s-Block Elements

Question1

Match the following.

List I (Reactions)		List II (Methods)	
(A)	$Mg(HCO_3)_2 \longrightarrow Mg(OH)_2 \downarrow + 2CO_2 \uparrow$	(I)	Clark's method
(B)	$M^{2+} + Na_4P_6O_{18}^{2-} \longrightarrow [Na_2MP_6O_{18}]^{2-} + 2Na^+$	(II)	Ion exchange method
(C)	$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_2O$	(III)	Boiling
(D)	$2NaZ + Ca^{2+}(aq) \longrightarrow 2Na^+ + CaZ(Z = \text{ Zeolite })$	(IV)	Calgon's method

The correct answer is

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Options:

A.

A-III, B-IV, C-I, D-II

B.

A-IV, B-II, C-I, D-III

C.

A-III, B-IV, C-II, D-I

D.

A-II, B-IV, C-I, D-III

Answer: A

Solution:

- **(A) $Mg(HCO_3)_2 \rightarrow Mg(OH)_2\downarrow + 2CO_2\uparrow$**

  This reaction shows the decomposition of magnesium bicarbonate upon heating (boiling) to form insoluble magnesium hydroxide and carbon dioxide. This process removes temporary hardness from water and is achieved by **Boiling**.

  So, (A) matches with **(III) Boiling**.

- **(B) $M^{2+} + Na_4P_6O_{18}^{2-} \rightarrow [Na_2MP_6O_{18}]^{2-} + 2Na^+$**

  In this reaction, hard water ions (M^{2+}, typically Ca^{2+} or Mg^{2+}) react with sodium hexametaphosphate ($Na_4P_6O_{18}^{2-}$), commonly known as Calgon. The Calgon forms a soluble complex with the metal ions, thereby sequestering them and preventing them from causing hardness. This is the principle behind **Calgon's method**.

  So, (B) matches with **(IV) Calgon's method**.

- **(C) $Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3\downarrow + 2H_2O$**

  This reaction shows calcium bicarbonate reacting with a calculated amount of slaked lime ($Ca(OH)_2$) to precipitate insoluble calcium carbonate. This method is specifically known as **Clark's method** for removing temporary hardness.

  So, (C) matches with **(I) Clark's method**.

- **(D) $2NaZ + Ca^{2+}(aq) \rightarrow 2Na^+ + CaZ$ (Z = Zeolite)**

  This reaction illustrates the exchange of calcium ions (Ca^{2+}) from hard water with sodium ions (Na^+) from sodium zeolite (NaZ). Zeolites are ion-exchange resins that replace hardness-causing ions with non-hardness-causing ions. This is the basis of the **Ion exchange method** (also known as the Zeolite process or Permutit process).

  So, (D) matches with **(II) Ion exchange method**.

Combining the matches:

A - III

B - IV

C - I

D - II

Comparing this with the given options:

Option A: A-III, B-IV, C-I, D-II (Matches our findings)

Option B: A-IV, B-II, C-I, D-III

Option C: A-III, B-IV, C-II, D-I

Option D: A-II, B-IV, C-I, D-III

The correct option is A.

The final answer is $\boxed{\text{A-III, B-IV, C-I, D-II}}$.

Question2

Observe the following statements.

Statement I Both LiF and CsI have low solubility in water.

Statement II Low solubility of LiF in water is due to smaller hydration enthalpy of ions and that of CsI is due to its high lattice enthalpy.

The correct answer is

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Options:

A.

Both Statement I and II are correct.

B.

Statement I is correct, but Statement II is not correct.

C.

Statement I is not correct, but Statement II is correct.

D.

Both Statements I and II are not correct.

Answer: B

Solution:

Statement I is correct but Statement II is not correct. It's correct form is,

Low solubility of LiF in water is due to its high lattice enthalpy and low solubility of CsI in water is due to its smaller hydration enthalpy.

Question3

In which of the following the *s*-block elements are arranged in the correct order of their melting points?

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Options:

A.

$Mg > Be > Na > Li$

B.

$Li > Be > Mg > Na$

C.

