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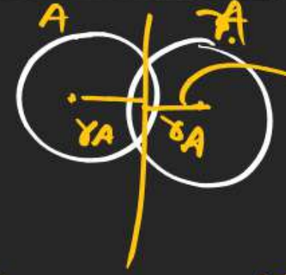
Periodic properties

① Atomic radii → we can't measure because atom does not have certain boundary

① Covalent radii

Homonuclear diatomic molecule (H_2, Cl_2, Br_2)



$d_{A-A} = r_A + r_A$

$2r_A = d_{AA}$

$$r_A = \frac{d_{A-A}}{2}$$

Ques find the r_{Cl} if d_{Cl-Cl} is 1.98 Å

$r_{Cl} = \frac{1.98}{2}$

$=$

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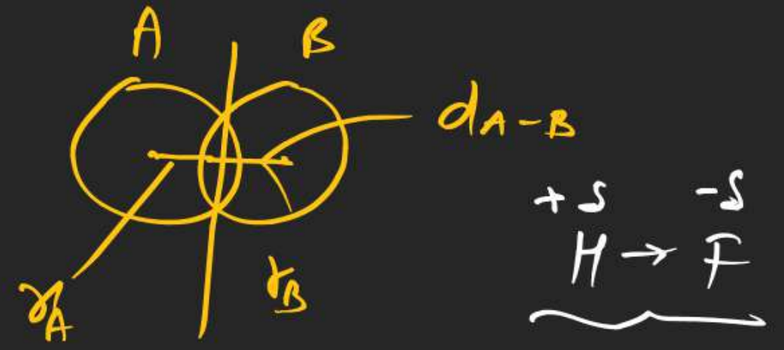
Heteronuclear diatomic molecule



+S -S

H → F

Shoumaker and Stevenson

$$d_{A-B} = r_A + r_B - 0.09|\Delta x| \text{ Å}$$

Δx = E.N diff

r_A = radius of A in A

r_B = radius of B in A

$$\boxed{d_{A-B} = r_A + r_B - 9|\Delta x| \text{ in pm}}$$

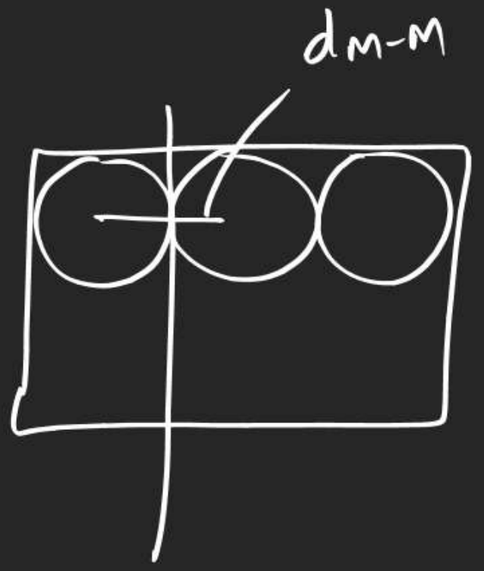
S·B·C·R D·B·C·R T·B·C·R

$C-C > C=C > C\equiv C$

We can not measure

X $H-H$ $O=O$

③ Metallic



$d_{M-M} = r_M + r_M$

$r_M = \frac{d_{M-M}}{2}$

Ex = d_{Cu-Cu} is 129 pm then r_{Cu}

$\frac{129}{2} = 64.5$ pm

Ionic Radii

- Cationic Radii
- anionic Radii

Cationic Radii

$$A > A^{+} > A^{+2} > A^{+3}$$

$$\frac{e}{p} = \frac{10}{10} \quad \frac{9}{10} \quad \frac{8}{10} \quad \frac{7}{10}$$

