Some Basic Concepts of Chemistry

Elemental Representation

E

M → Mass number → no. of (protons + neutrons)

Z → Atomic Number → no. of protons

$$M = n + p$$

$$Z = p$$

$n = (M) - (Z)$ **p, n**

$q_p = (+e) = +1.6 \times 10^{-19} C$

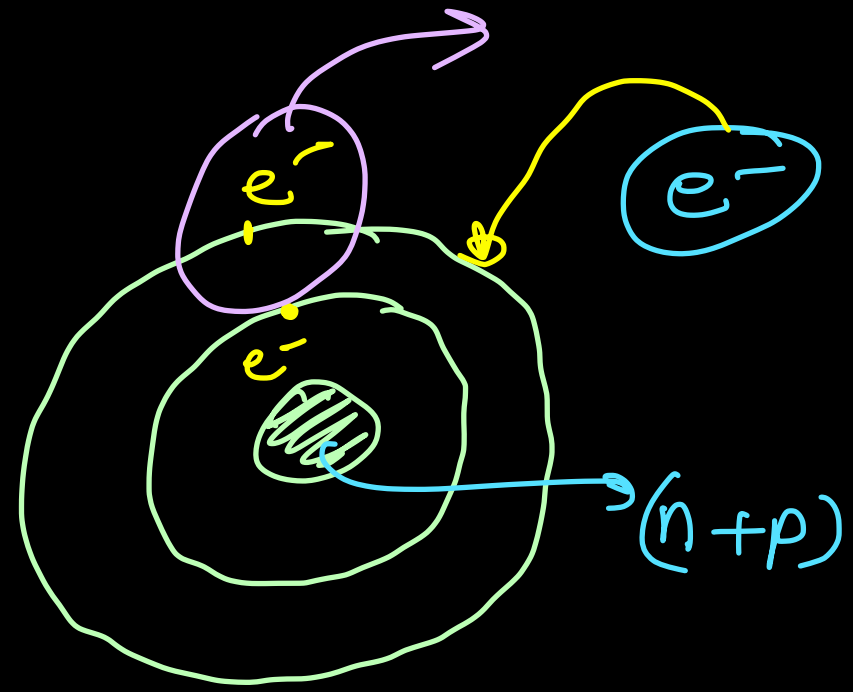
$q_e = (-e) = -1.6 \times 10^{-19} C$

O^{16}_{8}

$p = 8$

$n = 16 - 8 = 8$

$p = e = 8$



O^{2-}

$p = 8$

$n = 8$

$e^- = 10$

$^{23}_{11}Na$ (p+n)

p

Na^{+}

p = 11

n = 12

e = 10

$^{24}_{12}Mg \longrightarrow \underbrace{Mg^{2+}}_{(10e^-)} + \underline{\underline{2e^-}}$

#Q. Find the number of p, n and e present in $^{238}U_{92}$

$p = 92$

$n = 238 - 92 = 146$

$e = 92$

#Q. Find the total number of neutrons present in H_2O

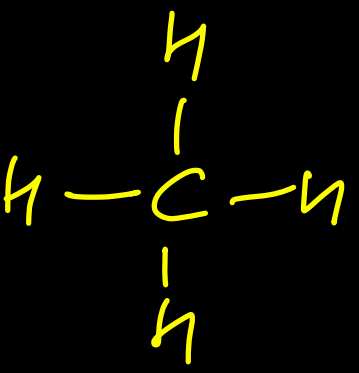
$p = 10$

$n = 8$

$e = 10$

	H_1^1	O_8^{16}	H_1^1
p	1	8	1
n	0	8	0
e	1	8	1

#Q. Find the total number of protons present in CH_4



C_6^{12} H_1^1

$p = 6 + 4(1) = 10$

$n = 6 + 4(0) = 6$

$e = 6 + 4(1) = 10$

	C	H	H	H	H
p	6	1	1	1	1
n	6	0	0	0	0
e	6	1	1	1	1

#Q. Find the total number of electrons present in NO_3^- (Nitrate)

N_7^{14} O_8^{16}

$p=7$	$p=8$
$n=7$	$n=8$
$e=7$	$e=8$

$$p = 7 + 3(8) = 31$$

$$n = 7 + 3(8) = 31$$

$$e = 31 + 1 = 32$$

#Q. Find the total number of electrons present in SO_4^{2-}

(SULPHATE)

