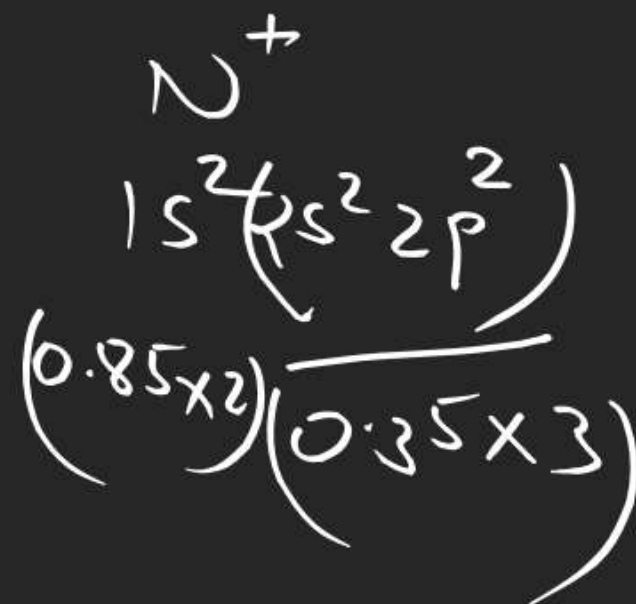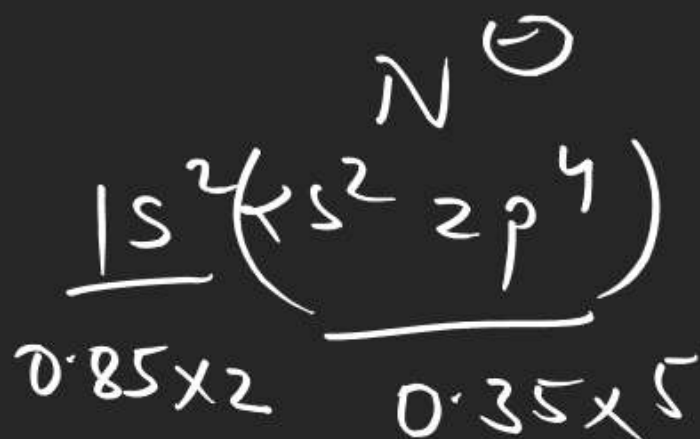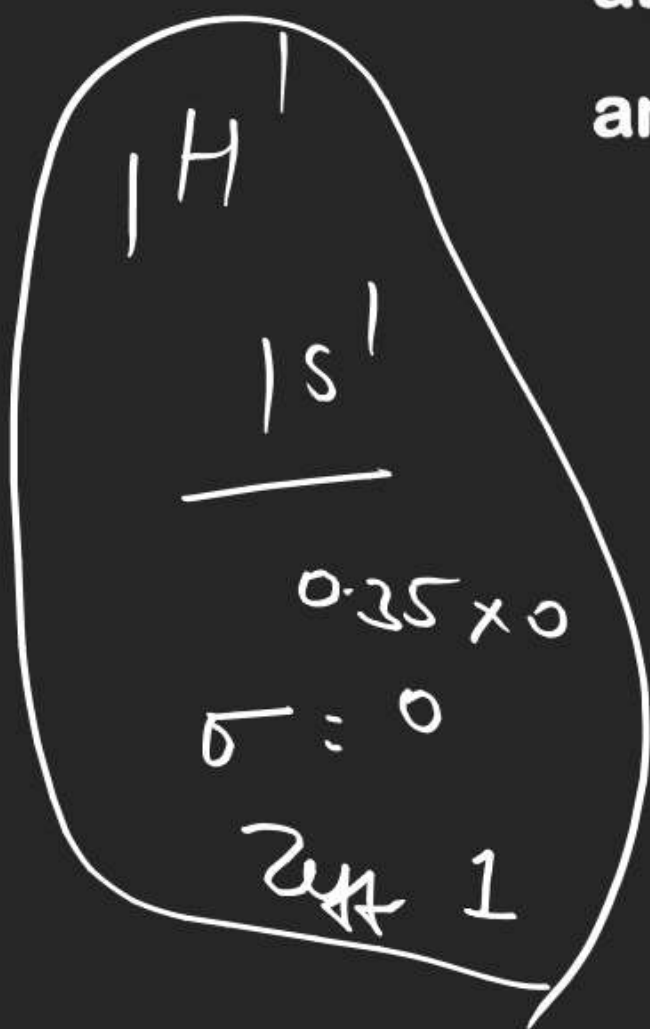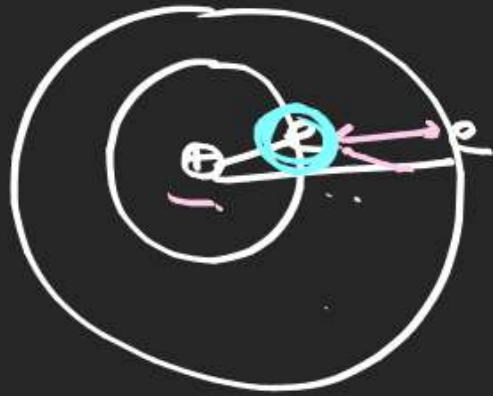# GENERAL CHEMISTRY

