M. D. C. Part I
Chem (Hons)

BERYLLIUM

Gp. B (Inorg. Chem
Unit 2(b)

Symbol → Be
Atomic number → 4
Atomic weight → 9.01
Electronic configuration
Be(4) → $1s^2 2s^2$

Position in Periodic table →
Since the last electron enters in 2nd orbit.
Last orbit No = 2 = Period No
Hence it is member of 2nd Period
Again,
Valence electrons = 2
Gr. No = II
Since last electrons enters in S-Orbital, hence Sub group is A.
It is member of S-block and is non-transition metals.
Hence it is placed in II A Group of Periodic table.
It is also member of alkaline earth metals. Gp. II A elements are Earth like material and five alkaline earth with water. Hence these are called alkaline earth metals.

Oxidation State :→

It shows fixed oxidation State of +2. +1 oxidation state is unstable and disproportionate to M and M^{+2} in Solution. +3 State can not be formed due to very high I.P III.

$Be \longrightarrow 2s^2$

$Be^{+} \longrightarrow 2s^1$ (unstable)

$Be^{+2} \longrightarrow 2s^0$ (stable)

$Be^{+3} \longrightarrow 1s^1 2s^0$ (can not be formed).

Nature of bonds in compounds :⟶.

Compounds of Be have Co-valent character in anhydrous salt like $BeCl_2$, BeO. But hydrated salt are ionic

$$BeCl_2, 4H_2O \equiv \left[Be(H_2O)_4\right]^{+2} 2Cl^-$$

The covalent bond character is due to ~~ionic~~ greater ionic potential due to small radius.

$$\text{Ionic potential, } \mu = \frac{\text{charge}}{\text{Radius}}.$$

Acid-Base nature :⟶.

Its oxides and hydroxides have amphoteric nature.

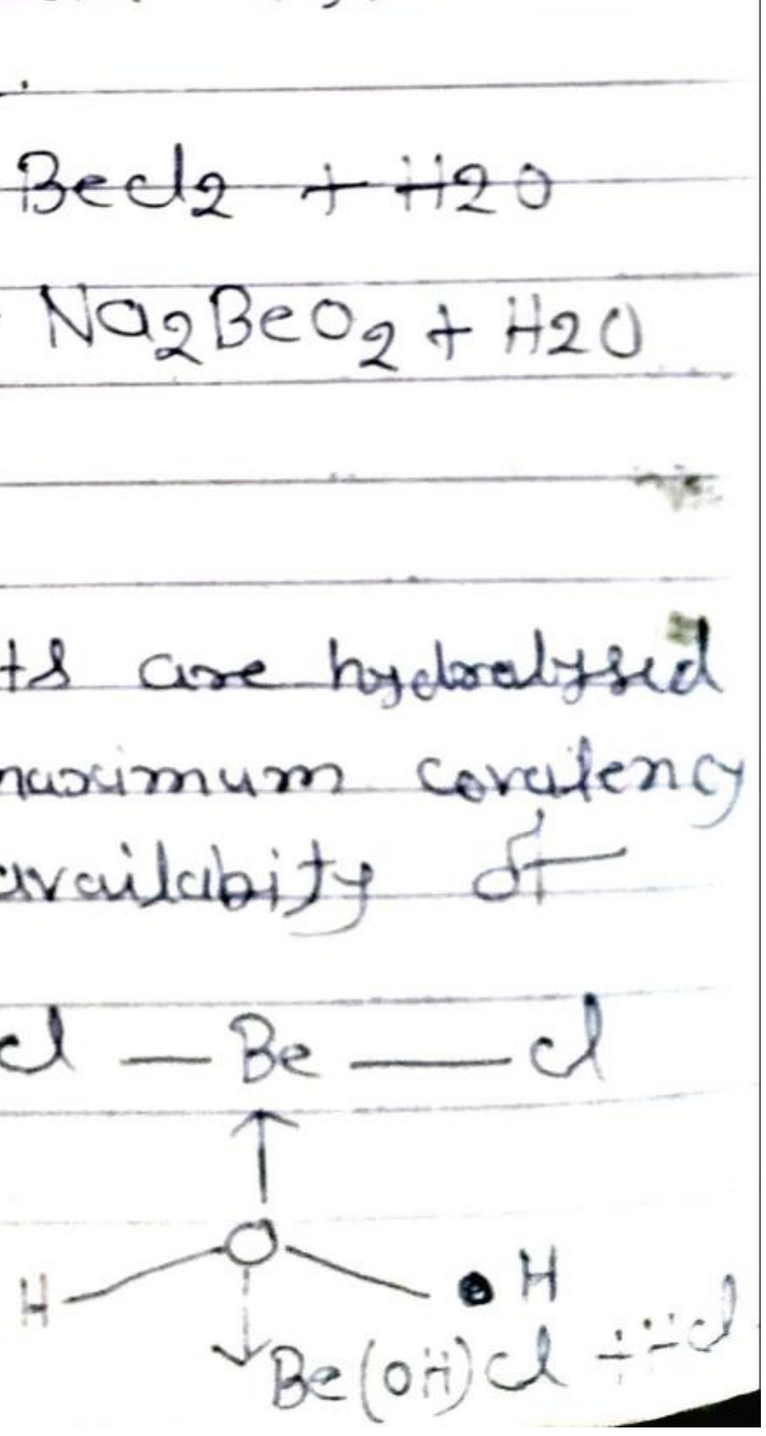
$$BeO + 2HCl \longrightarrow BeCl_2 + H_2O$$