S_{16}^{32} O_8^{16}

p = 16 | 0 = 8

n = 16 | n = 8

$p = 16 + 4(8) = 16 + 32 = 48$

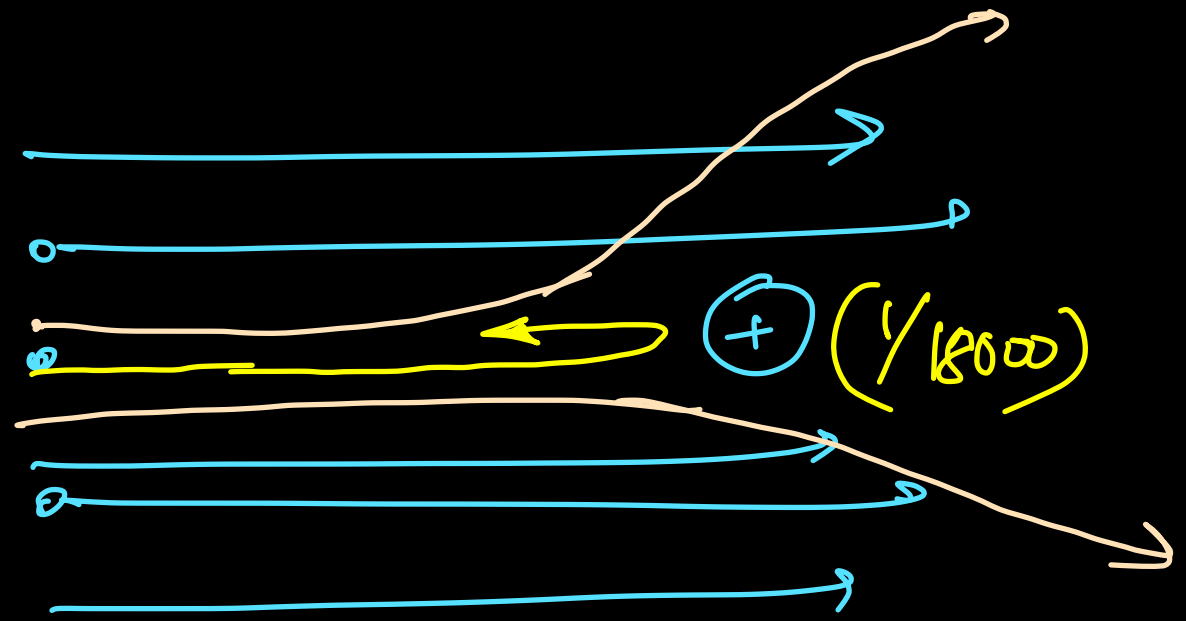
$n = 16 + 4(8) = 48$

$e = p + 2 = 50$

Alpha, Beta and Gamma Particles

α – Alpha : Helium Nucleus (He^{2+})

α_2^4



Beta (β) → (electrons) β_{-1}^0 e_{-1}^0

β^- (default) $\rightarrow$ β $\rightarrow$ (e^-)

$\beta^+ \rightarrow$ (position) positively charged electron

β^0_{+1}

γ ray $\rightarrow$ pure energy particle (massless)

(PHOTONS)

