S-block Elements (Alkali & Alkaline Earth Metals)

Question1

Which one of the following statements is correct?

[NEET 2023]

Options:

A.

All enzymes that utilise ATP in phosphate transfer require Ca as the cofactor

Β.

The bone in human body is an inert and unchanging substance

C.

Mg plays roles in neuromuscular function and interneuronal transmission

D.

The daily requirement of Mg and Ca in the human body is estimated to be $0.2\,-\,0.3g$

Answer: D

Solution:

Solution:

All enzymes that utilize ATP in phosphate transfer require Mg as the co-factor.

Bone in human body is not an inert and unchanging substance but is continuously being solubilised and redeposited.

Ca plays important role in neuromuscular function, interneuronal transmission, cell membrane integrity and blood coagulation.

The daily requirement of Mg and Ca in the human body is estimated to be 200 - 300mg (0.2 - 0.3g)

Question2

Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : Metallic sodium dissolves in liquid ammonia giving a deep blue solution, which is paramagnetic.

Reason R : The deep blue solution is due to the formation of amide.

In the light of the above statements, choose the correct answer from the options given below :

[NEET 2023]

Options:

A.

Both A and R are true but R is NOT the correct explanation of A $% \mathcal{A}$

Β.

A is true but R is false

C.

A is false but R is true

D.

Both A and R are true and R is the correct explanation of A $% \mathcal{A}$

Answer: B

Solution:

Solution

On dissolving alkali metal (sodium) in liquid ammonia, a deep blue solution is developed due to ammoniated electron which absorbs energy in visible region of light and imparts blue colour. Due to unpaired electron, solution is paramagnetic.

So, assertion statement is correct but reason is incorrect.

Question3

Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Lithium and beryllium unlike their other respective group members form compounds with pronounced ionic character.

Reason (R) : Lithium and Magnesium have similar properties due to diagonal relationship. In the light of the above statements, choose the correct answer from the options given below :

[NEET 2023 mpr]

Options:

A.

(A) is true but (R) is false.

B.

(A) is false but (R) is true.

C.

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

D.

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

Answer: B

Solution:

Li, Be forms predominately covalent compounds.

Question4

Identify the incorrect statement from the following [NEET-2022]

Options:

A. Alkali metals react with water to form their hydroxides.

B. The oxidation number of K in KO_2 is +4.

C. Ionisation enthalpy of alkali metals decreases from top to bottom in the group.

D. Lithium is the strongest reducing agent among the alkali metals.

Answer: B

Solution:

Solution:

Alkali metals show only '+1' oxidation state in all of their compounds.

 KO_2 is a super-oxide in which O_2^{-1} is anion and K^+ is cation oxidation state of K is +1.

Question5

Match List-I with List-II

List-I	List-II	
(a) Li	(i) absorbent for carbon dioxide	
(b) Na	(ii) electrochemical cells	
(c) KOH	(iii) coolant in fast breeder reactors	
(d) Cs	(iv) photoelectric cell	

Choose the correct answer from the options given below : [NEET-2022]

Options:

A. (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

B. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

C. (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)

D. (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

Answer: D

Solution:

Solution

- Cs is used in photoelectric cell due to its low ionisation enthalpy
- KOH used to adsorb CO2 and changes into K2CO3
- Liquid sodium metal is used as a coolant in fast breeder nuclear reactor
- Lithium is used in electrochemical cells

Question6

CaCl₂ and Ca(OCl)₂ are components of : [NEET Re-2022]

Options:

- A. lime water
- B. gypsum
- C. Portland cement
- D. bleaching powder

Answer: D

Solution:

Solution:

 ${\rm CaCl}_2$ and ${\rm Ca(OCl)}_2$ are components of bleaching powder.

Question7

If first ionization enthalpies of elements X and Y are 419 kJ mol^{-1} and 590 kJ mol⁻¹, respectively and second ionization enthalpies of X and Y

are 3069 kJ mol⁻¹ and 1145 kJ mol⁻¹, respectively. Then correct statement is : [NEET Re-2022]

Options:

- A. Both X and Y are alkaline earth metals.
- B. X is an alkali metal and Y is an alkaline earth metal.
- C. X is an alkaline earth metal and Y is an alkali metal.
- D. Both X and Y are alkali metals.

Answer: B

Solution:

Solution:

X-is alkali metal as it has large size, it's IE is less.

After loss of one electron, it gets inert gas configuration. So its IE_2 is very high.

Y is alkaline earth metal. It's IE is more than alkali metal due to stable ns^2 configuration. But its IE₂ is lower than alkali metal.

Question8

Among the following alkaline earth metal halides, one which is covalent and soluble in organic solvents is : [NEET 2021]

Options:

- A. Calcium chloride
- B. Strontium chloride
- C. Magnesium chloride
- D. Beryllium chloride

Answer: D

Solution:

Solution:

- Except for beryllium chloride all other chloride of alkaline earth metals are ionic in nature.
- Due to small size of Be, Beryllium chloride is essentially covalent and soluble in organic solvents.

Question9

The structures of beryllium chloride in solid state and vapour phase, are

[NEET 2021]

Options:

- A. Chain and dimer, respectively
- B. Linear in both
- C. Dimer and Linear, respectively
- D. Chain in both

Answer: A

Solution:

Solution: Beryllium chloride has a chain structure in the solid state as shown below



In vapour phase Beryllium chloride tends to form a chloro-bridged dimer.