Example :-

Q. What is the effective nuclear charge at the periphery of nitrogen atom when an extra electron is added during the formation of an anion. Also find the value of Z_{eff} when the atom is ionized to N^+.

$1H$

$1s^1$

$\overline{}$

0.35×0

$\sigma = 0$

$Z_{eff}\ 1$

$N^{\ominus}$

$\underline{1s^2}\left(\overline{2s^2\ 2p^4}\right)$

$0.85 \times 2 \qquad 0.35 \times 5$

N^+

$\underline{1s^2}\left(\overline{2s^2\ 2p^2}\right)$

$\left(0.85 \times 2\right)\left(0.35 \times 3\right)$

effective nuclear charge $[Z_{eff}]$

$$Z_{eff} = Z - \sigma$$

S.E

$\sigma = $ Slater Constant

Proton

e^-

Proton
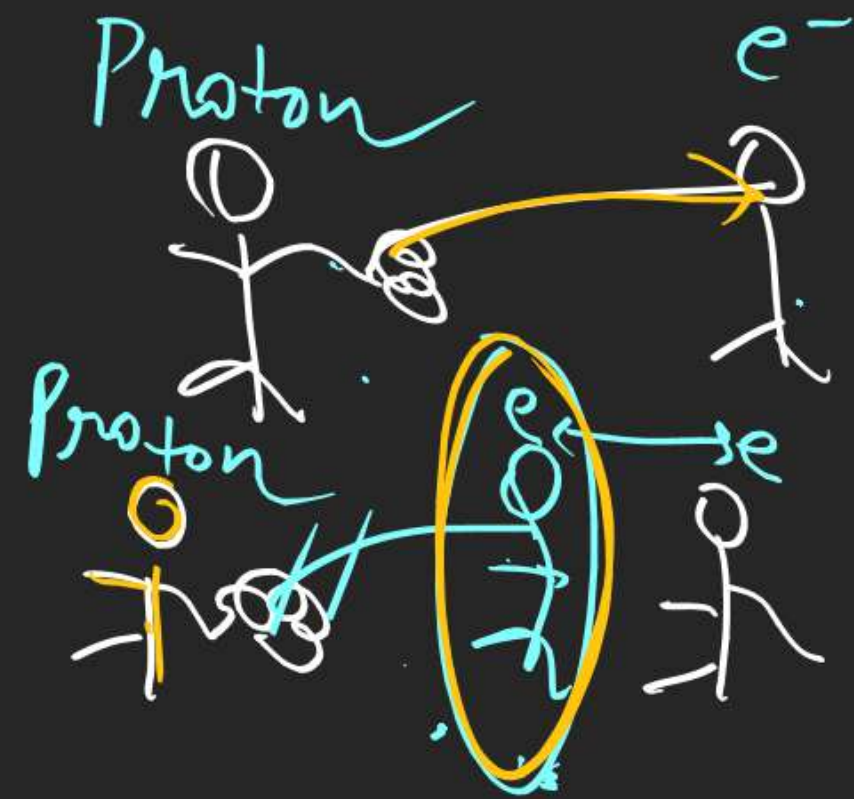
for ns and np e^-

① Write the conf. of an element

② arrange acc. to their shell

③ make groups, s and p in same group
d in diff group and f in diff. group

( )