$$[m_p = m_n = 1.67 \times 10^{-24}\ g = 1.67 \times 10^{-27}\ kg$$

$$= 1\ u \text{ or } 1\ amu$$

$$[m_e = 9.1 \times 10^{-31}\ kg]$$

$$* \left(\frac{m_p}{m_e} \simeq 1840\right) *$$

$$q_p = +e = 1.6 \times 10^{-19}\ C$$

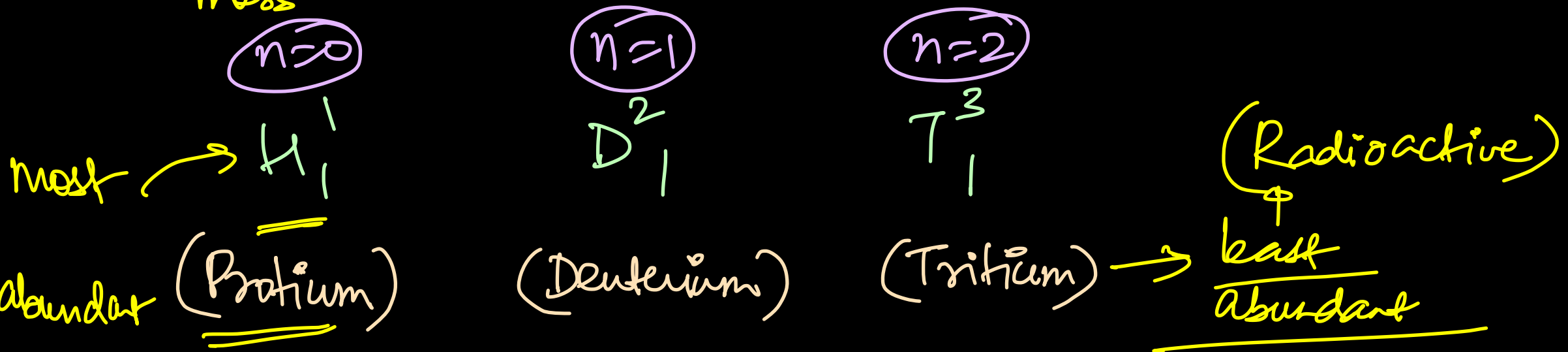
$$q_e = -e = -1.6 \times 10^{-19}\ C$$

$$q_n = 0$$

↳ neutron is a neutral particle

Isotopes

Species with same atomic number but different atomic mass.



These have the same no. of protons but diff. no. of neutrons.

C_6^{12}

C_6^{14}

(Radioactive)

$N_7^{14} \longrightarrow C_6^{14} + \beta_1^0$

Isobars

These have the same mass number but different atomic number:

Same (n+p)

They neither have same protons nor same neutrons but have the same (proton + neutron)

Isotones

These have the same number of neutrons

↳ Same $(M-Z)$

$M = n+p$

$Z = p$

$(M-Z) = (n)$

#Q. Comment whether the following are Isotones? (more than one correct)

1. $^{13}C_6$ and $^{14}N_7$ → (7n)

2. $^{30}Si_{14}$ and $^{31}P_{15}$ → (16n)

3. $^{38}Ar_{18}$ and $^{40}Ca_{20}$ → (20n)

4. $^{92}Mo_{42}$ and $^{86}Kr_{36}$ → (50n)

$C_6^{13} = 13-6 = 7$

$Ca_{20}^{40} = 40-20 = 20$

$Kr_{36}^{86} = 86-36 = 50$

Isodiaphers

These have the same neutronic excess w.r.t protons.

Same $(n-p)$

Same $(M-2Z)$

$n = M-Z$

$p = Z$

$(n-p) = (M-2Z)$

#Q. Comment whether the following are Isodiaphers? (Multi Correct)

1. $^{11}B_5$ and $^{13}C_6$ ✓
2. $^{234}Th_{90}$ and $^{238}U_{92}$ ✓
3. $^{224}Ra_{88}$ and $^{220}Rn_{86}$ ✓
4. $^{216}Po_{84}$ and $^{228}Th_{90}$ ✓

B :- $11-2(5) = 1$

C :- $13-2(6) = 1$

Th $234-2(90) = 234-180 = 54$

U $238-2(92) = 238-184 = 54$

Ra $224-2(88) = 224-176 = 48$

Rn $220-2(86) = 220-172 = 48$

Po $216-2(84) = 48$

T $228-2(90) = 48$

Isoelectronic

These have the same no. of electrons.

① CO_2 and N_2O

CO_2: $6 + 8\times2 = 22$

N_2O: $7\times2 + 8 = 22$

② How many of the following are Iso-electronic (All).

N^{3-} (7), O^{2-} (8), F^- (9), Ne (10), Na^+ (11), Mg^{2+} (12), Al^{3+} (13)

(10 electrons)

#Q. Comment whether the following are Isoelectronic?

1. Ne and Na^+ (10), (10) Na_{11} $Na^+ \rightarrow 10e^-$
2. CO and NO^+ (C-6 O-8) $14e^-$ $(N-7, O-8)^+$ $15-1=(14e^-)$
3. O^{2-} and Ne $10e^-$, $10e^-$
4. CO_2 and N_2O

$6+2(8)$ $2(7)+8$

22 22

ISOSTERS

They have the same number of atoms as well as same number of electrons

CO_2 N_2O

(22 e^-)

(3 atoms each)