9.1 \times 10^{-28} \, g$

$N_A = x$

$x = N_A \times 9.1 \times 10^{-28} \, g$

$$\boxed{x = 0.00055 \, g}$$

$x = 1 \times 0.00055 \, g$

Date:

M T W T F S

$$\boxed{\text{Mass} = \text{Mole} \times 5.5\times10^{-4}\,g}$$

$$\boxed{\text{mass} = \frac{N}{N_A} \times 5.5\times10^{-4}\,g}$$

$$\boxed{\text{mass} = \frac{\text{mass}}{\text{Molar mass}} \times 5.5\times10^{-4}\,g}$$

Q# The mass of $10\,e^-$ is:

(a) $5.5\times10^{-3}\,g$ ✓(b) $\frac{5.5}{N_A}\times10^{-3}$

✓(c) $9.11\times10^{-30}\,kg$ (d) All

$$\text{mass} = \frac{10}{N_A} \times 5.5\times10^{-4}$$

$\text{mass} = 10\times9.11\times10^{-31}\,kg$ $\boxed{m = \frac{5.5\times10^{-3}}{N_A}}$

$$\boxed{\text{mass} = 9.11\times10^{-30}\,kg}$$

$$\text{Mass} = \text{No \# } e^- \times 5.5\times10^{-4}\,amu$$

$$\times\, 9.11\times10^{-31}\,kg$$

$$\times\, 9.11\times10^{-28}\,g$$

$1e^- = 0.00055\,amu$

$10 : x$

0.00055×10

$5.5\times10^{-3} \rightarrow amu$

$\frac{5.5\times10^{-3}}{N_A}$

$$\text{No \# } e^- = \boxed{\frac{\text{mass}}{5.5\times10^{-4}\,amu}}$$

$$\boxed{= \frac{\text{mass}}{9.11\times10^{-31}\,kg}}$$

$$\boxed{= \frac{\text{mass}}{9.11\times10^{-28}\,g}}$$

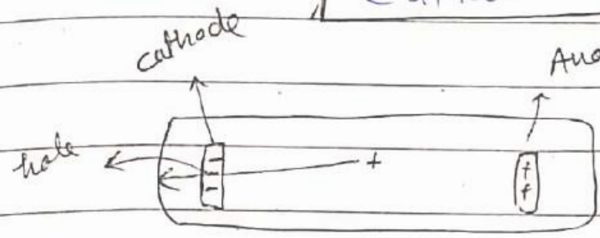
$P.P \propto \frac{1}{\text{charge}}$

Date:

Discovery of Proton

Apparatus ⟶ Same apparatus except

$\boxed{\text{Cathode}\ (-ve) \rightarrow \text{perforated}}$
↓
b/c proton has low P.P



Working ⟶ Same as es.

Properties:

Anode rays (look like to come from anode), Canal rays (Not in cox of H_2), Positive rays, proton rays (when H_2 ~~rays~~ gas used), Cationic ray (due to +ve charge),

Mass of Canal rays:

$\boxed{\text{Mass of canal rays} = \text{mass of proton}}$
(when H_2 used)

$\boxed{\text{Mass of canal rays} > \text{mass of proton}}$

$\boxed{\text{Mass of Canal rays} < \text{proton}}$

$\left(\text{Mass of canal rays} \propto Z \text{ or Molecular mass}\right)$

Scanned with CamScanner

Date: ______

M T W T F S

* Penetrating & ionizing power:
  ↳ No P.P & I.P

* X-rays:
  ↳ Not by proton rays.

* Composition:
  proton ⟶ made of $\boxed{\text{quarks}}$

* $1p = 1836 e^-$

$\boxed{np = n \times 1836 e^-}$

mass:

$\boxed{m_N > m_p > m_{e^-}}$

antineutrino

$\boxed{\text{mass of } N > \text{mass of } p \text{ by } m_{e^-} \text{ \& } m_{\bar{\nu}}}$

New lec

$\boxed{e/m \ \alpha \text{ charge}}$

$\boxed{e/m \ \alpha \text{ charge}}$

$\boxed{e/m \ \alpha \ \frac{1}{\text{mass}}}$ → same atoms.

different atoms & different charge

$e/m = \frac{\text{unit charge}}{\text{unit mass}}$ ✓

Date: M T W T F S

Comparison.

$$\frac{\text{Specie A}}{\text{Specie B}} = \frac{\text{unit charge}/\text{unit mass}}{\text{unit charge}/\text{unit mass}}$$

Q# The e/m of H^+ is how much that of α-particle.

$$\frac{H^+}{He^{+2}} = \frac{1/1}{2/4} = 2 \qquad \boxed{H^+ = 2He^{+2}}$$

Q# what is the order of e/m:

H^{+1}	He^{+1}	He^{+2}	Be^{+3}
$1/1$	$1/4$	$2/4$	$3/9$
1	0.25	0.5	0.33

$$\boxed{H^{+1} > He^{+2} > Be^{+3} > He^{+1}}$$

Q#

$Ne^{+1} < Ne^{+2} < Ne^{+3}$ — means charges same

Q# consider charge = same (1, 2, 3)

$* He > * CH_4 > * N_2 > * O_2 \rightarrow$ Neutral $\boxed{e/m}$ = 0

Q# min e/m ratio

a) He^{+1}	b) H^+	c) He^{+2}	d) Li
$1/4$	$1/1$	$2/4$	$0/0$
0.25	1	0.5	0

→ Neutral so $\boxed{q=0}$

$e/m = 1.75 \times 10^{11}$ C/Kg

$e/m\ P = 9.54 \times 10^{7}$ C/Kg

Date:________ M T W T F S

e/m ratio of proton:

$e/m = 9.54 \times 10^{7}$ C/Kg

$1Kg = 1.75 \times 10^{11}$ (10^8)

$1Kg$ of $p = 9.54 \times 10^{7}$ C

$1g$ of $p = 9.54 \times 10^{4}$ C

Q# W.O has max charge?

✓ (a) 1g e^- (b) 1g proton (d) Same (c) None

charge same but proto mass ↑

charge = mass(Kg) × 9.54×10^{7} C/Kg

charge = mass(g) × 9.54×10^{4} C/Kg

$$mass = \frac{charge}{9.54 \times 10^{7} C}$$

$$mass = \frac{charge}{9.54 \times 10^{4} C}$$

Charge on Proton:

$1p = 1.602 \times 10^{-19}$ C

$1p = 4.8 \times 10^{-10}$ e.s.u

$1p = +1$ (unit charge)

Date:

M T W T F S

1 mole of p = 96500 C

$\boxed{1 \text{ mole of } p = 1 F}$ X unit of electricity due to flow of e^- → so not used.

$\boxed{\text{Charge} = \text{No\# protons} \times 1.602 \times 10^{-19} C,\ 4.8 \times 10^{-10} esu}$

+1

$$\boxed{\text{No\# protons} = \frac{\text{charge given}}{1.602 \times 10^{-19} \text{ or } 4.8 \times 10^{-10} esu}}$$

Mass of Proton

$1p = 1.66 \times 10^{-27} kg$

$1p = 1.66 \times 10^{-24} kg$

$1p = 1.0073$ amu

$\boxed{1p \approx 1 \text{ amu}}$

Molar mass of proton

$1p = 1g$

$\boxed{1p = 1.0073 g}$

Date: M T W T F S

Mass = Mole given × 1g

1 mole e^- = 96500 C

1 mole p = 96500 C

m.m of e^- = 0.00055 g

$$\boxed{Mass = \frac{N}{N_A} \times 1g}$$

$$\boxed{Mass = \frac{Mass(protons)}{m.M} \times 1g}$$

$$\boxed{Mass = \frac{V}{V_m} \times 1g}$$

Discovery of Neutron

discover in this decay

Radioactivity

higher element

Artificial → unstable nuclei emit radiation → stable nuclei

Induced radioactivity → lower elements

Stable nucleus → unstable nucleus → emit Radiation.

* $\frac{n}{p}$ ratio = high
* $\frac{n}{p}$ ratio = very low

→ atom unstable → emits radiation.

Date:

M T W T F S

Decay

* α - Decay:

$$ {}^{A.N}_{x}X^{y = A.N} \longrightarrow {}_{x-2}X^{y-4} + {}_{2}He^{+2\,4} $$

$$ {}_{84}Po^{218} \longrightarrow {}_{82}Pb^{214} + {}_{2}He^{4} $$

* β - decay:

isobar produced

β = electron / Nuclear electron

$$ N \longrightarrow p^{+} + \bar{e} + \text{antineutrino} $$

is

$$ {}_{z}X^{y} \longrightarrow {}_{x+1}X^{y} + \bar{e} $$

$$ {}_{3}A^{6} \longrightarrow {}_{4}B + \bar{e} $$

P=3	P=4
N=3	N=2
Z=3	Z=4
A=6	A=6

(N — $\bar{e}$s + p + N

* Gamma decay

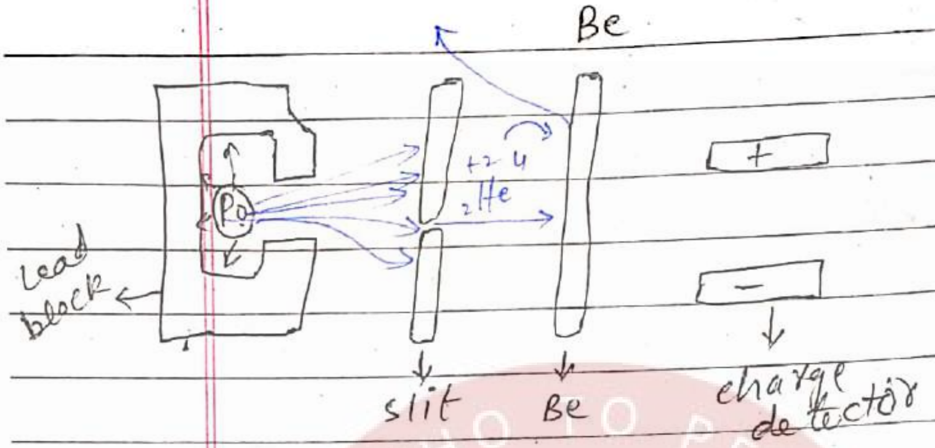
=> energy

$$ {}_{x}X^{y} \longrightarrow {}_{x}X^{y} + h\nu $$

less stable   more Stable → b/c it emitted energy

Date:

* Neutron produced due to α-decay



Lead block

* closely packed

* Focus alpha particle.

Slit.

Filter α-particle.

