Alkaline Earth Metals

PART - A
Section - I
Short Answer Questions (2M)

1. Write the elements of Group-IIA of Periodic table?

A. The Group IIA elements are
Beryllium (4)
Magnesium (12)
Calcium (20)
Stronsium (38)
Barium (56)
Radium (88)

2. Write the electronic configurations of Group IIA elements?

A. The electronic configurs of Group IIA elements are
Be - [He] $2s^2$
Mg - [Ne] $3s^2$
Ca - [Ar]$4s^2$
Sr - [Kr] $5s^2$
Ba - [Xe] $6s^2$
Ra - [Rn] $7s^2$

3. Why does Ionisation energy of Group IIA elements decrease from Be to Ra?

A. The first as well as the second ionisation energy decreases on going down the group from beryllium to Radium. This is to be expected on account of increase in the atomic radius or atomic size. As the atomic size increases, the attraction between the nucleus and the outermost electron decreases. Hence it is easier to remove an electron from the outermost shell as we go down.

4. What information does the irregularity in the trends of melting point and boiling point of alkaline earth metal give?

A. The irregularity in the trends of M.P and B.P arises due to the differences in the packing of atoms in the crystals and interatomic forces.

5. Why do you add KC*l* and Nacl to MgCl_2 during Mg extraction?

A. During the extraction of Magnesium sodium chloride (NaC*l*) and Potassium chloride (KC*l*) are added to the magnesium chloride (MgCl_2). This addition will lower the melting point of MgCl_2 and also increase the conductivity of the electroyte.

6. Write the electrode reactions during my extraction?

A. During electrolysis the following reactions takes place.
$MgCl_2 \rightarrow Mg^{2+} + 2Cl^-$
Reaction at cathode $Mg^{2+} + 2e^- \rightarrow Mg$

Reaction at Anode $2Cl^- \rightarrow Cl_2 + 2e^-$

$\therefore MgCl_2 \rightarrow Cl_2 + Mg$

7. How the electronegativity varies in the Group IIA elements?

A. Alkali earth metals have strong electropositive character. So, they have low electronegatives. The values of electronegativity decreases from Beryllium to Radium.

Section - II
Very Short Answer Questions (1M)

1. "Group II A metals are often called alkaline earth metals" - Why?

A. They were found in abundance in earth crust.

2. How the Atomic size varies from beryllium (Be) to Radium (Ra)?

A. The Atomic Size increases on moving down from Be to Ra.

3. Why the electronegativity decreases from Be to Ra?

A. Due to increase in atomic Size.

4. "Alkaline earth metals are chemically very reactive" - Why?

A. Due to their high electro positive character.

5. Why Group IIA elements do not occur in elemental state?

A. Group IIA elements are very reactive and hence do not occur in elemental state.

6. Give one example of which has hygroscopic in nature?

A. $BeCl_2$ (Beryllium Chloride)

7. Name two ores of magnesium?

A. The important two ores of magnesium are

1) Magnesite ($MgCO_3$)

2) Carnalite ($MgCl_2$: KCl. $6H_2O$)

8. What are the electrodes used in the magnesium extraction?

A. Iron pot is cathode and graphite rod is anode.

9. Which metals are present in dolomite?

A. The metals present in dolomite are

1) Magnesium 2) Calcium

10. Which reaction is used in the thermite process?

A. When magniseum burn in air giving rise to a mixture of oxides and nitrides

$Mg + air \rightarrow MgO + Mg_3N_2$

The above reaction also generates a lot of heat. This reaction is used in thermite process in metallurgy of aluminium.

11. How many water molecules are present in Epsom salt?

A. Chemical formula of empsom salt is $MgSO_4$. $7H_2O$. It has seven water molecules.

12. What happens calcium, strontium and barium react with cold water?

A. Calcium, strontium and barium react with cold water to liberate hydrogen.

$M + H_2O \rightarrow M(OH)_2 + H_2 \uparrow$ (M = Ca, Sr, Ba)

13. During electrolysis of $MgCl_2$. Magnesium floats on molten electrolyte $MgCl_2$. Why?

A. The density of magnesium is less than the electrolyte. Hence it floats on electrolyte.

14. Why a stream of coal gas is passed over floating magnesium during electrolysis of $MgCl_2$?

A. To prevent the oxidation.

15. What happens when $BeCl_2$ is exposed to air?

A. $BeCl_2$ is covalent hygroscopic. When its exposed to air absorbs moisture and fumes in air.

Section - III
Long Answer Questions (4M)

1. Discuss the trends in properties of alkaline earth metals?

A. The different properties are

1) Atomic size: The atomic size of these alkaline earth metals increase from Be to Ra. This is diue to increase of an extra shell as we go from Be to Ra.

2) Ionization Energy: The ionization energy of these metals decreases as we go down in the periodic table from beryllium to radium. As the atomic size increases, the attraction between the nucleus and the outermost electron decreases. Hence it is easier to remove an electron from the outermost shell as we go down. This results in a decreasing trend in the ionization energy as we go down from Be to Ra.