④ ns and np e^- Contribute = 0.35

$(n-1)$ shell Contribute = 0.85

Rest shell Contribute = 1

Que. Calculate Z_{eff} of $4s e^-$ in Fe

$$_{26}Fe = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$$

$$_{26}Fe = 1s^2\ (2s^2\ 2p^6)\ (3s^2\ 3p^6)\ (3d^6)\ \boxed{4s^2}$$

$\overset{o}{t}\ \overset{p}{n}$

1×10 0.85×14 0.35×1

$\sigma =$ $10\ +\ 11.9\ +\ 0.35$

$\sigma = 22.25$

$Z_{eff} = 26 - 22.25$

$= 3.75$

Qu1 Calculate Z_{eff} of $4s\,e^-$ यूं $_{30}Zn$

$$_{30}Zn = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}$$

$$= 1s^2\left(2s^2\,2p^6\right)\left(3s^2\,3p^6\right)\left(3d^{10}\right)\boxed{4s^2}$$

$0.35 \times \underline{1}$

1×10

0.85×18

$10 + 15.3 + 0.35$

$\sigma = 25.65$

$Z_{eff} = Z - \sigma$

$= 30 - 25.65$

$= 4.35$

$_3^{Li}$

$1S^2 \, 2S^1$

$0.85 \times 2 \quad 0.35 \times 0$

$\sigma \quad 1.70$

$Z_{eff} = 3 - 1.70$

$= 1.30$

$_4^{Be}$

$\underline{1S^2 \, 2S^2}$

$0.85 \times 2 \quad 0.35 \times 1$

$1.70 + 0.35$

$\sigma = 2.05$

$Z_{eff} = 4 - 2.05$

$_5^{B}$

$1S^2 (2S^2 \, 2p^1)$

$0.85 \times 2 \quad 0.35 \times 2 \quad + 0.35 \times 3$