Po:

Source of α-particle.

unstable

$$^{218}_{84}Po \longrightarrow {}^{214}_{82}Pb + {}^{4}_{2}He^{+2}$$

$$_{4}Be^{9} + {}_{2}He^{4} \longrightarrow {}_{0}n^{1} + {}_{6}C^{12}$$

stuck in Be & become unstable

For stability ⟹ it emits particle

p.p ⇓

$p.p \propto \frac{1}{charge}$

Date: M T W T F S

new particle produced

Nuclear Rxns:

α- Bombarbed:

4 add in our release

$${}_{x}X^{y} + {}_{2}He^{4} \longrightarrow {}_{x+1}X^{y+3} + {}_{1}P^{1}$$

come here & emit one

$${}_{x}X^{y} + {}_{2}He^{4} \longrightarrow {}_{x+2}X^{y+3} + {}_{0}n^{1}$$

Neutron Bombarbed:

$${}_{x}X^{y} + {}_{0}n^{1} \longrightarrow {}_{x-2}X^{y-3} + {}_{2}He^{4}$$

$${}_{x}X^{y} + {}_{0}n^{1} \longrightarrow {}_{x+1}X^{y+1} + e\bar{s}$$

-ve β-decay

$$n = p + e\bar{s} + A\cdot\text{neutrino}$$

$${}_{x}X^{x} + {}_{0}n^{1} \longrightarrow {}_{x}X^{x+1} + \gamma$$

Date:________ New lec (M)(T)(W)(T)(F)(S)

~~MCQs~~.

1. Angle b/w vectors $\vec{A}$ & $\vec{B}$ is given by:

$$\boxed{\theta = \sin^{-1}\left(\frac{|\vec{A}\times\vec{B}|}{|\vec{A}||\vec{B}|}\right)}$$

MCQs:

if $|\vec{A}\times\vec{B}| = \sqrt{3}$ and $A=1$ $B=2$ then θ b/w A & B.

$\sin^{-1}\sqrt{\frac{3}{2}}$ $\boxed{60^\circ}$

2. Angle b/w vectors if D.P & Cross Pro are given

$$\boxed{\theta = \tan^{-1}\left(\frac{|\vec{A}\times\vec{B}|}{\vec{A}\cdot\vec{B}}\right)}$$

MCQs:

The magn of D.P & C.P of 2 vectors are $6\sqrt{3}$ and 6 respectively. Find the angle b/w $\vec{A}$ & $\vec{B}$.

$\boxed{\theta = 30^\circ}$

Date:

M T W T F S

(3) $V \cdot P \neq D \cdot P$

$\vec{A} \times \vec{B} \neq \vec{A} \cdot \vec{B}$

But magnitude $\longrightarrow$ can equal.

$|\vec{A} \times \vec{B}| = \vec{A} \cdot \vec{B}$

if $\theta = 45^\circ$

MCQs:

$\vec{\tau} = \vec{r} \times \vec{F}$ & $W = \vec{F} \cdot \vec{d}$

$\Downarrow$

$\vec{\tau} \neq W$

$\boxed{|\vec{\tau}| = W}$ if $\theta = 45^\circ$

MCQs:

$\hat{i} \cdot (\hat{k} \times \hat{i}) = \underline{\qquad}$. $\hat{j}$ $\hat{i} \times \hat{j} = 0$

$\hat{j} \cdot (\hat{k} \times \hat{j}) = \underline{\quad = 0 \quad}$. $\hat{i}$ $\hat{j} \times \hat{i}$

MCQs:

$\hat{i} \cdot (\hat{j} \times \hat{k}) = \underline{\quad 1 \quad}$. $\hat{i}$ $\hat{i} \parallel \hat{i} = \theta = 0^\circ$

(a) 0 (b) 1 ✓ (c) -1 (d) 2

Scanned with CamScanner

lie in same plane -

Date:______ M T W T F S

MCQs:

Three vectors $\vec{A}$, $\vec{B}$ & $\vec{C}$ are coplaner then $\vec{A}\cdot(\vec{B}\times\vec{C})$ is always zero B/C

get $\vec{D}$

$D \perp$ to $\vec{A}$

same plane as B & C.

$\boxed{\vec{B}\times\vec{C} \text{ is } \perp \vec{A}}$

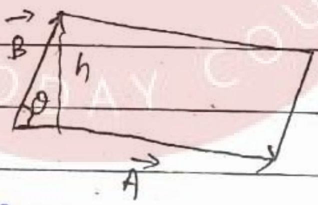
$\boxed{|\vec{A}\times\vec{B}| = \text{Plane Area}}$

if $A=B$ & $\theta=90^\circ$ ⇓ Area of Square

if $A\neq B$ & $\theta=90^\circ$ ⇓ Area of rectangle

if sides are equal (or) unequal & $\theta\neq 90^\circ$ ⇓ Area of parallelogram.

$\boxed{\text{having No } 90^\circ}$



Area of parallelogram $= l\times h$

$= l = \vec{A}$ $h = by$

* vector quantity
* its direction is normal to the plane

$\vec{A} = ABy\hat{n}$

$\boxed{A = AB\sin\theta\,\hat{n}}$

Date:

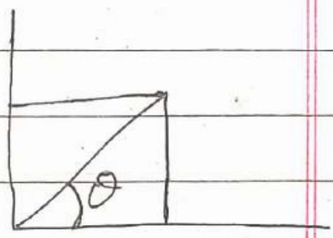
M T W T F S

Area of traingle

$$Area = \frac{1}{2}(\vec{A} \times \vec{B})$$

if $\theta = 90^\circ$

$\Downarrow$



Area of Right angle traingle $= \frac{1}{2} AB \sin 90^\circ$

$= \boxed{\frac{1}{2} AB}$

Date: ______ Lec # New M T W T F S

Properties of Neutron

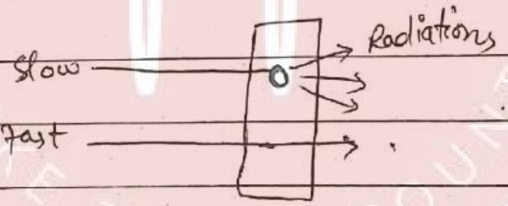
* $e/m = 0$
* Free neutron decay
  ($N = P + e^- +$ Anti-neutrino)
* Types

Slow Neutron ⇓ Velocity Less than 1 evolt

Fast Neutron ⇓ Velocity > 1.2 ev

* More effective in Nuclear rxn. ⇓ stay down in Nucleus

Less effective



* Made of quarks
* $\boxed{1\,N = 1842\,e^-}$
* mass:

$\Rightarrow 1\,N = 1.66 \times 10^{-27}$ Kg

$\Rightarrow 1\,N = 1.66 \times 10^{-24}$ Kg

$\rightarrow$ $1\,N = 1.0087$ amu

$1\,N = 1$ amu

Date:

M T W T F S

Molar mass of N:

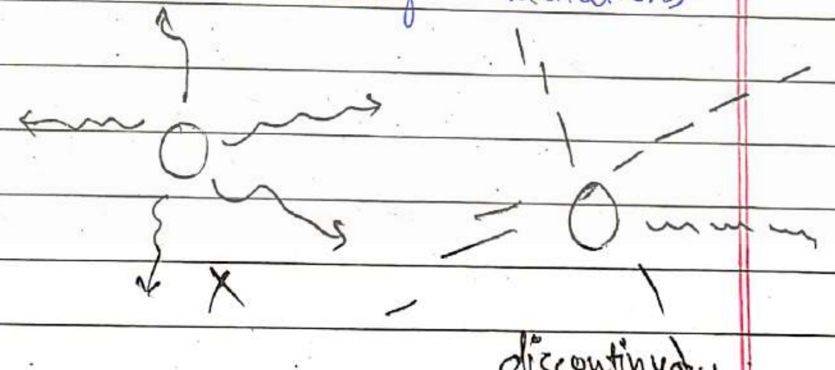
1 mole N = 1.0087 g

$\boxed{1\ mole\ N = 1g}$

Nuclear rxn	Chemical rxn
* due to Nucleus	* due to e^-
* atoms identity change	* atoms identity remain same
* More energy involve	* Less energy involve
* independant of Condition.	* depend on Condition.
* C&P Physical properties change	* C.P → changes. P.P → May or may not change.

Planks Quantum Theory

* Based on Radiation.
* Black body radiations.



discontinuous form.

M T W T F S

Date:

① Light absorb or emit in discontinuous form. called Packet of energy or Pulse of energy

or energy wave

* in light (visible) called photons.

* Quanta (other E.M radiations)

② Unit of Radiation

⇓

Quanta

Photon / Quanta:

* chargeless
* Rest mass = 0
* Mass in case of motio ≠ 0
* called effective mass.

* Rest energy = 0
* Energy in motion = $h\nu$
* $\boxed{e/m = 0}$

$h\nu \quad h\nu \quad h\nu$

Rad

Date: M T W T F S

③ **Energy:**

photon, source

$$\boxed{E \propto \nu}$$

$E = h\nu$

radiation ← $\boxed{E = nh\nu}$

④ **Velocity:**

V_{photon} is independant of frequency, λ, Energy, $\vec{\nu}$

depend on medium

$$\boxed{V = \lambda\nu}$$

Microwave — x-ray

$\lambda\uparrow \nu\downarrow$ $\qquad$ $\nu\uparrow \lambda\downarrow$

⑤ **Intensity:** → Ep not depend.

intensity → No# photons.

(A) ~ ~ ~ less intense

(B) ~ ~ ~ ~ ~ More intense

→ E_{phot} = same

$\boxed{E_{photon}}$ is independant of intensity

Date: # matter is condensed form of energy

M T W T F S

Momentum:

$E = \frac{hc}{\lambda}$ $E \Rightarrow mc^2$

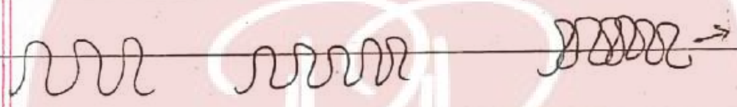
$m\cancel{c}^2 = \frac{h\cancel{c}}{\lambda}$

as wave photon ← $\boxed{\lambda = \frac{h}{mc}}$ $mc = \frac{h}{\lambda}$ $h = mc\lambda$

$\boxed{\lambda = \frac{h}{\text{momentum}}}$

$\lambda \alpha \frac{1}{\text{mass}}$

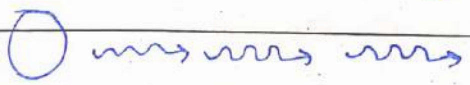
Particle Nat ↑ $\hat{\lambda}$ ↓



⇒ X – rays ⟶ more $\vec{P}$ & more particle nature.

④ Quantization of Energy:

energy of radiation is quantized



b/c photons are always be in whole integral.

(*) Min energy of radiation is $\boxed{h\nu}$

$> h\nu$

$< h\nu$ ✗

Date:

M T W T F S

Relation

$\boxed{E = nh\nu}$ $\boxed{E = \frac{nhc}{\lambda}}$ $\boxed{E = nhc\bar{\nu}}$

$\boxed{\nu = c\bar{\nu}}$

$E = nh\nu$

$E = nhc\bar{\nu}$

$\cancel{n}\cancel{h}\nu = \cancel{n}\cancel{h}c\bar{\nu}$

$E = \frac{nhc}{\lambda}$ $E = nhc\bar{\nu}$

$\frac{\cancel{n}\cancel{hc}}{\lambda} = \cancel{n}\cancel{h}\cancel{c}\bar{\nu}$ $\boxed{\bar{\nu} = \frac{1}{\lambda}}$ $\boxed{\nu = \frac{c}{\lambda}}$

$\boxed{E \propto \nu \propto \bar{\nu} \propto \frac{1}{\lambda}}$

Q#

How many photons are present in a radiation having energy 6.64×10^{-33} & wavelength 10^{-2}?