$Be > Mg > Li > Na$

D.

$Li > Mg > Na > Be$

Answer: C

Solution:

The correct order of melting point of *s*-block element is,

$Be > Mg > Li > Na$

Melting point decreases down the group. Group 2 has higher melting point than group 1 due to high charge density and strong metallic bonding.

Question4

Match the following

Lis- I (Chemical)		List-II (Use)	
A.	KOH	I.	Coolant

Lis- I (Chemical)		List-II (Use)	
B.	$Na(l)$	II.	Antacid
C.	Li	III.	Electrochemical cells
D.	$Mg(OH)_2$	IV	Absorbent for CO_2

The correct answer is

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Options:

A.

A-II, B-III, C-IV, D-I

B.

A-IV, B-I, C-III, D-II

C.

A-IV, B-III, C-II, D-I

D.

A-III, B-IV, C-I, D-II

Answer: B

Solution:

A. KOH (Potassium hydroxide)

- KOH is a strong base that absorbs carbon dioxide (CO_2) forming potassium carbonate.

✅ **Use:** Absorbent for CO_2.

$\rightarrow A \rightarrow IV$

B. Na(l) (Liquid sodium)

- Liquid sodium metal is used as a **coolant** in nuclear reactors because of its high thermal conductivity.

✅ **Use:** Coolant.

→ B → I

C. Li (Lithium)

- Lithium is used in **electrochemical cells** (batteries).

✅ **Use:** Electrochemical cells.

→ C → III

D. $Mg(OH)_2$ (Magnesium hydroxide)

- $Mg(OH)_2$ is a weak base, used as an **antacid** ("milk of magnesia").

✅ **Use:** Antacid.

→ D → II

✅ **Therefore, correct matching is:**

A–IV, B–I, C–III, D–II

👉 **Correct Option: B**

Question5

When burnt in excess of oxygen, sodium forms a compound X and potassium forms a compound Y. The magnetic natures of X and Y respectively are

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Options:

A.

Both X and Y are paramagnetic in nature

B.

X is diamagnetic and Y is paramagnetic in nature

C.

X is paramagnetic and Y is diamagnetic in nature

D.

Both X and Y are diamagnetic in nature

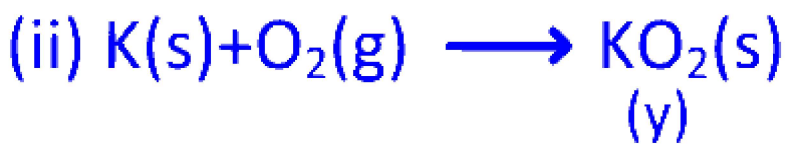
Answer: B

Solution:

The reaction mention is as follows,

(i) $2Na(s) + \underset{\text{(excess)}}{O_2(g)} \longrightarrow \underset{(X)}{Na_2O_2(s)}$

Sodium peroxide O_2^{2-} has all its electrons paired making it diamagnetic.



The superoxide has one unpaired electrons, making it paramagnetic.

Question6

The hydroxide of which of the following metal reacts with both acid and alkali?

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Options:

A. Mg

B. Na

C. Be

D. Ca

Answer: C

Solution:

Beryllium hydroxide is an amphoteric hydroxide. It can react with both acid and alkalis to produce salt and water.

$$Be(OH)_2 + \underset{\text{Acid}}{2HCl} \longrightarrow BeCl_2 + 2H_2O$$

$$Be(OH)_2 + 2NaOH \longrightarrow Na_2BeO_2 + 2H_2O$$

Question7

Consider the following reactions.

$$Cs + O_2 \text{ (excess)} \rightarrow X$$
$$Na + O_2 \rightarrow Y$$

Identify the correct Statement about X and Y

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Options:

A. Y is monoxide and X is superoxide.

B. Y is peroxide and X is peroxidce.

C. Y is peroxide and X is superoxide.

D. Y is superoxide and X is peroxide.

Answer: C

Solution:

The complete reaction is as follolits

$$Cs + \underset{\text{(Excess)}}{O_2} \longrightarrow \underset{\substack{\text{Casesium} \\ \text{superoxide}}}{CsO_2} \quad \text{(Product X)}$$

$$Na + O_2 \longrightarrow \underset{\substack{\text{Sodium} \\ \text{peroxide}}}{Na_2O_2} \quad \text{(Product Y)}$$

Hence, Y is peroxide and X is superaxite

Question8

Choose the correct statement from the following.