$.85 \times 2$

$_6^{C}$

$1S^2 (2S^2 \, 2p^2)$

$_7^{N}$

$1S^2 (2S^2 \, 2p^3)$

$_8^{O}$

$_9^{F}$

$N = \dfrac{1S^2 (2S^2 \, 2p^3)}{0.85 \times 2 \quad 0.35 \times 4}$

$O = \dfrac{1S^2 (2S^2 \, 2p^4)}{0.85 \times 2 \quad 0.35 \times 5}$
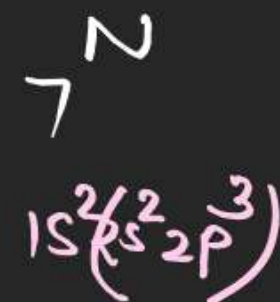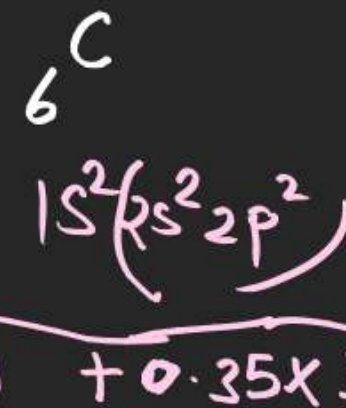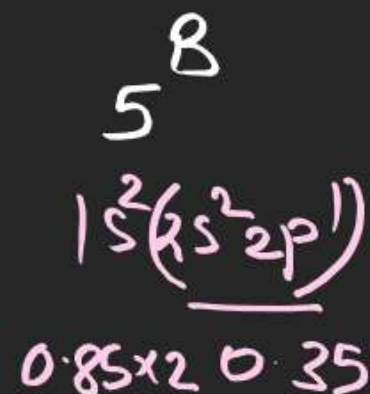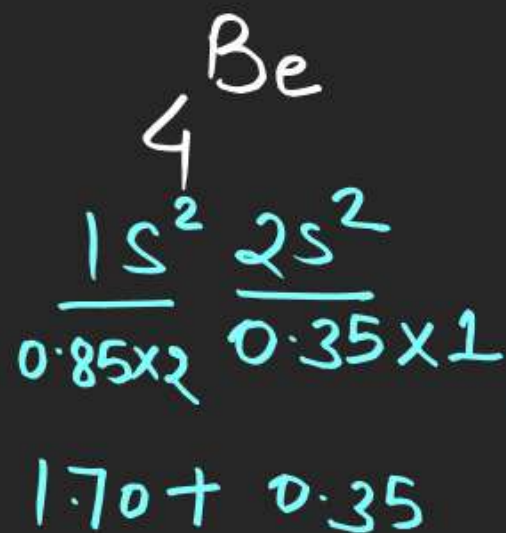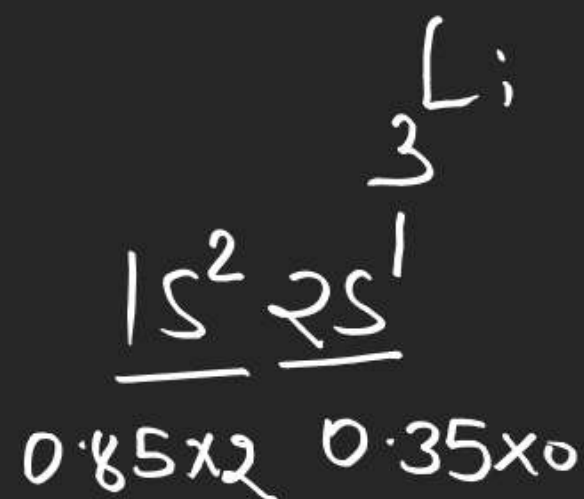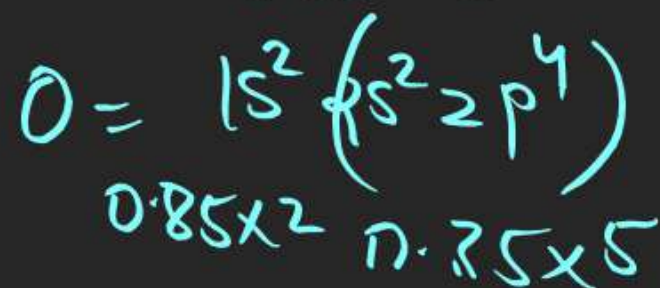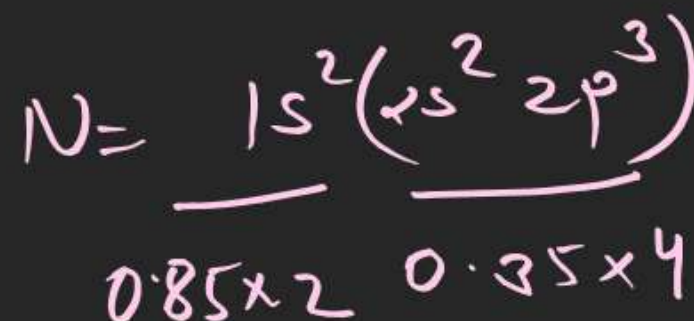
$$f = \dfrac{1s^2 \overbrace{(2s^2 \; 2p^5)}}{\underbrace{0.85 \times 2}_{} \quad \underbrace{0.35 \times \underline{6}}_{}}$$

$$\boxed{\begin{array}{l} \text{for } d \ e^- \\ \hline \text{for } d e^- = 0.35 \\ \quad Rest = 1 \end{array}}$$

Que Calculate Z_{eff} of <u>last</u> e^- of Fe_{26}

$$_{26}Fe = 1s^2 \ 2s^2 \ 2p^6 \ 3s^2 \ 3p^6 \ 4s^2 \ 3d^6$$

$$= \underline{1s^2 (2s^2 \ 2p^6)(3s^2 \ 3p^6)(3d^6)} \ 4s^2$$
$$\underset{1\times18}{} \qquad \underset{(0.35\times5)}{}$$
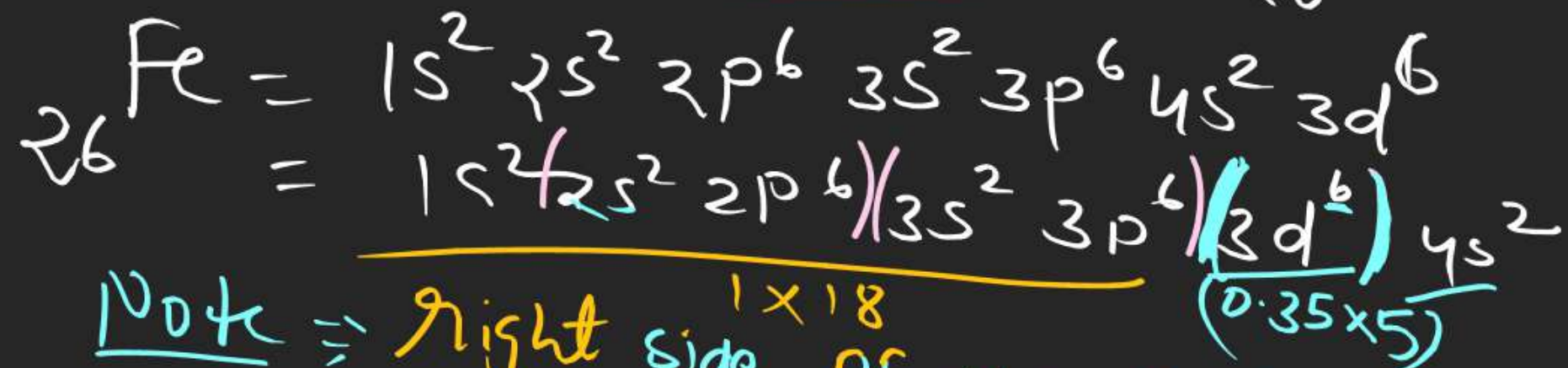
Note ⇒ right side of the group do not Contribute towards σ