$E = \frac{nhc}{\lambda}$ $n = \frac{E\lambda}{hc} = \frac{6.64 \times 10^{-34} \times 10^{-2}}{6.62 \times 10^{-34} \times 3 \times 10^{8}}$

$= 0.33 \times 10^{-10}$

$\boxed{3.3 \times 10^{-11}}$

Date:______ M T W T F S

Bohr's Atomic Model

* Semic classical model.
* based on Plank's Quantum theory

Postulates:

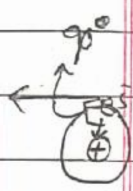
* Nucleus → a dense part in center of atom.

⇒ here electron present

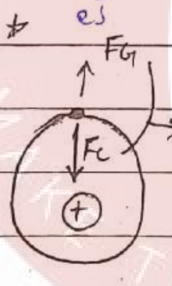
* Stationary state

⇒ e^- in its shell energy nor absorb nor emit

Reason:



* Work on e^- = Zero
* e^- is a ~~stationary~~ standing wave.



both equal

$\boxed{\text{energy loss} = 0}$

$F_c = F_G$ on e^- same

(B) Atom is stable b/c e^- present in stationary state

Date: New (M)(T)(W)(T)(F)(S)

Bohr's Theory

endo

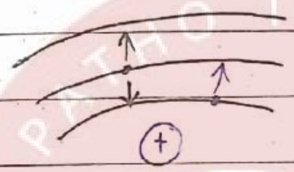
(3) excitation = e^- gain energy

exo

(4) de-excitation = lose energy.

excitation = De-excitation

$E, \lambda, \nu, \bar{\nu}$ $\quad$ $E, \lambda, \nu, \bar{\nu}$



e^- in 1^{st} shell = only excitation

↓

1s

(5) Energy of photon

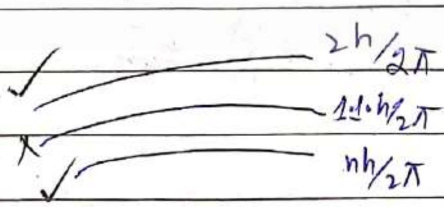
$\Delta E = E_2 - E_1$

(6) Angular Momentum

⇒ Locate position of shell

Shell will exis

when $L \rightarrow$ quantized



Date:

(M) (T) (W) (T) (F) (S)

* L is Quantized

$$\boxed{mvr = \frac{nh}{2\pi}}$$

$L \propto n$

$\left(r \propto n^2 \quad v \propto \frac{1}{n} \right)$

$$\boxed{L = n(1.05 \times 10^{-34})}$$

$$\boxed{\Delta L = L_H - L_{lower}}$$

principle on p. Quantum Number

⇒ Independ of Nature of atom

or Nature of ion

Orbital A.M:

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

depend on (Azimuthal Q-number)

For S:

$l = 0$ $\boxed{L = 0}$ 2s, 3s, 4s.

For P: $\boxed{L = \sqrt{2}\, \frac{h}{2\pi}}$ 3p, 2p, 4p

For d:

$L = \sqrt{6}\, \frac{h}{2\pi}$ 3d, 4d,

Date:

M T W T F S

For 7:

$$L = \sqrt{12}\,\frac{h}{2\pi}$$

Application

Radius of Atom:

It is distance of e^- from nucleus to any shell.

$$\boxed{r = \frac{\varepsilon_0 h^2}{\pi m e^2}\left(\frac{n^2}{Z}\right)}$$

Value:

$$\boxed{r = 0.529\,A^\circ \times \frac{n^2}{Z}}$$

Depend of "r":

$$\boxed{r \propto n^2} \quad \boxed{r \propto \frac{1}{Z}}$$

Q# Which one has max radius?

ⓐ ✓ (H)   ⓑ He^{+1} ⓒ Li^{+2} ⓓ Be^{+3}

Q#

$$\boxed{r \propto \frac{1}{e^2}}$$

if charge on e^- double then radius decrease by:

a) 4 times.

Date:

M T W T F S

$$\boxed{r \propto \frac{1}{m}}$$

if me double then radius half

* Radius of 1st shell to any Shell

$$\boxed{r_H = n_H^2 r_1} \text{ imp}$$

Q# The radius of 3rd shell is how much that of radius of 1st shell?

$$r = (3)_H^2 r_1$$

$$\boxed{r = 9r_1}$$

* Radius B/w Any two Shells.

$$\boxed{r_H = \frac{n_H^2}{n_L^2} r_L} \text{ imp}$$

Q# The radius of 4th shell is how much than that of 2nd shell?

$$r_4 = \frac{(4)^2}{(2)^2} \times r_2$$

$$\boxed{r_4 = 4r_2}$$

Date: M T W T F S

Radius of H & other ions:

$$\boxed{r_H = Z\, r_{ion}}$$

Q# Radius of Li^{+2} is how much that of H.

$$\left(r_H = 3\, r_{Li^{+2}}\right)$$

Radius b/w any two ions:

Radius of He^{+1} is how much that of radius of B^{+4}.

$$\boxed{r_L = \frac{Z_H}{Z_L} \times r_H}$$

$$r_{Hi^{+2}} = \frac{5}{3}\, r_{B^{+4}}$$

$$\left(r_{He^{+1}} = 2.5\, r_{B^{+4}}\right)$$

Distance b/w Two Radii:

$$\boxed{\text{Distance} = \frac{n_H^2 - n_L^2}{Z}(0.529\,Å)}$$

Date: ________ M T W T F S

Q# The separation b/w 4th & 2nd shell in He^{+1} is:

$$D = \frac{16-4}{2} \times 0.529$$

$$= 6 \times 0.529 A^{\circ}$$

$$= \cancel{7.303} \ \boxed{3.174 A^{\circ}}$$

* Ratio:

$$\frac{r_1}{r_2} = \frac{n_1^2}{n_2^2} \quad (Z = \text{Same})$$

$$\boxed{\begin{array}{c} r_1 : r_2 : r_2 \\ n_1^2 : n_2^2 : n_3^2 \end{array}}$$

New Lec

For Same atom / ion

$$\frac{r_1}{r_2} = \frac{n_1^2}{n_2^2} \quad (\text{Same})$$

same shell

$$\boxed{\frac{r_1}{r_2} = \frac{Z_2}{Z_1}} \quad (\text{different Atom})$$

Q# The ratio of radii of 2nd shell in He^{+1} & Li^{+2} is:

$$\boxed{\frac{r_{He^{+1}}}{r_{Li^{+2}}} = \frac{3}{2} = 3:2}$$

Date:

M T W T F S

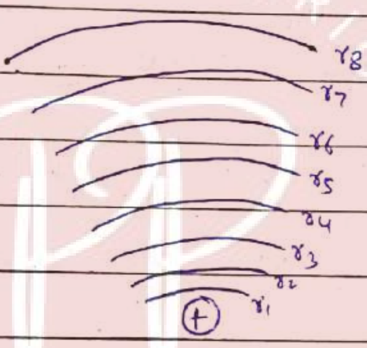
$$\boxed{\frac{r_1}{r_2} = \frac{n_1^2 Z_2}{n_2^2 Z_1}} \rightarrow \text{different shell } \& \text{ different atom.}$$

Q# The ratio of radius of 2nd shell in Li^{+2} & 4th shell of He?

$$\frac{r_{Li^{+2}}}{r_{He}} = \frac{(2)^2 \times 2}{(4)^2 \times 3} = \frac{8}{48} = \frac{1}{6}$$

Consective Radii

$$\boxed{r_2 - r_1 > r_3 - r_2 > r_4 - r_3}$$



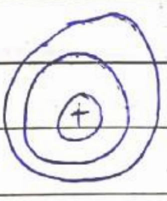
Energy of Electron

energy at infinity:

$e \rightarrow$ at $\infty \rightarrow$ outside atom

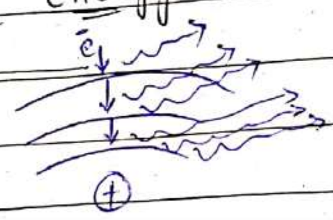
$\boxed{E = 0} \rightarrow$ compared to atom.

P.E



Date: Exothermicity of e^-s

Release of Energy:



(Here energy with e^-s is less b/c max amount of Energy is released)

$\Rightarrow$ $\boxed{\text{Energy release} \propto \text{attraction}}$

$\Rightarrow$ $\boxed{\text{Release of energy} \propto \frac{1}{n^2}}$

$\Rightarrow$ $\boxed{\text{Release of energy} \propto Z^2}$

Negative value of energy:

↳ shows Release of energy

$\boxed{-\text{ve value of } E \propto \frac{1}{n^2}}$

$\boxed{-\text{ve value of } E \propto Z^2}$

Energy of Electron:

$\boxed{E \text{ of } e^-s \propto n^2}$

$\boxed{E \text{ of } e^-s \propto \frac{1}{Z^2}}$

Scanned with CamScanner

Date: M T W T F S

Types of Energy

$$\boxed{E_T = E_{K.E} + E_{P.E}}$$

Total E:

$$E_T = \frac{-e^4 m}{8\varepsilon_0^2 h^2} \times \frac{Z^2}{n^2}$$

$\boxed{E_T \propto \frac{1}{Z^2}}$ $\boxed{E_T \propto n^2}$

$\boxed{E_T \propto \frac{1}{e^4}}$ $\boxed{E_T \propto \frac{1}{m}}$

Q# ~~Ever~~ which one man Energy in 1^{st} shell?