$$BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$$

Hydrolysis :⟶.

Be^{+2} salts are hydrolysed due to unsaturation of maximum covalency and availability of empty p-orbitals.

$$BeCl_2 + H_2O \longrightarrow$$



Magnetic Property :→

Be and Be^{+2} and their compounds are diamagnetic. This is because. Here there is no possibility of unpaired electron.

$$n = 0$$

$$\mu = \sqrt{n(n+2)} \quad B.M$$

$\mu = 0 \longrightarrow$ Diamagnetic.

Occurence :→.

It is never found in free state. It occurs in a no. of minerals;

Cheif ores :→.

(i) Beryl ~~Ber~~ $3\,BeO.Al_2O_3.6SiO_2$

(ii) Bromellite →. BeO.

Extraction :→.

~~Extracti~~ Extraction Be is generally done from beryl. From beryl are first of all, fused beryllium chloride is obtained which on electrolysis gives Be. The most important method used is alkal fusion method.

Beryl.

$3BeO.Al_2O_3.6SiO_2$.

Fused with conc. H_2SO_4 and extracted with water.

solution
$BeSO_4.Al_2(SO_4)_3$

Residue
SiO_2.

$(NH_4)_2SO_4$.

$BeSO_4$ (Solution)

$(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$
Alum crystals.

NH_4OH

$Be(OH)_2$ ppt.

$(NH_4)_2SO_4$.

Δ

$BeO \xrightarrow{C+Cl_2} BeCl_2 \xrightarrow{Fused} BeCl_2$ fused.