3) Electronegativity: Group IIA elements have strong electropositive character. So, they have low electronegativities. For these elements the electronegativity decrease on moving down the Group.

4) Melting and Boiling Points: Melting points and boiling points do not show regular trends. However, these are higher than those of alkali metals.

2. Write the reaction of Group - IIA elements with (i) Oxygen (ii) hydrogen (iii) chlorine?

A. Alkaline earth metals are chemically very reactive due to their high electropositive character. They do not occur in the free state. They readily react with a number of non-metals to form compounds.

i) Reaction with Oxygen: All the group IIA elements burn in oxygen to form oxides.

$2M + O_2 \rightarrow 2MO$ (M: Be, Mg, Ca, Sr, Ba & Ra)

In addition to oxides, barium forms peroxide when heated in excess of oxygen.

$Ba + O_2 \rightarrow BaO_2$

These elements also burn in air giving rise to a mixture of oxides and nitrides.
$Mg + air \rightarrow MgO + Mg_3N_2$

ii. Reactions with Hydrogen: All the elements be react with hydrogen to form hydrides, MH_2
$M + H_2 \rightarrow MH_2$ (M = Mg, Ca, Sr and Ba)

All the hydrides are reducing reagents and are readily hydrolyzed by water and dilute acids to give rise to hydrogen.
$MH_2 + 2H_2O \rightarrow M(OH)_2 + 2H_2 \uparrow$

iii. Reaction with Chlorine: All the alkaline earth metals react with chlorine to form chloride MCl_2
$M + Cl_2 \rightarrow MCl_2$ (M: alkaline Earth Metal)

MCl_2 can also be prepared by reaction of the metals with hydrogen chloride.
$M + 2HCl \rightarrow MCl_2 + H_2\uparrow$

3. Describe the method of extraction of magnesium from its ore?

A. The electrolytic method of extraction of magnesium chloride involves in two steps. They are
1) Preparation of anhydrous $MgCl_2$

a) From Magnesite: The ore is heated in presence of air to 450°C. It decomposes to magnesium Oxide.
$MgCO_3 \rightarrow MgO + CO_2$
The resultant Mgo is mixed with carbon powder and heated to about 1000°C in a flow of chlorine gas at this temparature MgO reacts with carbon and chlorine to give rise to magnesium chloride and carbon monoxide.
$MgO + Cl_2 \rightarrow MgCl_2 + CO\uparrow$

b) From Carnalite: After initial dressing of ore carnalite is heated. It loses four water molecules.
$KCl.MgCl_2.6H_2O \rightarrow KCl.MgCl_2.2H_2O+4H_2O$
The resultant dihydrate is heated in a stream of HCl gas at 350°C.
$KCl.MgCl_2.2H_2O+HCl \rightarrow KCl.MgCl_2.2H_2O\uparrow$
Anhydrous $MgCl_2$ (along with KCl) thus obtained is subjected to electrolysis.

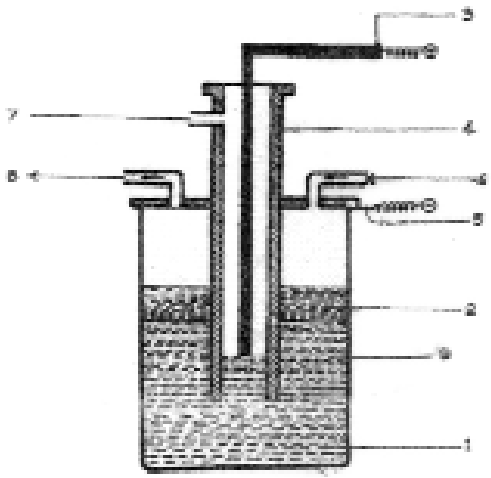
2) Electrolysis of anhydrous $MgCl_2$: In this step anhydrous $MgCl_2$ is mixed with $NaCl$ and KCl. The electrolysis is carried out in an iron pot which acts as cathode. A graphite rod enclosed in a porcelain tube is dipped into the electrolyte and acts as anode. The iron vessel is maintained at 700°C by external heating. The porcelain tube has an outlet for letting off chlorine gas. During electrolysis the following reactions take place.
$MgCl_2$ (Molten) $\rightarrow Mg^{2+} + 2Cl^-$

Reaction at cathode: $Mg^{2+} + 2e^- \rightarrow Mg$

Reaction at anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

$\therefore MgCl_2 \rightarrow Cl_2 + Mg$

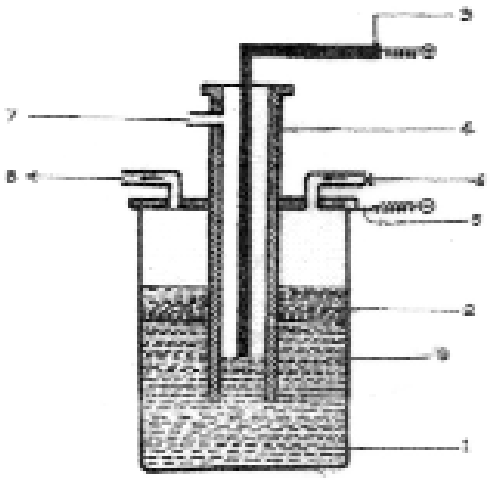
Chlorine gas liberated at anode escapes through the porcelain tube. Magnesium formed at cathode floats on the electrolyte. A stream of coal gas is passed over floating magnesium to prevent oxidation will be 99.9% pure. The experimental arrangement is shown in the figure.