I. In vapour phase $BeCl_2$ exists as chlorobridge dimer.

II. $BeSO_4$ is readily soluble in water.

III. BeO is completely basic in nature.

IV. $BeCO_3$ being unstable, is kept in the atmosphere of CO_2.

V. $BeCO_3$ is less soluble among all the carbonates of group 2 elements.

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Options:

A. II, III, IV

B. I, II, IV

C. I, IV, V

D. II, III, V

Answer: B

Solution:

Statements given in I, II and IV are correct, while III and V are incorrect. Their correct forms are BeO is an amphoteric oxide. $BeCO_3$ is most soluble among all the carbonate of group 2 elements.

Question9

Identify the compound which gives CO_2 more readily on heating?

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Options:

A. $CaCO_3$

B. $NaHCO_3$

C. Na_2CO_3

D. Li_2CO_3

Answer: D

Solution:

Lithium oxy salts are heat unstable and decomposes easily when heated, forming the stable oxide.

Lithium carbonate decomposes into lithium oxide and carbon dioxide when heated.

$Li_2CO_3 \longrightarrow Li_2O + CO_2 \uparrow$

Question10

What is the correct stability order of KO_2, RbO_2, CsO_2 ?

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Options:

A. $KO_2 < CsO_2 < RbO_2$

B. $CsO_2 < KO_2 < RbO_2$

C. $CsO_2 < RbO_2 < KO_2$

D. $KO_2 < RbO_2 < CsO_2$

Answer: D

Solution:

Stability of superoxides increases with increase in size and electropositivity of metal.

Hence, the correct order is $KO_2 < RbO_2 < CsO_2$.

Question11

Assertion (A) MgO, CaO, SrO **and BaO are insoluble in water.**

Reason (R) In aqueous medium the basic strength of MgO, CaO, SrO **and BaO increases with increase in the atomic number of metal.**

The correct option among the following is

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Options:

A. Both (A) and (R) are correct and (R) is the correct explanation of (A).

B. Both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. (A) is correct but (R) is not correct.

D. (A) is not correct but (R) is correct.

Answer: D

Solution:

A is not correct, but R is correct. The correct form of A is: Magnesium oxide (MgO) is soluble in water. It is due to sparingly its dominating covalent nature.

Question12

Which of the following set of metals have strong tendency to form super oxides?

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Options:

A. Li, Na, Be

B. Be, Mg, Ca

C. K, Rb, Cs

D. Li, Be, Mg

Answer: C

Solution:

Alkali metals have strong tendency to form superoxides due to their small sizes.

Therefore, potassium (K), rubidium (Rb) and Cs (cesium) form super oxides very easily.

Question13

Identify the correct statements with respect to compounds of beryllium.

I. Beryllium oxide is amphoteric in nature.

II. Beryllium hydride is formed by the reaction of beryllium with hydrogen.

III. Beryllium hydride is formed by the reaction of beryllium chloride with lithium aluminium hydride.

IV. Beryllium sulpahte is the least soluble sulphate among the sulphates of alkaline earth metals.

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Options:

A. I and II only

B. I and III only

C. II and IV only

D. II and III only

Answer: B

Solution:

Beryllium oxide is amphoteric in nature i.e. it, behaves both as an acid and a base. Beryllium doesn't react with hydrogen because its oxidation potential is low.

Beryllium hydride is formed when beryllium chloride $(BeCl_2)$ reacts with lithium aluminium hydride $(LiAlH_4)$.

Beryllium sulphate is readily soluble in water as higher hydration enthalpy of Be^{2+} overcomes the lattice enthalpy. Hence, statements I and III are correct while II and IV are incorrect.