$BeCl_2 \longrightarrow Be^{+} + 2Cl^{-}$

$Be^{+2} + 2e \rightarrow Be$ at ~~anode~~ cathode

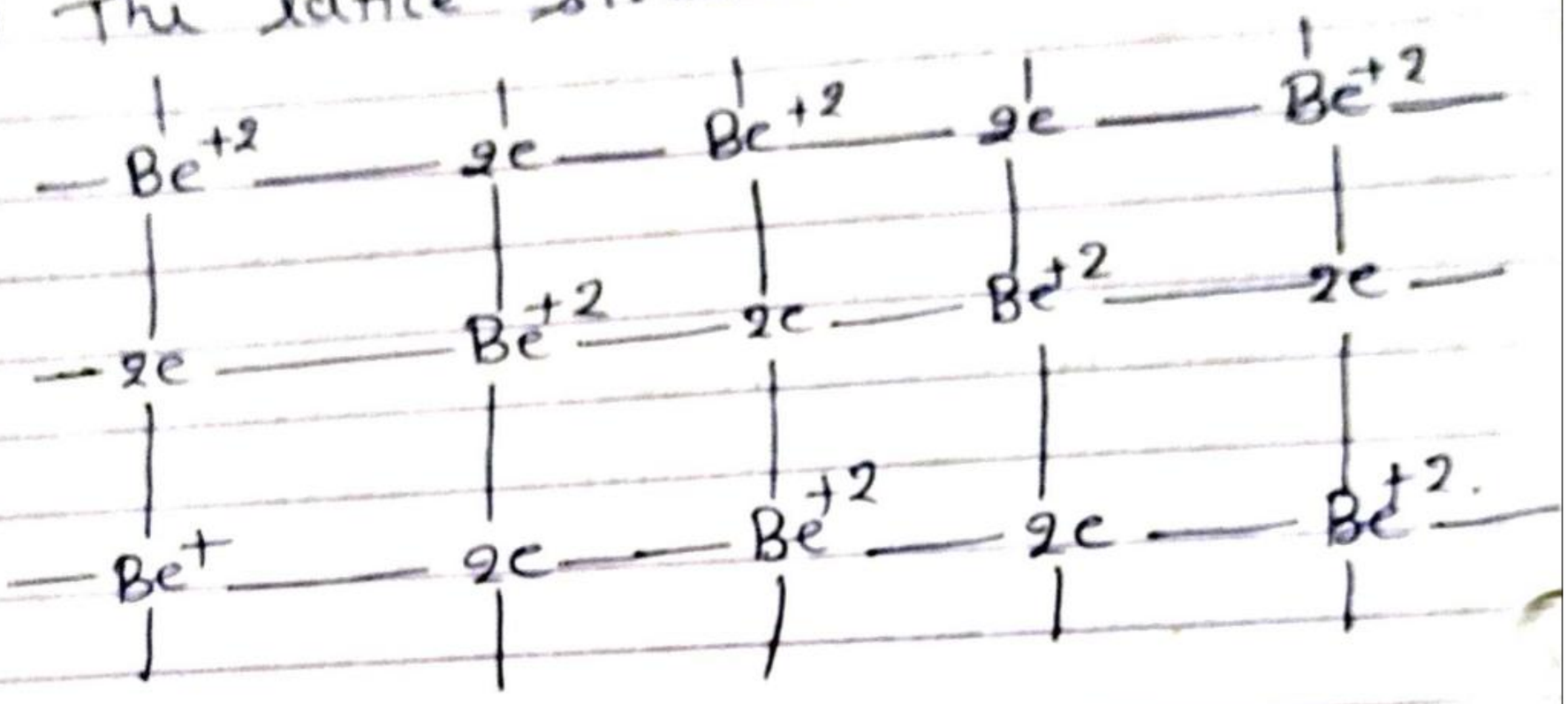
$2Cl^{-} \longrightarrow Cl_2 + 2e$ at anode

$BeCl_2$ Fused, $\xrightarrow{\text{Electrolysis}} Be + Cl_2$.

Properties :→

(1) Physical Properties :→

(i) It is silvery white metal
(ii) It is malleable and takes a high polish
(iii) It is a light metal
(iv) The lattice structure is as :-



(v) The m.p and b.p are high in comparision to other members of Gr. II A. due to covalent character.

m.p = 1278 °C
B.p = 2600 °C.

(2) Chemical Properties :→

(i) $Be + H_2 \xrightarrow{\Delta} BeH_2$.
(ii) $Be + \frac{1}{2}O_2 \xrightarrow{\Delta} BeO$
(iii) $3Be + N_2 \xrightarrow{900^\circ C} Be_3N_2$
(iv) $Be * X_2 \xrightarrow{\Delta} BeX_2$.
(v) $2Be + C \longrightarrow Be_2C$
(vi) $Be + H_2O \xrightarrow[\text{steam}]{\Delta} BeO + H_2$.
(vii) Dil. HCl

$Be + 2HCl \longrightarrow BeCl_2 + H_2$.

(viii) Dil. H_2SO_4.

$Be + H_2SO_4 \longrightarrow BeSO_4 + H_2$.

(ix) Dil. HNO_3 :

Be + HNO_3 ⟶ It becomes passive (inert)

(x) Be with NaOH

Be + 2NaOH ⟶ $Na_2BeO_2 + H_2$

(xi) Be decomposes partially SiO_2 into Si.

$2Be + SiO_2 \longrightarrow 2BeO + Si$

The metal is above H in the chemical series and so they react dil. acids to give H_2. It is amphoteric so it reacts with NaOH also.

Uses :⟶

(i) Be is used as windows in X-rays tubes.

(ii) It is used in the production of alloys :-

Be – Fe alloy ⟶ Manufacture of aerobic parts.

Be – Cu alloy ⟶ Manufacture of Ball Bearings.

Important Compounds :→

(1) Beryllium oxide (BeO)

(2) Beryllium hydride (BeH_2)

(3) Beryllium chloride ($BeCl_2$)

(4) Basic beryllium acetate Be_4O (CH_3CO