ⓐ Li^{+2} ⓑ Be^{+3} ⓒ He^{+1} ✓ ⓓ Same

$\boxed{E_T \propto \frac{1}{Z^2}}$

Potential energy:

$$E_{P.E} = \frac{-e^4 m}{4\pi\varepsilon_0^2 h^2}\left(\frac{Z^2}{n^2}\right)$$

$\boxed{E_{P.E} \propto \frac{[illegible]}{n^2}}$ $\boxed{E_{P.E} \propto \frac{1}{m}}$

$\boxed{E_{P.E} \propto \frac{1}{\varepsilon_0^4}}$ $\boxed{E_{P.E} \propto \frac{1}{Z^2}}$

Date:

K.E of e^-:

$R = \frac{e^4 m}{8\varepsilon_0^2 h^3 c}$

$$\boxed{E_{K.E} = \frac{e^4 m}{8\varepsilon_0^2 h^2} \times \frac{Z^2}{n^2}}$$

$\frac{e^4 m}{8\varepsilon_0^2 h^2}$

$\boxed{E_{K.E} \propto Z^2}$ $\boxed{E_{K.E} \propto \frac{1}{n^2}}$

$\boxed{E_{K.E} \propto e^4}$ $\boxed{E_{K.E} \propto m}$

Nature of Energy:

E_T → less than zero ⇓ −ve

$E_{P.E}$ → less than zero ⇓ −ve

$E_{K.E}$ → more than zero ⇓ +ve

Value of Energy:

$$\boxed{E_T = -2.18 \times 10^{-18} \left(\frac{Z^2}{n^2}\right) \text{J/atom}}$$

$$\boxed{1 \text{ atom energy} = -2.18 \times 10^{-18} \left(\frac{Z^2}{n^2}\right) \text{J}}$$

⇓ = contain one electron so

⇓ this is energy of (one e^-)

Date: M T W T F S

energy of one e^- = $-2.18\times10^{-18}\left(\frac{Z^2}{n^2}\right)$ J

$$\boxed{\text{energy of "n" } e^- = \frac{\text{No\#}}{\text{atom}} \times -2.18\times10^{-18}\left(\frac{Z^2}{n^2}\right) J}$$

Q# The energy of 100 e^- in 2nd shell of He^{+1}

E of $e^- = \cancel{100}\,10^2 \times -2.18\times10^{-16}\left(\frac{2}{\cancel{2}}\right)^2$

$$\boxed{E \text{ of } e^- = -2.18\times10^{-16}}$$

$E_T = -1312.36\left(\frac{Z^2}{n^2}\right)$ kJ/mol

$$\boxed{1 \text{ mol of atom} = -1312.36\left(\frac{Z^2}{n^2}\right) kJ}$$

1 mole of e^- = $-1312.36\left(\frac{Z^2}{n^2}\right)$ kJ

General:

$$\boxed{E \text{ of "n" mol atom} = \text{Moles of } e^- \text{ or moles of atom} \times -1312.36\left(\frac{Z^2}{n^2}\right) kJ}$$

Q# The energy of 0.5 mole of He^{+1} atom in 4th shell?

$E = 0.5 \times -1312.36 \times \frac{2^2}{4^2}$

$$\boxed{= \frac{0.5\times -1312.36}{4} kJ}$$ $\frac{\cancel{4}}{\cancel{16}}$

$$E = -13.6\left(\frac{Z^2}{n^2}\right) eV$$

Date:

M T W T F S

"E" of e^- in 1st & Any Shell:

$$E = n_H^2 E_1$$

E of 4th shell is 16 $\hat{}$ than E_1

"E" of e^- b/w any two shell:

$$E_H = \frac{n_H^2}{n_L^2} \times E_L$$

"E" of Any ion with H atom:

$$E_H = Z^2_{(ion)} \times E_{ion}$$

Q# E of Li^{+2} is how much that of energy of H?

$$E_H = 9 \times E_{Li^{+2}}$$

$$\boxed{E_{Li^{+2}} = \frac{E_H}{9}}$$

E_H is 9 times $\hat{}$ than Li^{+2} energy.

Energy b/w any two ions:

$$E_L = \frac{Z_H^2}{Z_L^2} \times E_H$$

Date:

M T W T F S

Q# The energy of Li^{+2} is how much that of Be^{+3}.

$$E_{Li^{+2}} = \frac{(4)^2}{(3)^2} \times E_{Be^{+3}}$$

$$E_{Li^{+2}} = \frac{16}{9} \times E_{Be^{+3}}$$

$$\boxed{E_{Li^{+2}} = 1.7\, E_{Be^{+3}}}$$

→ E of Li^{+2} is 1.7 times ↑ than Be^{+3}

Ratio

$$\boxed{\frac{E_1}{E_2} = \frac{n_1^2}{n_2^2}} \quad (Z = \text{Same})$$

$$\boxed{\frac{E_1}{E_2} = \frac{Z_2^2}{Z_1^2}} \quad \left(\begin{matrix}\text{different atom}\\ \text{same shell}\end{matrix}\right)$$

$$\boxed{\frac{E_1}{E_2} = \frac{n_1^2}{n_2^2} \times \frac{Z_2^2}{Z_1^2}} \quad \left(\begin{matrix}\text{different atom}\\ \text{in shell}\end{matrix}\right)$$

Ratio of Energy

$$\frac{P.E}{K.E} = \frac{-\cancel{e^4 m}/4\cancel{\epsilon_0^2 h^2}}{+\cancel{e^4 m}/8\cancel{\epsilon_0^2 h^2}} = \frac{1/4}{1/8}$$

$$\boxed{\frac{P.E}{K.E} = \frac{2}{1}}$$

$$\boxed{P.E = 2K.E}$$

⇓

means P.E is 2 ↑ than K.E in an atom.

means to attract e^-s — to remove e^-s.

Date:

P.E — K.E

e^- present due to this P.E

New Lec

Energy difference:

=> energy of photon.

$$\Delta E = \frac{e^4 m}{8\varepsilon_0^2 h^2}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] Z^2$$

actually energy of photon.

$$\boxed{\Delta E = 1312.36\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] Z^2}$$

* $\Delta E \propto Z^2$
* $\Delta E \propto n^2$
* $\Delta E \propto e^4$ (if)
* $\Delta E \propto m$ (if)

Frequency:

$$\Delta E = h\nu$$

$$\boxed{\nu = \frac{e^4 m}{8\varepsilon_0^2 h^3}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

Date:

M T W T F S

$\boxed{\nu \propto z^2}$ $\boxed{\nu \propto \Delta n}$ $\boxed{\nu \propto e^4}$ $\boxed{\nu \propto m}$

Wave number:

$$\nu = c\bar{\nu}$$

$$\bar{\nu} = \frac{e^4 m}{8\varepsilon_0^2 h^3 c}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] z^2$$

$$\boxed{\bar{\nu} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] z^2}$$

$\bar{\nu} \propto e^4$ $\bar{\nu} \propto m$ $\bar{\nu} \propto z^2$ $\bar{\nu} \propto \Delta n$

Rydberg Constant:

* Theoritical Constant

also depend on nature of gas

$$\boxed{R = \frac{e^4 m}{8\varepsilon_0^2 h^3 c}}$$ ($R \propto e^4$)(electron)

$$\boxed{R = \frac{\Delta E}{hc}}$$ $$\boxed{R = \frac{e^4 m}{8\varepsilon_0^2 h^3 c} z^2}$$

($R \propto z^2$)

unit:

$$R = \frac{E}{hc} = \frac{\cancel{J}}{\cancel{J}\cdot \cancel{sec} \times \frac{m}{\cancel{sec}}}$$

Same as wavenumber ← $\boxed{R = m^{-1}}$

Date:

M T W T F S

Wavelength:

$$\bar{\nu} = \frac{1}{\lambda}$$

$$\boxed{\frac{1}{\lambda} = \frac{e^4 m}{8\epsilon_0^2 h^3 c}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

$$\left(\lambda \propto \frac{1}{Z^2}\right) \quad \left(\lambda \propto \frac{1}{\Delta E}\right) \left(\lambda \propto \frac{1}{\Delta n}\right)$$

$$\left(\lambda \propto \frac{1}{e^4} \propto \frac{1}{m}\right)$$

$(\vec{E})$ In terms of R:

$$\Delta E = hc\bar{\nu}$$

imp

$$\boxed{\Delta E = Rhc\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

ν:

$$\Delta E = h\nu$$

imp

$$\boxed{\nu = Rc\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

$\bar{\nu}$:

$$\nu = c\bar{\nu}$$

imp

$$\boxed{\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

λ:

$$\bar{\nu} = \frac{1}{\lambda}$$

imp

$$\boxed{\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) Z^2}$$

Date: ______ M T W T F S

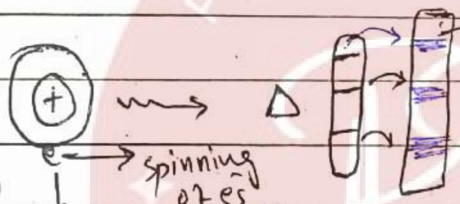
Defects in Bohr Model

① unielectronic: → H, He^{+1}, Li^{+2}

e^- is independant
↳ No e^- e^- repulsion.

② Fine structural of atom:

Splitting of Spectral lines into its components called Fine — ⇓ due to spin orbit Coupling



→ Fine structure

e → spinning of e^- ⇓ M.F

(axis) ↓ ↑ orbital spin ⇓ M.F

interact each other ⇓ some energy changes occur ⇓ due to which Fine structure

③ Bohr → atom is $\boxed{2D}$
But
atom is $\boxed{3D}$

* Shape of atom ↳ circular / eliptical ⇑ Bohr

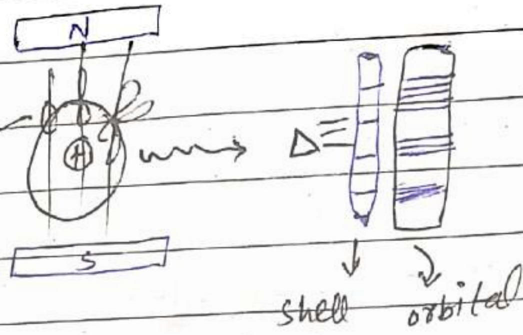
→ Bohr model doesnot obey uncertainity principle.

Scanned with CamScanner

Date:

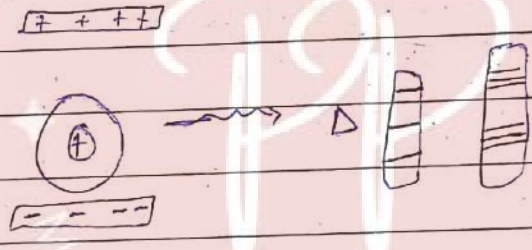
Zeeman effect:

not explain by Bohr



interact different with M. field due to which energy become differs.

Stark effect:

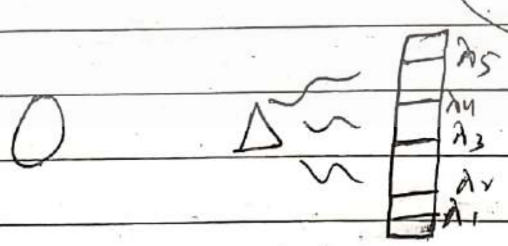


electric field.

Spectrum

Arrangement of wavelength & frequence in ascending order

Spectral lines



each lines in spectrum

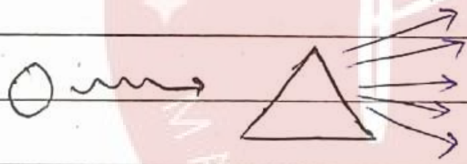
* spectral lines $\longrightarrow$ represent specific λ & f

$$\boxed{\text{intensity of spectral line} \propto \text{No \# photons}}$$

* Used for quantitative & qualitative analysis.

* (Distance b/w spectral lines $\longrightarrow$ depend on nature of Atom)

④ Angle of deflection:



$$\boxed{\text{Angle of deflection} \propto E \propto f \propto \bar{\nu} \propto \frac{1}{\lambda}}$$

100% C·S not possible.

Date: ↑ (M)(T)(W)(T)(F)(S)

Continuous: Spectrum:

↳ almost all λ are present.

↳ No missing wavelength.