+ive charge ↑ size ↓

$$Fe^{+2} > Fe^{+3}$$

$$Al > Al^{+} > Al^{+3}$$

Anionic

$$X < X^{-} < X^{-2}$$

$\frac{e}{p} = \frac{10}{10} \quad \frac{11}{10} \quad \frac{12}{10}$

-ive charge | size ↑

$$O < O^{-} < O^{-2}$$

$$N < N^{-} < N^{-2} < N^{-3}$$

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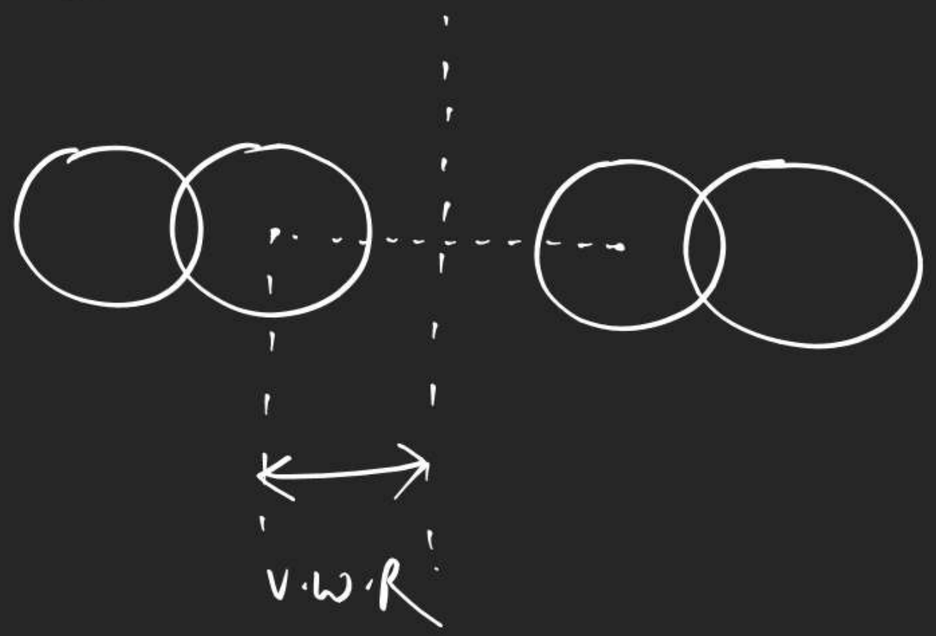
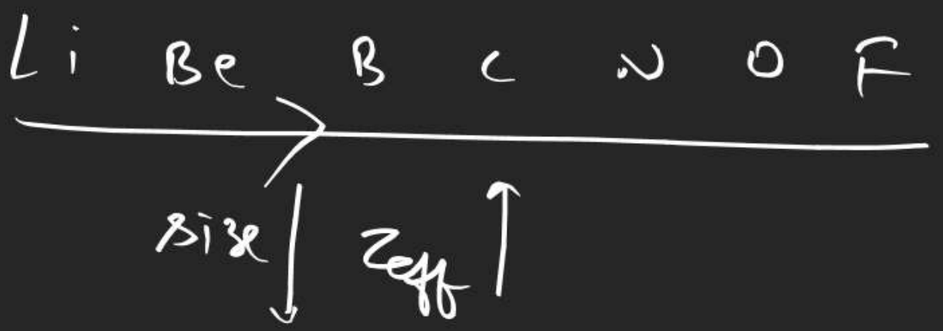
V.W.R



$V \cdot W \cdot R > C \cdot R$

Noble gas and CH_4

along the period



-Ve $\overline{T_i}$ Li > Be > B > C > N > O > F

due to V.W.R

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down the group

Li | Be
Na | Mg
K | Ca
Rb | Sr
Cs | Ba

↓ ↓ size ↑ because shell ↑

P-Block

B
143pm Al
135pm Ga
In
Tl

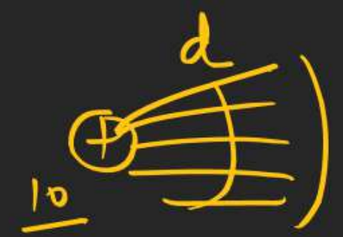
167pm 170pm
B < Ga < Al < In < Tl

due to poor s-E of 3d sub shell

Scandide Contraction

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

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



S.E

s > p > d > f

C
Si = up²
Ge
Sn
Pb

order of size

C < Si < Ge < Sn < Pb

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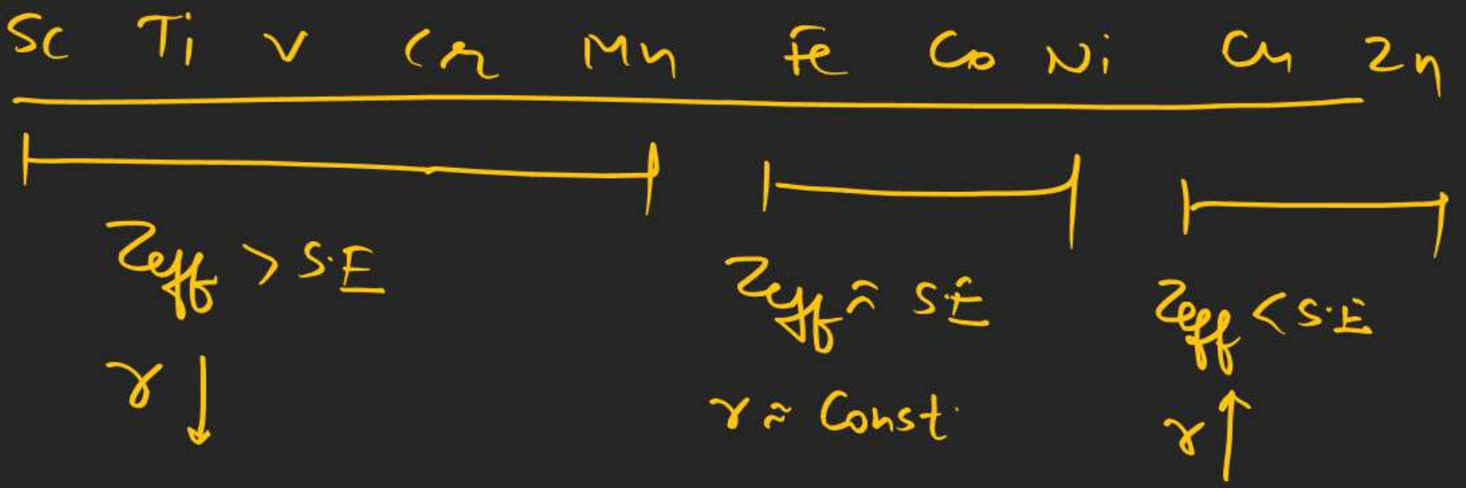
d-Block