Electrolytic reduction of magnesium chloride

1. Iron Cell, 2. Magnesium, 3. Graphite Anode, 4. Porcelain hood, 5. Iron Cathode, 6. Coal gas, 7. Chlorine, 8. Coal Gas, 9. Molten Electrolyte.

4. Draw the chart showing the extraction of magnesium from its ore?



Electrolytic reduction of magnesium chloride

1. Iron Cell, 2. Magnesium, 3. Graphite Anode, 4. Porcelain hood, 5. Iron Cathode, 6. Coal gas, 7. Chlorine, 8. Coal Gas, 9. Molten Electrolyte.

PART - B

1. Which of them is readioactive element
   a) Mg b) Ca c) Ra d) Sr
2. The general outer electronic configuration of alkaline earth metals is
   a) ns^1 b) ns^2 c) np^6 d) nd^5
3. How many water molecules are present in carnalite?
   a) one b) Three c) six d) Nine
4. How the ionization energies varies as we go from Berillium to Radium?
   a) increase b) constant c) decrease d) First increase then decrease
5. Beryllium reacts with
   a) Cold Water b) Hot Water c) Steam d) None of the above
6. Which of tehse elements gives dazzling light when it burns in air
   a) Mg b) Ca c) Sr d) Ra
7. Of these element which is not react with hydrogen
   a) Ca b) Be c) Ba d) Mg
8. Pauling Scale is used for measuring
   a) Electropositive character b) Electronegativity
   c) Ionization Energy d) Atomic Radius
9. Which of the following is an ore of Mg?
   a) Beryl b) Barytes c) Carnalite d) Hematite
10. During the electrolytic extraction Mg, the cathode is
    a) Iron pot b) Graphite c) KC*l* and NaC*l* d) Porcelain tube
11. Which of the following metal gives peroxide in addition to oxide when burnt in excess of air
    a) Be b) Mg c) Ca d) Ba
12. CaO is
    a) Acidic b) Basic c) Ca d) Ba
13. $[Ne]3s^2$ is the electronic configuration of
    a) Be b) Mg c) Ca d) Sr
14. Which of the following property increases from Be to Ra?
    a) EN b) Ionization Energy c) Atomic Size d) None

KEY

1) b	2) b	3) c	4) c	5) d	6) a	7) b
8) b	9) c	10) a	11) d	12) d	13) b	14) c

II. Fill in the Blanks(1/2 M)

1. Alkaline Earth Metals belongs _____ block elements.
2. The chemical formula of magnesite is _____
3. The electronegativity of Group IIA elements _____ from Be to Ra.
4. Alkaline earth metals ionization energy _____ as we go down from beryllium to radium.
5. The metallic bond between atoms in the alkaline earth metals is stronger than in _____
6. Group IIA elements react with water to liberate _____
7. $Mg + 2H_2O$ (hot) $\rightarrow$ _____ + $H_2 \uparrow$
8. When barium is heated in excess of oxygen given _____
9. Group IIA elements burn in air giving rise to a mixture of _____ and _____
10. _____ use in making crackers.

11. MgO release _____ ion when dissolved in water.
12. Chlorides all elements of Group IIA are ionic but _____is covalent.
13. Group IIA elements are extracted from their _____ by electrolytic reduction.
14. The reagent used to prepare BeH_2 from $BeCl_2$ is _____
15. _____ and _____ are added to $MgCl_2$ during Mg extraction.
16. Least abundant alkaline earth metal in the erath crust is _____
17. Barytes is an ore of _____
18. The number of water molecules present in epsom salt is _____
19. If carnalite is heated, it loses _____ water molecules.
20. During the electrolysis of $MgCl_2$ a stream of _____ gas is passed over floating magnesium to prevent oxidation.
21. In extraction of magnesium the iron vessel is maintained at _____ by external heating.

KEY:

1) S	2) $MgCO_3$	3) Decreases
4) Decreases	5) Alkaline Metals	6) Hydrogen
7) Mg(OH)2	8)Barium Peroxide	9) Oxides and Nitrides
10) Magnesium	11) OH^-	12) Beryllium Chloride
13) Chlorides	14) Lithium Aluminium Hydride	15) NaCl, KCl
16) Radium	17) Barium	18) Seven
19) Four	20) Coal	21) 700°C

III. Matching (1/2 Mark each)

1.	$CaCO_3$. $MgCO_3$	[ ]	a) Epsom Salt
2.	$MgCl_2.KCl.6H_2O$	[ ]	b) Dolomite
3.	$BaSO_4$	[ ]	c) Beryl
4.	$Be_3Al_2(SiO3)_6$	[ ]	d) Barytes
5.	$MgSO_4$. $7H_2O$	[ ]	e) Carnalite

KEY:

1) b 2) e 3) d 4) c 5)a