⇓

* Means No missing colour.
* No clear cut boundry.
* present in

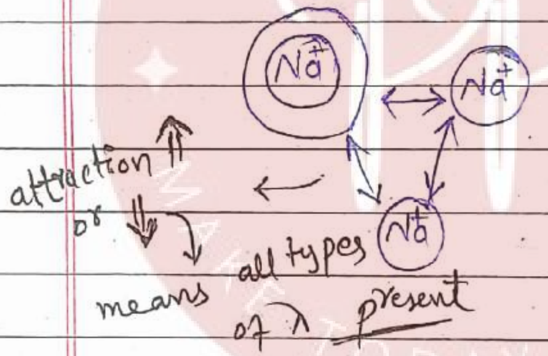
=> black body

=> Free electron → absorb or emit all types of λ

=> Light (Sunlight).

=> present in * Solid, * dense liquid,

* high density Gas.
* high Concentrated gas.



Atomic Spectrum:

=> Characteristics of Atom.

=> identity of Atom.

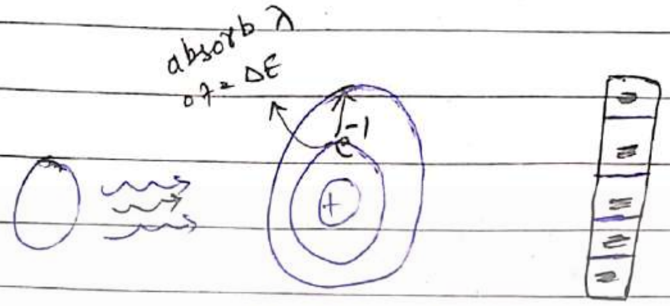
=> Some λ are missing.

=> Clear cut boundries b/w colours

Date:

(M)(T)(W)(T)(F)(S)

Atomic absorption Spectrum:



* unexcited atom.
* due to excitation of es.
* dark lines show (absorbed wavelength)
* back ground white (emitted λ)

* Source is needed.
* $\boxed{\text{Sensitive spectroscopy}}$

obey

* Beer lambert Law (absorption ∝ concentraction)

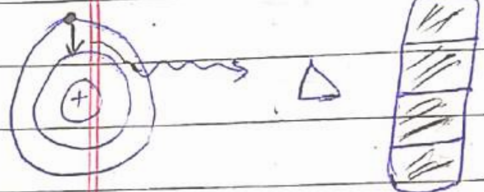
$A = \varepsilon_0 C l$

* low density gas
* in Cool gas occur
* used in spray of liquid

New Lec

Date:

Atomic Emission Spectroscopy:



=> produce due to deexcition.

=> by excite atom.

=> spectral lines → $\boxed{\text{bright}}$

=> Background → Dark.

=> donot / obey Beer lambert's Law

=> less sensitive.

=> No Source is needed.

=> Fast spectroscopy.

=> Low density Gas or Spray of liquid

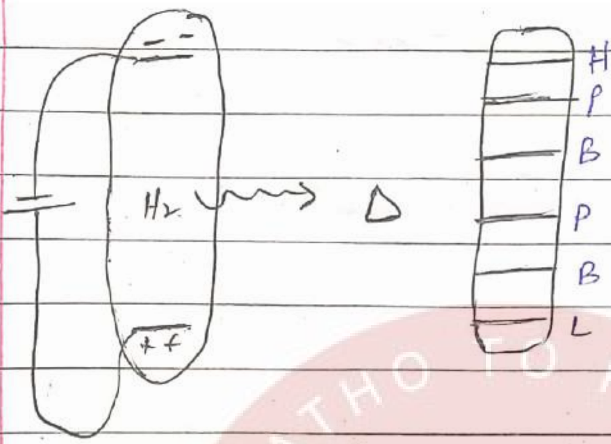
=> hot Gas.

mixture of gas → Continuous spect

1 gas → line spectrum.

Hydrogen Spectrum

=> Based on line emission spectroscopy



Lyman Series:

=> $n_{th} \longrightarrow n_1$

=> $\lambda = 200nm \rightarrow 400nm$

=> UV region

limiting lines ⟶ $\boxed{n_\infty \rightarrow n_1}$

$\boxed{n_2 - n_1 < n_3 - n_1 < n_\infty \rightarrow n_1}$

⇓

high $E, \nu, \bar{\nu}$

Balmer Series:

$n_{th} \rightarrow n_2$

$\lambda = 400nm - 800nm$

visible region.

Date:

M T W T F S

es from

H_α lines $\rightarrow$ $n_3 \rightarrow n_2$

H_β lines $\rightarrow$ $n_4 \rightarrow n_2$

H_γ lines $\rightarrow$ $n_5 \rightarrow n_2$

$\boxed{\Delta n \propto E, \nu, \bar{\nu}}$

Limiting Lines

* $n_{\infty}' \rightarrow n_2$
* Fall in UV region ($\lambda = 362$ nm)

Paschan Series:

* $n_{th} \rightarrow n_3$
* Near IR
* $\lambda = 800\,nm - 1400\,nm$

* $\Delta n \propto E, \nu, \bar{\nu}$

Bracket Series:

* $n_{th} \rightarrow n_4$
* Mid IR
* $\lambda = 1400\,nm - 2200\,nm$
* $E, \nu, \bar{\nu} \propto \Delta n$

* Pfund Series:

$n_{th} \rightarrow n^5$

For IR

$\lambda = 2200\,nm - 30,000\,nm$

Date:

Hamphry Series:

* nth — 6th (n)
* microwave rigion
* λ = above 30,000nm.

$E, \nu, \bar{\nu}$:

$\boxed{\text{Lyman > Balmer > paschan > Bracket > Pfund > Hampry}}$

No. spectral lines or Transition:

① e^- to G.state:

$$\boxed{N = \frac{n(n-1)}{2}}$$

② B/w any two shells:

$$\boxed{N = \frac{\Delta n(\Delta n+1)}{2}} \quad (\Delta n = \text{hig} - \text{Low})$$

Q# an e^- exist in 5^{th} shell. How many s.lines produce?

$$N = \frac{5(5-1)}{2}$$

$$= \frac{5 \times \cancel{4}}{\cancel{2}} = 10$$

Date:

M T W T F S

Q# e^- exist in 5^{th} shell how many visible spectral lines it produces?

produce when e^- to (2)

$$\text{S-Lines} = n_{shell} - n_{R\cdot shell}$$

$$= 5 - 2$$

$$= 3$$

means visible UV IR etc

$$\boxed{\text{Required s-lines} = n_{shell} - n_{req\,shell}}$$

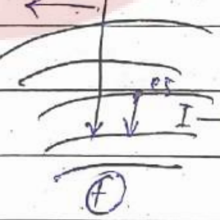
Q# e^- exist in 6^{th} shell & it moves to 2^{nd} shell. No. spectral lines are:

$$\text{s-lines} = \frac{4(4+1)}{2} = \frac{20}{2} = 10$$

Longest & Shortest λ:

$\Delta E \uparrow \lambda \downarrow$

e^- from ∞



$I \rightarrow \Delta E \downarrow \lambda \uparrow$

e from near shell.

$$\boxed{\lambda_{shortest} = \frac{n_1^2}{R}}$$ n_1 = Required Series.

n_1 = R. series

$n_2 = n_1 + 1$

$$\boxed{\lambda_{Longest} = \frac{(n_2 \times n_1)^2}{[(n_2)^2 - (n_1)^2]\,R}}$$

Date:

Q# The $\lambda_{shortest}$ in Paschan :

$$\lambda_s = \frac{(3)^2}{R} = \boxed{\frac{9}{R}}$$

Q# The Longest λ of Balmer Series is:

$n_1 = 2$
$n_2 = 3$

$$\lambda_{Longest} = \frac{(2 \times 3)^2}{(3^2)-(2)^2 R} = \boxed{\frac{36}{5R}}$$

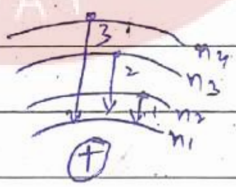
Q# The Ratio of shortest to λ_L of Lyman Series is:

$$\lambda_s = \frac{1}{R} \quad \lambda_L = \frac{(1 \times 2)^2}{(2)^2-(1)^2 R} = \frac{4}{3R}$$

$$\frac{\lambda_s}{\lambda_L} = \frac{1}{\cancel{R}} \times \frac{3\cancel{R}}{4} = \boxed{\frac{3}{4}}$$

Q# The $\vec{\bar{\nu}}$ of 3^{rd} spectral lines of lyman Series.

$$\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$



$n_1 = 1 \quad n_2 = 4$

$$\bar{\nu} = R\left(\frac{1}{1} - \frac{1}{16}\right)$$

$$= R\left(\frac{16-1}{16}\right)$$

$$\boxed{\bar{\nu} = \frac{15R}{16}}$$

Date:

M T W T F S

$\boxed{\text{No \# Spectral lines} = \text{Same } e^-}$

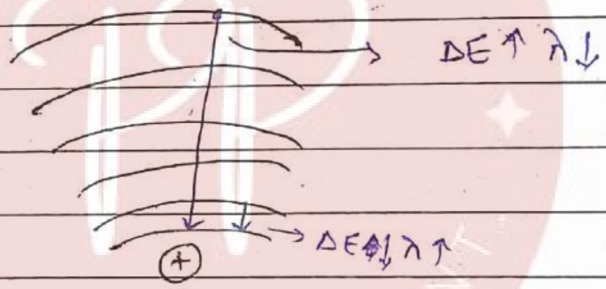
Q# The no. spectral lines in H is same as:

✓ (a) He^{+1} b) Li^{+1} c) Be^{+1} d) H

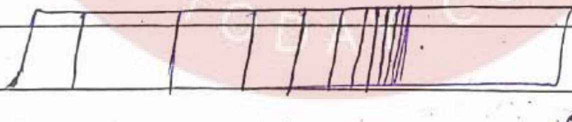
⇓

but λ/E differs of s. lines

$\boxed{\text{Distance b/w spectral lines decrease} \Rightarrow \text{As we move away from Nucleus}}$



+ ⟶ outer (∞)



X-rays ⟶ Cause

I.P ⇓ e^- remove

=> High energetic rays

=> less wavelength.

=> unknown X-rays.

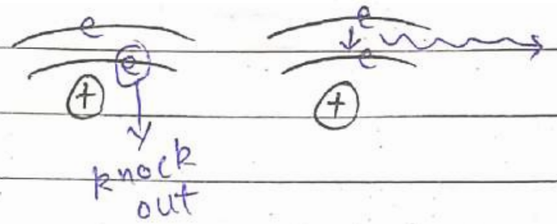
=> discover in discharge tube

Date:

M T W T F S

1) Characteristics:

produce due to inner trasition of e^-.

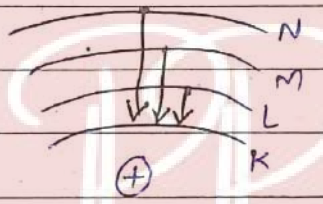


* each atom specific x-rays.

due to

* de-excitation of e^-.