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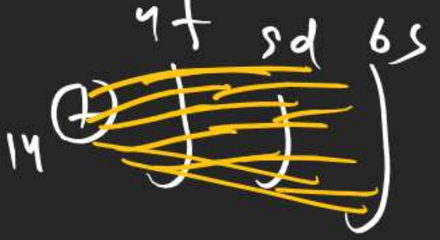
down the group:

$Ti < Zr \approx Hf$

160pm 159pm

3d	I T.S	Sc	Ti	.....	Cu Zn
4d	II T.S	Y	Zr	.....	Ag Cd
5d	III T.S	$_{57}La$	$_{72}Hf$	.....	Au Hg
		$_{89}Ac$	Ku 104		



$Sc < Y < La < Ac$

$_{58}Ce$ — $_{71}Lu$ 4f series / Lanthanide

$_{90}Th$ — Lr 5f series / Actinide
103

3d series element < 4d series element ≈ 5d series element

Ans order of size

Li^+ Mg^{+2} K^+ Rb^+

+ive charge | size

$Mg^{+2} < Li^+ < K^+ < Rb^+$

$$s^{-2} < p^{-3}$$

I.E

$$\times \quad Na_{(s)} \xrightarrow{-e} Na^{+} \quad I.E$$

$$Na_{(g)} \xrightarrow{-e} Na^{+}_{(g)} \quad I.E$$

Successive

$$Na \xrightarrow[I.E_1]{-e} Na^{+} \xrightarrow[I.E_2]{-e} Na^{+2} \xrightarrow[I.E_3]{-e} Na^{+3}$$

$$\frac{e}{p} = \frac{11}{11} \quad \frac{10}{11} \quad \frac{9}{11} \quad \frac{8}{11}$$

रासायनिक III > रासायनिक II > रासायनिक of I.E

$$I.E_3 > I.E_2 > I.E_1$$

always

$$(I.E)_n > (I.E)_{n-1}$$

Unit

endothermic

1 eV/atom = 96.4 KJ/mole

1 eV/atom = 23.1 KCal/mole

fact:

① $Z \uparrow$ I.E $\uparrow$

② $Z_{eff} \uparrow$ I.E $\uparrow$

③ $n \uparrow$ I.E $\downarrow$

④ ℓ (s < p < d < f) $\uparrow$ I.E $\downarrow$

⑤ Half filled and fully filled

$N > O$

$2s^2 2p^3$ $\quad$ $2s^2 2p^4$

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Penetration effect

(Closeness toward nucleus)

$s > p > d > f$

Be $1s^2 2s^2$ > B $1s^2 2s^2 2p^1$

Mg > Al

Ca > Ga

N	>	P
P	>	S
As	>	Se

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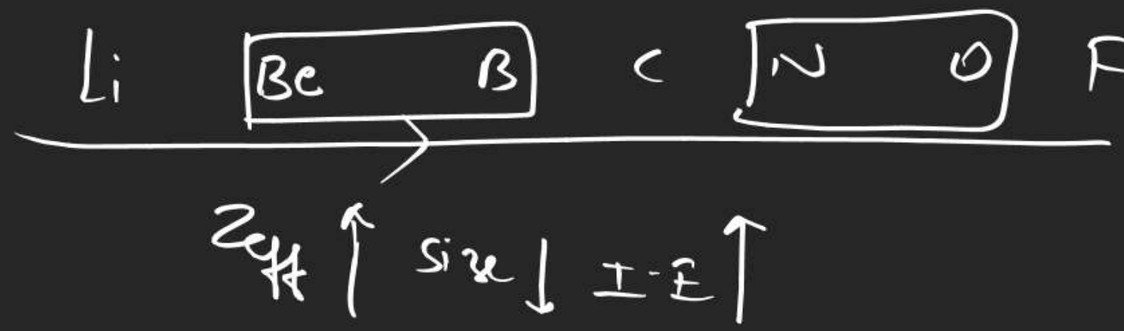
along the period



$Li < B < Be < C < O < N < F$ <<< Ne

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down the group