$$\overline{\sigma} = 19.75$$

$$Z_{eff} = 26 - 19.75$$
$$= 6.25$$

Que Calculate Z_{eff} of last e^- $\left[3d\right]$ of $_{30}^{}Z$?

$_{30}Zn = 1s^2 \; 2s^2 2p^6 \; 3s^2 3p^6 \; 4s^2 \; 3d^{10}$

$\quad = 1s^2 \left(2s^2 2p^6\right)\left(3s^2 3p^6\right)\left(3d^{10}\right) 4s^2$

$\underbrace{\qquad\qquad\qquad\qquad\qquad}_{1 \times 18}$ $\underline{0.35 \times 9}$

$\sigma = 21.15 \quad \left(18 + 0.35 \times 9\right)$

$Z_{eff} = 30 - 21.15$

$\quad = 8.85$

Calculate Z_{eff} on 11th e^- of Cl

$_{17}Cl = 1s^2 (2s^2 2p^6)(3s^2 3p^5)$

$\underset{1 \times 2}{} \quad \underset{0.85 \times 8}{} \quad \underset{0.35 \times 6}{}$

$= 2 + 6.8 + 2.1$

$\sigma = 10.9$

$Z_{eff} = 17 - 10.9$

$= \underline{6.1}$

Only for $1S^2$

$$\sigma = \underline{0.30}$$

$_2He = \underline{1S^2}$

$$\sigma = 0.30$$

$$Z_{eff} = Z - 0.30$$
$$= 2 - 0.30$$
$$= \underline{1.70}$$

GENERAL CHEMISTRY

5. Value of Z_{eff} of $4s$ electron of $_{21}Sc$ is.

(A) 4　　　　　(B) 3　　　　　(C) 2　　　　　(D) 1

$$_{21}Sc = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$$

$$= 1s^2(2s^2\ 2p^6)(3s^2\ 3p^6)(3d^1)\ 4s^2$$

$$\underbrace{}_{1\times 10}\ \underbrace{}_{0.85\times 9}\ \underbrace{}_{0.35\times 1}$$

$$10 + 7.65 + 0.35$$

$$\sigma = \underline{18} \quad \frac{10+8}{18}$$

$$Z_{eff} = 21 - 18$$

$$= \underline{3}$$

$$_3Li = \overset{\overbrace{(0.85\times2)}}{\underset{1S^2}{\underset{1.70}{}}}\; \underset{2S^1}{\overset{0.35\times0}{}}$$

$$_{11}Na = \underset{1\times2}{1S^2}\; \underset{0.85\times8}{\overbrace{(2S^2\; 2p^6)}}\; \underset{0.35\times0}{3S^1}$$

Li

$$\left.\begin{array}{l} Na \\ K \\ Rb \\ Cs \end{array}\right\} Z_{eff} = 2.2$$

$$\underline{2} + 6.8$$

$$\sigma \quad \underline{8\cdot8}$$

$$Z_{eff} = 11 - 8\cdot8$$

$$= 2\cdot2$$

$$_{19}K = \underset{1\times10}{1S^2\; 2S^2\; 2p^6\; 3S^2\; 3p^6}\; \underset{0.85\times8}{}\; \underset{0.35\times0}{4S^1}$$

$$10 + 6\cdot8$$

$$\sigma = 16\cdot8$$

$$Z_{eff} = 19 - 16\cdot8$$

$$= 2\cdot2$$

Homework

DPP $\longrightarrow$ 1 2 3 4

Sheet of General Chemistry