K series:



$K_\alpha \rightarrow L \rightarrow K$

$K_\beta \rightarrow M \rightarrow K$

$K_\gamma \rightarrow N \rightarrow K$

$E, \nu, \bar{\nu}$:

$\boxed{K_\gamma > K_\beta > K_\alpha}$

Intensity:

$\boxed{K_\alpha > K_\beta > K_\gamma}$

I.P:

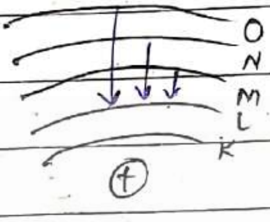
$\boxed{\text{Ionization} \propto \text{intensity}}$

$\boxed{K_\alpha > K_\beta > K_\gamma}$

Date:

L-Series:

$L_\alpha = M - L$



$L_\beta = N - L$

$L_\gamma = O - L$

$E, \nu, \bar{\nu}$:

$\boxed{L_\gamma > L_\beta > L_\alpha}$

Intensity / I.P:

$\boxed{L_\alpha > L_\beta > L_\gamma}$

* M - series:

$E, \nu, \bar{\nu}$:

$\boxed{M_\gamma > M_\beta > M_\alpha}$

Intensity / I.P:

$\boxed{M_\alpha > M_\beta > M_\gamma}$

Over all order

$E, \nu, \bar{\nu}$:

$\boxed{K > L > M}$

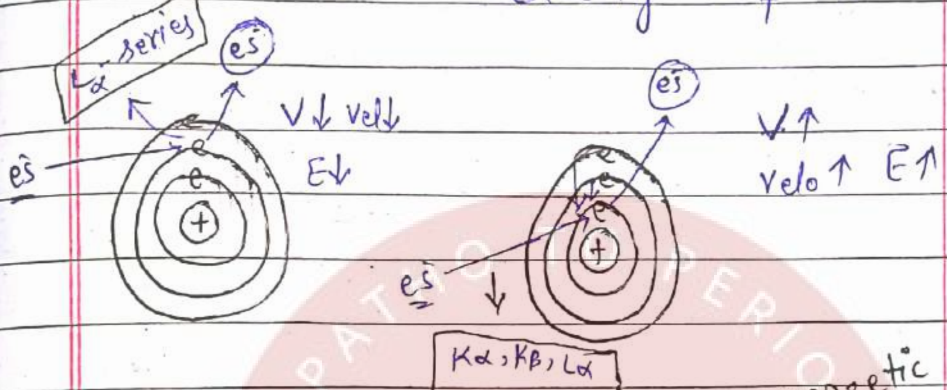
NO x-rays: or E of x-rays:

E, ν, $\bar{\nu}$, No#

→ depend on nature of atom.

→ depend on voltage

→ velocity of es.



high energetic

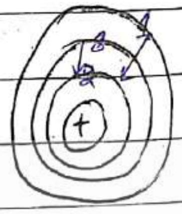
More No. x-rays.

$\boxed{\text{NO \# x-ray} \propto \text{voltage}}$

$\boxed{E, \nu, \bar{\nu} \propto \text{voltage}}$

Date: ______ New Lec (M)(T)(W)(T)(F)(S)

Q# types of X-rays in Na?

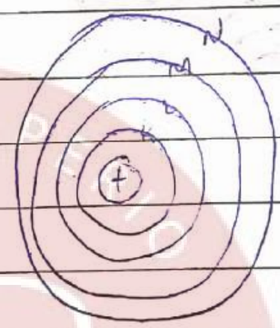


K_α, K_β, L_α

Types = 2

No = 3

Q# in Ca:



L_α
L_β
L_γ
M_α
M_β

* K_α, K_β, K_γ
* L_α, L_β
* M_α

Types = 03

No = 06

Properties of X-rays:

I.P:

* $K_{series} > L > M$
* $K_\alpha > L_\alpha > M_\alpha$
* $K_\beta > L_\beta > M_\beta$

$\boxed{\text{I.P} \propto \text{particle nature}}$

Ionization power trend ↑

$\boxed{\alpha\text{-particle} > \beta\text{-particle} > \gamma\text{-rays} > \text{X-rays} > \text{UV}}$

Date:______ M T W T F S

* P.P:

$$\boxed{P.P \propto \frac{1}{\lambda}}$$

$\boxed{\gamma\text{-rays} > x\text{-rays} > UV > \text{neutrons} > e^-}$

* No charge & mass
* $e/m = 0$
* Diverges * produce flourosence & black photographic film.

Mosly's Law

* Study elements = 38
from $\boxed{Al \longrightarrow gold}$
* x-rays frequency find experimentally & Theoritically

* M. Form:

2p 3p 2p

Frequency ↑↑ attrall ↑↑ ← $\sqrt{\nu} \propto Z_{eff}$

$\sqrt{\nu} \propto Z - b$ (due to shielding)

$$\boxed{\sqrt{\nu} = a(Z-b)}$$

$$\sqrt{\nu} = aZ - ab$$

Date:

M T W T F S

$$\boxed{\nu = a^2(z-b)^2}$$

$$\boxed{\nu = a^2(z^2+b^2-2zb)}$$

$$\boxed{\sqrt{\frac{c}{\lambda}} = a(z-b)}$$

$$\boxed{\frac{c}{\lambda} = a^2(z-b)^2} \qquad \lambda \propto \frac{1}{(z-b)^2}$$

$$\nu = c\bar{\nu}$$

$$\boxed{\sqrt{c\bar{\nu}} = a(z-b)} \qquad \bar{\nu} \propto (z-b)$$

Ratio:

$$\frac{\nu_1}{\nu_2} = \frac{a^2(z_1-b)^2}{a^2(z_2-b)^2}$$

→ shielding
↳ const for a shell

Constant:

$a =$ Constant

$$\boxed{a = \sqrt{Rc\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]}}$$

unit of "a":

shows energy gap b/w shell ← $a = \sqrt{\cancel{m^{-1}} \times \cancel{m}/\text{sec}}$

$$\boxed{a = \sqrt{\frac{1}{\text{sec}}}} \quad \boxed{a = \sqrt{H_z}} \quad \boxed{H_z^{1/2}}$$

or

$$a = \sqrt{\nu}$$

Scanned with CamScanner

Date:________ M T W T F S

depend of "a":

depend on

$\boxed{\text{Type of x-rays}}$ not on

Nature of Substance.

Value:

2nd shell to 1st shell

value of "a" for $K\alpha = ?$

$n_1 = 1 \quad n_2 = 2$

$$a = \sqrt{Rc\left(\frac{1}{(1)^2} - \frac{1}{(2)^2}\right)}$$

depend of inner es

$$\boxed{a = \sqrt{Rc\frac{3}{4}}}$$

b:

(b) = Screening constant

→ Find by Slatter's Rule

No unit

Depend:

depend on X-rays Series

but not depend on

Nature of Atom

$$\boxed{\sqrt{\nu} \propto \frac{1}{b}}$$

* K-Series: ⟶ $b = 1$
* L-Series: ⟶ $b = 7.4$
* M-Series: ⟶ $b = 19.2$

b for $\boxed{M > L > K}$

Date:

Q# The ratio of frequency of $K\alpha$ of He to Li?

Sol:

$$\frac{\nu_{He}}{\nu_{Li}} = \frac{a^2(z-b)^2}{a^2(z-b)^2}$$

$$= \frac{\left(\sqrt{\tfrac{3}{4}Rc}\right)^2 (2-1)^2}{\left(\sqrt{\tfrac{3}{4}Rc}\right)^2 (3-1)^2}$$

$$\boxed{\frac{\nu_{He}}{\nu_{Li}} = \frac{1}{4}}$$

Quantum Mechanics

⇒ e^- ~~cond~~ consider as a wave

(#) De-Broglie's Equation

* wave
- → wave nature
- → Particle nature

* particle
- → Wave nature
- → particle " "

* Valid for microscopic object. (e, p, n, atom)

* based on
$\boxed{\text{Einstein } \& \text{ planks equation}}$

Date: M T W T F S

$E = mc^2$ $\quad E = \frac{hc}{\lambda}$

$m\cancel{c^2} = \frac{h\cancel{c}}{\lambda}$

$\boxed{mc = \frac{h}{\lambda}}$

For waves:

$\boxed{\lambda = \frac{h}{mc}}$ → speed of light

$\left(\lambda \alpha \frac{1}{p \cdot \text{nature}} \quad \lambda \alpha \frac{1}{p} \quad \lambda \alpha \frac{1}{m}\right)$

| γ rays > x-rays > UV ligh > visible |

⇓ more particle nature λ ⇓

For particle:

$\boxed{\lambda = \frac{h}{mv}}$ → replace with C

mass should be in "Kg"

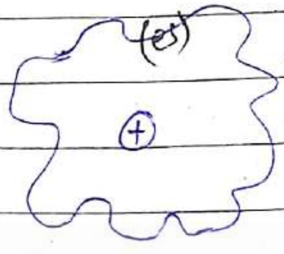
property of wave ← $\lambda \alpha \frac{1}{p}$ $\quad \lambda \alpha \frac{1}{m}$

$\boxed{\text{wave nature } \alpha \frac{1}{m}}$

more wave nature order | e^- > proton > neutron > He^{+2} |

Standing Waves

e^- ⟶ acts as a standing wave



Bohr's equation is compensated in De-broglie's equation.

$$mvr = \frac{nh}{2\pi}$$

$$\boxed{2\pi r = \frac{nh}{mv}}$$

$$\frac{h}{mv} = \lambda$$

$$\boxed{2\pi r = n\lambda}$$

Circumference of standing wave is integral multiple of de-broglie wavelength.

Q# Circumference of st. wave in 6th shell?

$$2\pi r = n\lambda$$

$$\boxed{2\pi r = 6\lambda}$$

x ——— y

$\boxed{\text{No\# standing waves} = \text{No \# of sub-shell}}$

No# sub shell = shell No

Q# How many standing waves are present in 3^{rd} shell of Na?

$\boxed{\text{Standing waves} = 3}$

Q# How many standing waves are present in last e^- present in 3s?

$\boxed{\text{Standing waves} = 01}$

Shrodinger Wave Equation

=> It is Quantum mechanical approach

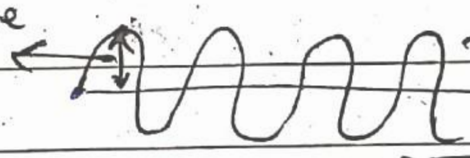
=> derived equation for $\boxed{\text{particle wave}}$

=> $\psi^2 \rightarrow$ (i.e) $\rightarrow$ show probability of e^-

ψ is actually $\rightarrow$ probability of orbital

It is amplitude of wave

ψ = amplitude of wave



$\rightarrow$ waves with particle.

=> Valid for $\boxed{\text{Particle}}$

=> It is Confirmation of de-broglie's wavelength.

