1. Structures of $BeCl_2$ in solid state, vapour phase and at very high temperature respectively are:
[2023 (06 Apr Shift 2)]
(1) Monomeric, Dimeric, Polymeric
(2) Dimeric, Polymeric, Monomeric
(3) Polymeric, Monomeric, Dimeric
(4) Polymeric, Dimeric, Monomeric

2. Given below are two statements:
Statement I: Boron is extremely hard indicating its high lattice energy.
Statement II: Boron has highest melting and boiling point compared to its other group members.
In the light of the above statements, choose the most appropriate answer from the options given below
[2023 (12 Apr Shift 1)]
(1) Both Statement I and Statement II are incorrect
(2) Statement I is correct but Statement II is incorrect
(3) Both statement I and Statement II are correct
(4) Statement I is incorrect but Statement II is correct

3. Better method for preparation of BeF_2, among the following is
[2023 (13 Apr Shift 2)]
(1) $BeO + C + F_2 \xrightarrow{\Delta} BeF_2$
(2) $(NH_4)_2 BeF_4 \xrightarrow{\Delta} BeF_2$
(3) $Be + F_2 \xrightarrow{\Delta} BeF_2$
(4) $BeH_2 + F_2 \xrightarrow{\Delta} BeF_2$

4. If the formula of Borax is $Na_2\ B_4O_x(OH)_y \cdot zH_2O$, then $x + y + z =$ _____
[2023 (13 Apr Shift 2)]

5. For a good quality cement, the ratio of silica to alumina is found to be
[2023 (15 Apr Shift 1)]
(1) 1.5
(2) 4.5
(3) 2
(4) 3

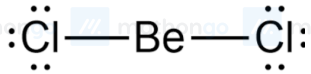
ANSWER KEYS

1. (4) **2.** (3) **3.** (2) **4.** (17) **5.** (4)

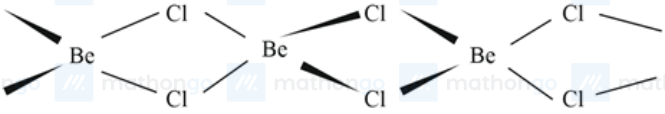
1. (4)

$BeCl_2$ is dimeric in vapour phase. The coordination number of beryllium is 3.

$BeCl_2$ is monomeric at high temperature. The coordination number of beryllium is 2.



$BeCl_2$ is polymeric in solid state. The coordination number of beryllium is 4.



2. (3)

Boron is extremely hard as it exists as B_{12} icosahedral molecular units which accounts for its high lattice energy. So, statement-I is correct.

Due to small atomic size boron forms strong covalent bonds with the neighbouring atoms. Thus, boron atoms are closely packed in its solid, thus boron has high melting and boiling points. So, statement-II is also correct.

3. (2)

The beryllium fluoride cannot be easily prepared by simple methods. It is known that beryllium oxide dissolves in aqueous hydrofluoric acid with the formation of the fluoride, but on evaporation of the resulting solution some of the combined acid is lost, and the residue is believed to be an oxy fluoride.

Thermal decomposition of $(NH_4)_2\,BeF_4$, is the best route for the preparation of BeF_2

$(NH_4)_2\,BeF_4 \longrightarrow 2\,NH_4\ F + BeF_2$

4. (17)

The crude name of borax is Tincal. It has the molecular formula $Na_2\,B_4O_7.10H_2O$ and structural formula of borax is $Na_2[\,B_4O_5(OH)_4].8H_2O$

Based on the structural formula, $x = 5,\ y = 4$ and $z = 8$

$(x + y + z) = 5 + 4 + 8 = 17$

5. (4) For a good quality cement the ratio of silica (SiO_2) and alumina ($Al_2\,O_3$) should be between 2.5 to 4.0. Similarly, the ratio of lime (CaO) to the total oxide mixtures consisting of SiO_2, $Al_2\,O_3$ and $Fe_2\,O_3$ should be roughly $2:1:1$, If lime is in excess, the cement cracks during setting.