New Lec

Quantum Numbers

Principle Quantum Number.

about gives information

* Shell
* Energy $\propto n$
* Radius $\propto n$
* $P.E \propto n^2$
* $\boxed{\text{Shell number} = \text{period Number}}$
* $K.E \propto \frac{1}{n^2}$
* Momentum $\propto n$
* size of atom $\propto n$
* size of atom $\propto n$

  2s < 4s < 5s

* Size of sub-shell $\propto n$
* probality of e's $\propto \frac{1}{n}$

* No. e's in shell = $\boxed{2n^2}$
* No. orbital in shell = $\boxed{n^2}$
* No. orientation of orbital in shell = $\boxed{n^2}$

Azimuthal Quantum Number:

→ sec Q.N
→ subsid. Q.N
→ orbital A.mome Q.Nu

* depen on P.Q.N.
* ~~Sub-shell information.~~
* $l = n-1$
* $l = 0,\ n = 1$
* $n = l + 1$

determine:

① No. # sub shell in a shell = $\boxed{n}$

1^{st} shell = $l=0$ s

2^{nd} shell = $l=0,1$ s, p

3^{rd} shell = $l=0,1,2$ s, p, d

4^{th} shell = $l=0,1,2,3$ s, p, d, f

5^{th} shell = $l=0,1,2,3,4$ s, p, d, f, g

6^{th} shell = $l=0,1,2,3,4,5$ s, p, d, f, g, h

7^{th} shell = $l=0,1,2,3,4,5,6$ s, p, d, f, g, h, i

imaginary

② Shape of sub-shell:

→ Related to Azimuthal Q-number

③ Energy of sub-shell:

$E \propto (n+l)$ value

$3s < 4s$

$n+l=3$ $n+l=4$

④ Number of orbitals in sub-shell

$\boxed{\text{orbitals} = (2l+1)}$

Scanned with CamScanner

shows by M. Q. Number.

orbital = $2l+1$

$m = 2l+1$

$$\boxed{l = \frac{m-1}{2}}$$

⑤ No. e^- in a sub-shell =

shows by S.Q. Number ← $e^- = 2(2l+1)$

$m_s = 2(2l+1)$

$2l+1 = \frac{m_s}{2}$ $\quad$ $2l = \frac{m_s - 1}{2}$

$$\boxed{l = \frac{m_s - 1}{4}}$$

Q#

No # e^- in g:

g = l = 4 $\quad$ $2(2 \times 4 + 1)$

18 e^-

⑥ Orbital Angular Momentum:

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

⑦ Possibility of Sub-Shell:

1^{st} shell = 1s ⟶ 7s

2^{nd} shell = 2p ⟶ 7p

3^{rd} shell = 3d ⟶ 7d

4^{th} shell = 4f ⟶ 7f

5^{th} shell = 5g ⟶ 7g

6th shell → 6h → 7h

7th shell → 7i

Magnetic Quantum Number

* orientations of orbitals.

=> orbitals

* degeneracy of orbital
* Zeeman & starck effect

=> depend on Azimuthal Q.N

$$\boxed{m = 0, \pm l}$$

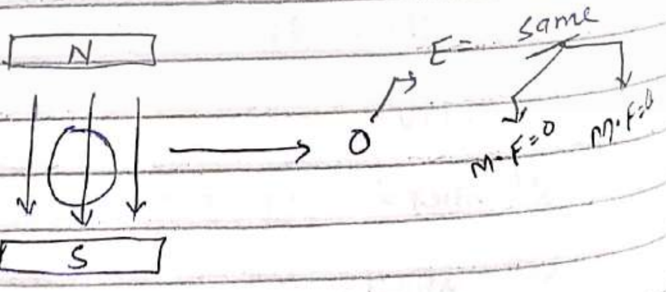
No M. field:

$p \rightarrow p_x, p_y, p_z$ → Degenerate (Same energy)

M. field present:

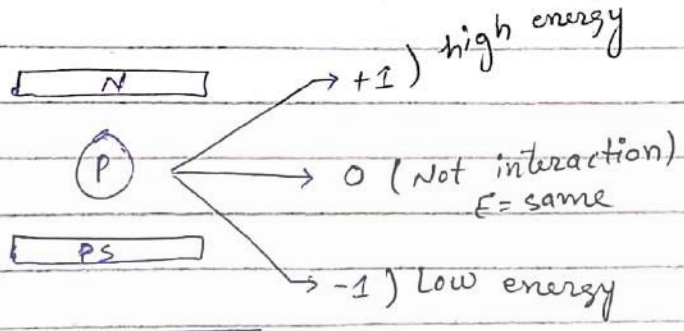
$p \rightarrow p_x, p_y, p_z$ → Degenerate vanish.

S - sub shell:



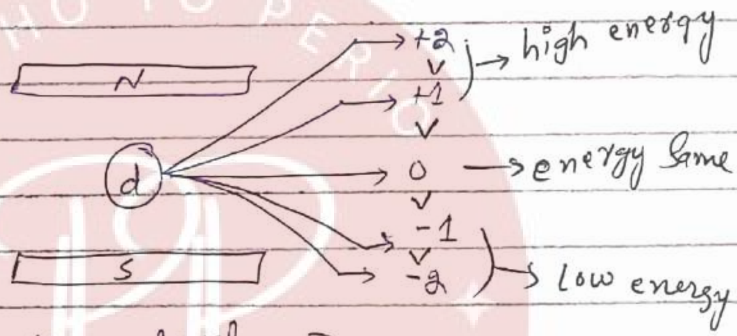
* Orientation possible for s-sub shell = 0 = 1

p- sub shell =



$\boxed{m = +1, 0, -1}$

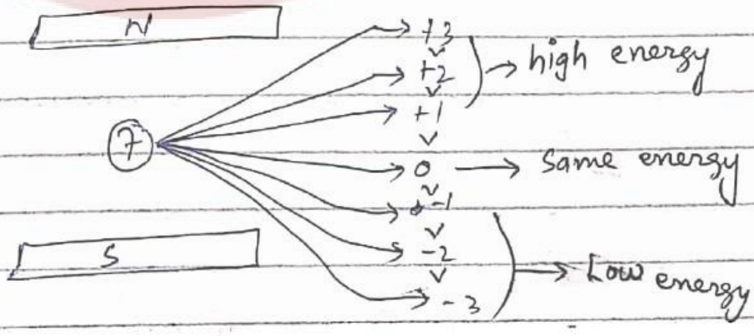
d- Sub shell:



energy level = 5
orientation = 5

$\boxed{m = +2, +1, 0, -1, -2}$

f - orbital:



$\boxed{m = +3, +2, +1, 0, -1, -2, -3}$

No # orientation or value of m:

For Sub shell:

$= (2l+1)$

For obital:

$= n^2$

Q#
How many values of m can assume when $n=5$ & $l=4$

$= 2(2\times4+1)$
$= 9$

Q#
How many orientation can assume when in 4th shell.

$= n^2 = (4)^2$
$= 16$

Q# How many e^- are present in Na having $m=0$?

a) 4 b) 5 c) 6 d) 7 ✓ e) None

Sol:

Na = $1s^2$, $2s^2$, $2p^6$, $3s^1$

$1s^2$	$2s^2$	$2p^6$	$3s^1$	
$m=0$	$m=0$	$m=0$	$m=0$	
2	2	2	1	$= 7\ e^-$

Q# How many e^- are present in F having $m=-1$?

F = $1s^2$, $2s^2$, $2p^5$

$m=0$ $m=0$ $m=+1, 0, -1$ → These numbers are orbitary.

+1 0 -1

| 11 | 11 | 1 |

⇓

$\boxed{1 \text{ or } 2\ e^- \text{ Answer}}$

Q#: How many e^- are present if $n=4$, $l=3$ & $m=\pm 1$?

Sol:

$m=+1$ $\quad$ $m=-1$

$2e^-$ $\quad$ $2e^-$ $= \boxed{4e^-}$

Q#: How many e^- are possible if $n=6$ & $n=4$ & $m=0, \pm 1$

Sol:

$m=0$ $\quad$ $m=+1$ $\quad$ $m=-1$

$2e^-$ $\quad$ $2e^-$ $\quad$ $2e^-$ $= \boxed{6e^-}$

$e^- \longrightarrow$ shell $\rightarrow$ subshell $\rightarrow$ orbital $\Downarrow$ max in one $= 2$

Spin Quantum Number

=> independant Quantum Number.

* e^- → clockwise spin $\boxed{+\frac{1}{2}}$
  → Anti-clock wise spin $\boxed{-\frac{1}{2}}$

Q => Why "ms" is in fraction?

$$\boxed{\text{Total spin} = \text{unpaired } e^- \left(\pm\frac{1}{2}\right)}$$

$+$ → C.W
$-$ → A.C.W

Q# Total spin of e^- in O is:

$_8O = 1s^2, 2s^2, 2p^4$

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

↓ they have spin

$T. spin = \cancel{2}\left(+\frac{1}{\cancel{2}}\right)$

$T. spin = \boxed{\pm 1}$

Q#: Total spin of e^- in N?

$\rightarrow N = 1s^2, 2s^2, 2p^3$

| ↑ | ↑ | ↑ | $3 \times \left(\pm \frac{1}{2}\right) = \boxed{\pm \frac{3}{2}}$

Q# Which one is Correct for ~~last~~ unpaired e^- in Cl = ?

(a) $n = 3$ $l = 1$ $m = 0$ $s = -\frac{1}{2}$

b) $n = 3$ $l = \cancel{2}\,1$ $m = 0$ $\boxed{s = \pm \frac{1}{2}}$ → shows two e^-

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

d) All not possible.

Sol:

$Cl = 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

| ↑↓ | ↑↓ | ↑ |

→ $n = 3$
$l = 1$
$m = 0, +1, -1$

→ one e^-
↓
so $m_s = +\frac{1}{2}$ or $-\frac{1}{2}$

Q#: The sum of all Q# No for unpaired e^- in Na?

Sol:

$Na = 1s^2, 2s^2, 2p^6, 3s^1$ $n = 3$ $m = 0$

| ↑ | $s = 0$ $s = -\frac{1}{2}$ or $+\frac{1}{2}$

Sum = $n + l + m + s$

$= 3 + 0 + 0 + \frac{1}{2} = \frac{7}{2}$

Sum = $n + l + m + s$

$= 3 + 0 + 0 - \frac{1}{2} = \frac{5}{2}$

Q# The Sum of all Q-number for unpaired e^- in F = ?

$2p^5$ $\quad$ $n = 2$

$\boxed{\uparrow\downarrow | \uparrow\downarrow | \uparrow}$ $\quad$ $l = 1$

$m = +1, 0, -1$ $\quad$ $s = +\frac{1}{2}, -\frac{1}{2}$

Sum = $n + l + m + s$

$(+\frac{1}{2})$ $\Rightarrow 2 + 1 + 1 + \frac{1}{2} =$ $\quad$ $(-\frac{1}{2})$ $* \; 2 + 1 + 1 - \frac{1}{2} =$

$\Rightarrow 2 + 1 + 0 + \frac{1}{2} =$ $\quad$ $* \; 2 + 1 + 0 - \frac{1}{2} =$

$\Rightarrow 2 + 1 - 1 - \frac{1}{2} =$ $\quad$ $* \; 2 + 1 - 1 - \frac{1}{2} =$

Note:

Each Q #No is differe by 1 unit.

$n = \underbrace{1, 2}_{1}, \underbrace{3}_{1}, \underbrace{4}_{1}, \underbrace{5}_{1} \ldots$ $\quad$ $m = +2, +1, 0$ (1, 1)

$l = +1, 0, -1$ (1, 1) $\quad$ m_s $+\frac{1}{2}, -\frac{1}{2}$ (1)

difference is 1 necessary

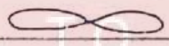
New Lec

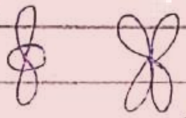
Degenerate Orbital:

orbitals having Same energy

Multielectronic System

→ Same energy
→ Same or different shape

$P =$ p_z  p_y 

d_{z^2} 

=> orientation different

Condition:

* Same n value
* Same l value
* different m value

Degenerate orbitals in

$S = 0$ $\quad$ $f = 07$

$p = 03$

$d = 05$

Q# Which one is degenerate orbital?

a) $3p_x, 3p_y, 4p_z$ $\quad$ b) $4p_x, 4p_y, 4d_{z^2}$

c) $3s, 4s, 5s$ $\quad$ d) $3d_{xy}, 3d_{yz}, 3d_{z^2}$

Same n $\quad$ same l

(#) For unielectronic System

* Same "n" value necessary.
* Any "l" value

Q# Degenerate orbitals in Hydrogen?

a) $3P_x$, $3d_{x^2z^2}$, 4s (b) ✓ $3P_x$, $3d_{xy}$, 3s
c) $3P_x$, $4P_y$, 4s d) None

Note:

Energy of es in same orbital different due to interaction of its M. field

(#) Shape of Orbital

* Related to Azimuthal Q. No.

orbitals:

* 3-Dimensional
* imaginary path
* directional character except "s"
* imaginary boundry.
* Max es = 2
* Min es = 0
* energy $\boxed{s < p < d < f}$

Penetration of orbitals

⇓

to come close to the nucleus.

$s > p > d > f$

* defined by 3 Q. NO

$3P_x$ → m; n; l

* Specifically defined by magnetic Q# no
  * obey uncertainity principle.
  * Donot obey Bohr's Rule.

Shieldlng power: $\boxed{S > p > d > f}$

due to spherical shape

Symmetry:

S → more symmetrical

other → unsymmetrical

Region → lobes

Region → Nodes

* S-orbital:

spherical

lobes = 1

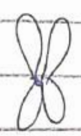
* P-orbitals:

dumbell

lobes = 02

* d-orbitals:

double dumbell



lobes = 04

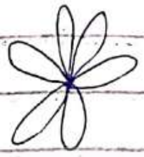
dz^2 → 2 lobes

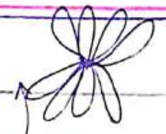
dz^2 → 1 ring

dz^2 → torus shape

dz^2 → Colar shape

f - orbital





4 - orbitals → lobes = 08

2 - orbitals → lobes = 08

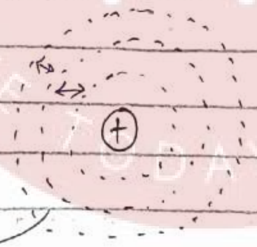
1 - orbital → lobes = 02 + 2 Rings

Node

* Region where electronic density is zero
* 3 - Dimensional
* imaginary

⇒ Radial Node:

* Spherical region where electron density is zero
* depend on principal & Azimuthal Q.No



Node

$\boxed{\text{Size of Node (Radial)} \propto n}$

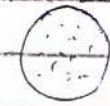
⇒ Angular Node / Nodal plane:

These are imaginary plane or cone where electron density is zero which pass from a region

* depend on Azimuthal Q No & Not "n"

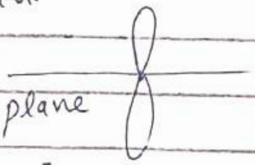
* independant of Size of orbital

* S- orbital ($l=0$)



A·N = 0 (zero)

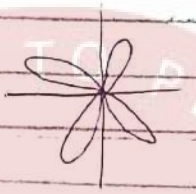
* P-orbital:



1 plane

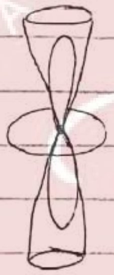
A·N = 1

* d-orbital:



A·N = 2

dz^2:



$\boxed{A·N = 02}$

↓

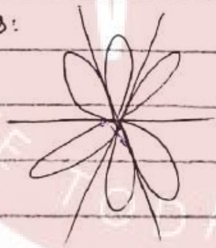
Nodal cone present.

* 8 - lobes

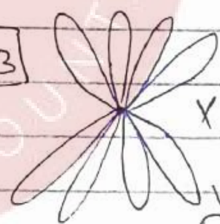
* f - orbitals:

↓

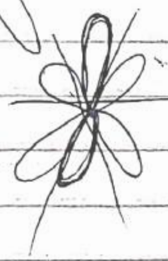
$l = 3$

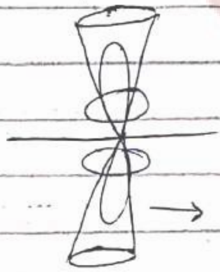


$\boxed{A·N = 03}$



X





→ 2 cones

1 plane

$\boxed{03 A·N}$

$p_x, p_y,$

For orbitals:

$R\cdot N = n - l - 1$

$A\cdot N = l$

Total node $= n - 1$

For Sub-shell:

~~$R\cdot N = (2l+1)(n-l-1)$~~

$A\cdot N = (2l+1)(l)$

Total node $= (2l+1)(n-1)$

For shell:

Total node $= n^2(n-1)$

$R\cdot N = \Sigma$ R·N of all sub-shell

$A\cdot N = \Sigma$ A·N of all sub-shell

Q# R·N in $4d_{xy}$

$R\cdot N = 4-2-1 = 1$

Q# Total nodes in 4s orbital:

$4-1 = 3$

Q# A·N in 4p:

$(2+1)(1)$

3

Q# Total nodes in 3rd shell:

$3^2(3-1)$ $\quad 9\times 2 = 18$

Q# A·N in 5th shell is:

5th shell = 5s, 5p, 5d, 5f, 5g

$0 \quad 3 \quad 10 \quad 21 \quad 36 = 70$

* Electronic Configuration

It is the arrangement of e^-s in shell, subshell, orbitals.

(#) Auf Bau's Principle:

- German word = Building up
- deals about energy of orbitals
- filling of orbitals.

* e^-s are filled in the increasing order of energy.

1	2	3	4	5	6	7
s	sp	sp	s$\boxed{d}$p	sdp	s$\boxed{f}$dp	sfdp
			$\boxed{(n-1)d}$		$\boxed{(n-2)f}$	

$\longrightarrow$ energy order / filling of e^-s in orbital.

Q#
which orbital can be filled after 6s?
4f $\boxed{\text{sfdp}}$

(n+l) Rule:

Energy $\propto l$ Energy $\propto n$

$s < p < d < f$ $\boxed{E \propto (n+l) \text{ value}}$

(n+l) Same

$\hookrightarrow$ then $\boxed{E \propto n}$

Q# W.O.F has max energy?

a) 5s b) 4p c) 3d d) Same

$5+0=5$ $4+1=5$ $3+2=5$

Q# How many e^- are possible if $n+l$ is 4.

$n+l=4$ → $4s = 2e^-$, $3p = 6e^-$ → $\boxed{8e^-}$, x

is sub-shell.

Q# How many value of m assume if $n+l=6$?

$n+l=6$ → $6s \Rightarrow 1$ orbital, $5p \Rightarrow 3$ orbitals, $4d \Rightarrow 5$ orbital

$\boxed{9 \text{ orbital}}$ or m-value

each orbital has its own "m" value

Removing of e^-:

Z up to 20:

Removing orbital = high energ.

Z beyond 20:

* Arrange orbital to n value
* Remove e^- = high energy

Q# Z = 31

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^1$

⇓

(1) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^1$ high energy

e^- removal order ← $\boxed{4p \rightarrow 4s \rightarrow 3d \rightarrow 3p \rightarrow 3s}$

Scanned with CamScanner

Chemical properties:

Generally

valence e^- =	chemical properties
Same	Same

Exception:

Group II → ns^2

He → $1s^2$

ns^2, $1s^2$ ⇓ different c.p

Q#

W.O has same c.p?

As $A = 1s^2, 2s^2, 2p^6, 3s^2$

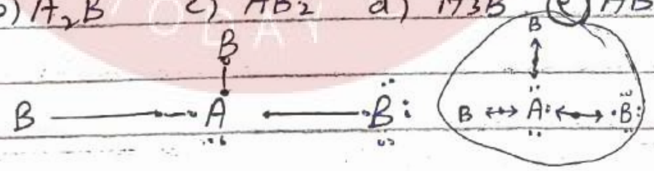
a) ~~$1s^2$~~ He   b) $2p^6$ c) $1s^2, 2s^2$ ✓   d) Both a & c

Chemical formula:

$A = 1s^2, 2s^2, 2p^6, \underline{3s^2, 3p^3} \rightarrow 5e^-$

$B = 1s^2, 2s^2, 2p^6, \underline{3s^2, 3p^5} \rightarrow 7e^-$

a) AB   b) A_2B c) AB_2 d) A_3B e) AB_3 ✓



Note:

Combine in order to complete octet or doublet.

last e^- in "s" orbital then transfer of e^- occur (ionic bond)

$\ddot{A}$

Q# $A = 1s^2, 2s^2, 2p^4$ $B = 1s^2, 2s^2, 2p^6, \underbrace{3s^2, 3p^5}_{7}$

$B - \ddot{A} - B$ (AB_2)

Q# $A = 1s^2, 2s^2, 2p^6, 3s^2 \rightarrow 2 \rightarrow$ will loss — one to one B, one to another B

$B = 1s^2, 2s^2, 2p^6, 3s^2, 3p^5 \rightarrow 7 \rightarrow$ require one $\rightarrow$ (AB_2)

Hund's Rule

=> deals about the pairing of e's.

| 1 | 1 | 1 | ✓

① → e's with same spin singally filled.

| 1 | 1 | ↓ | X

② → then pairing occur.

=> valid for degenerate orbital

=> Not valid for "S" orbital due to no degenerate orbitals.

=> valid for orbitals having more than $\boxed{\text{one e's}}$

Q# Hund's Rule is obeyed by?

H	He	Li	Be	B	C ✓
$1s^1$	$1s^2$	$1s^2, 2s^1$	$1s^2, 2s^2$	$1s^2, 2s^2, 2p^1$	$1s^2, 2s^2, 2p^2$
X	X	X	X	X	

Pauli's Exclusion Principle

=> No e^- have opposite spin.
=> Spin Q. No of two e^- is always different.

Valid

=> Valid for orbital having more than 1 e^-

* More than half e^- in sub shell.

Q# Pauli's exclusion principle is valid for:

a) $2s^1$ b) $3p^3$ c) $4f^2$ d) $3d^6$ ✓

| ↑ | X

| ↑ | ↑ | ↑ | X

| ↑ | ↑ | | | | X

| ↑↓ | ↑ | ↑ | ↑ | ↑ |

Q#: obey hund's rule | ↑↑ | ↑ | ↑ | → not obey which obey

donot obey $\boxed{\text{pauli's exclusion principle}}$

| ↑↑ | ↑↑ | ↑↑ | → hund's rule not tells about the spinning of e^-

Q# | ↑↓ | ↑ | |

→ not obey $\boxed{\text{hund's Rule}}$

but obey Pauli's exclusion principle