Question10

In which one of the following arrangements the given sequence is not strictly according to the properties indicated against it? [NEET 2021]

Options:

- A. HF < HCl < HBr < HI : Increasing acidic strength
- B. $H_2O < H_2S < H_2Se < H_2Te$: Increasing pK avalues
- C. NH₃ < PH₃ < AsH₃ < SbH₃ : Increasing acidic character
- D. $CO_2 < SiO_2 < SnO_2 < PbO_2$: Increasing oxidizing power

Answer: B

Solution:

Solution:

Stronger is the acid, lower is the value of pK_a . On moving down the group, bond dissociation enthalpy of hydrides of

group 16 elements decreases hence acidity increases and pK_a value decreases. Correct order of pK_a value will be H $_2O > H _2S > H _2Se > H _2Te$

Question11

The following metal ion activates many enzymes, participates in the oxidation of glucose to produce ATP and with Na, is responsible for the transmission of nerve signals. [2020]

Options:	
A. Copper	
B. Calcium	
C. Potassium	
D. Iron	
Answer: C	

Question12

HCl was passed through a solution of CaCl₂ MgCl₂ and NaCl. Which of the following compound(s) crystallise(s)? (2020)

Options:

- A. Only NaCl
- B. Only MgCl₂
- C. NaCl, $MgCl_2$ and $CaCl_2$
- D. Both MgCl_2 and CaCl_2

Answer: A

Solution:

(a) When HCl is passed through the solution $\rm Cl^-$ ion concentration increases. Hence ionicproduct becomes more than solubility product. Only $\rm NaCl$ is crystallised due to less solubility than $\rm MgCl_2$ and $\rm CaCl_2$

Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal ($M\,$) as the cofactor. $M\,$ is (NEET 2019)

Options:

A. Sr

B. Be

C. Mg

D. Ca

Answer: C

Solution:

Solution: All enzymes that utilise ATP in phosphate transfer require magnesium as the cofactor.

Question14

Which of the following is an amphoteric hydroxide? (NEET 2019)

Options:

A. Be(OH) $_{2}$

B. Sr(OH)₂

C. Ca(OH)₂

D. M g(OH) $_2$

Answer: A

Solution:

Solution:

Be(OH)₂ is amphoteric in nature as it reacts with acid and alkali both. Be(OH)₂ + 2OH⁻ \rightarrow [Be(OH)₄]²⁻ Be(OH)₂ + 2H Cl + 2H ₂O \rightarrow [Be(OH)₄]Cl ₂

Question15

Crude sodium chloride obtained by crystallisation of brine solution does not contain (Odisha NEET 2019)

Options:

A. MgSO₄

B. N a_2SO_4

C. M gCl₂

D. $CaSO_4$

Answer: A

Solution:

Solution:

Crude sodium chloride, generally obtained by crystallisation of brine solution contains sodium sulphate (N a_2SO_4), calcium sulphate (CaSO₄), calcium chloride (CaCl₂) and magnesium chloride (M gCl₂) as impurities. Crude sodium chloride does not contain M gSO₄

Question16

Which of the alkali metal chloride (M Cl) forms its dihyrate salt (M Cl .2H $_2$ O) easily ? (Odisha NEET 2019)

Options:

A. LiCl

B. CsCl

C. RbCl

D. KCl

Answer: A

Solution:

LiCl is deliquescent and crystallises from aqueous solution as hydrates, LiCl .2H $_2$ O.

Question17

Among CaH ₂, BeH ₂, BaH ₂, the order of ionic character is (NEET 2018)

Options:

A. BeH $_2$ < CaH $_2$ < BaH $_2$

B. CaH $_2$ < BeH $_2$ < BaH $_2$

C. BeH $_2$ < BaH $_2$ < CaH $_2$

D. BaH $_2$ < BeH $_2$ < CaH $_2$

Answer: A

Solution:

Solution:

BeH $_2$ < CaH $_2$ < BaH $_2$ On moving down the group, metallic character of metals increases. So, ionic character of metal hydrides increases. Hence, BeH $_2$ will be least ionic.

Question18

Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is $1s^22s^22p^3$, the simplest formula for this compound is (NEET 2018)

Options:

A. $M g_2 X_3$

B. M gX $_2$

C. $M g_2 X$

D. Mg_3X_2

Answer: D

Solution:

C

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Electronic configuration of X is 1s^2, 2s^22p^3. So, valency of X will be 3
Magnesium ion = M g<sup>2+</sup>
Mg<sup>2+</sup> X<sup>3-</sup>
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2 3

Formula : $M g_3 X_2$

Question19

Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field? (NEET 2017)

Options:

A. K

B. Rb

C. Li

D. Na

Answer: C

Solution:

The hydration enthalpy of alkali metal ions decreases with increase in ionic sizes i.e., $Li^+ > N a^+ > K^+ > Rb^+ > Cs^+$ Hence, lithium having maximum degree of hydration will be least mobile. The order of ionic mobility is $[Li_{(aq)}]^+ < [N a_{(aq)})]^+ < [K_{(aq)}]^+ < [Rb_{(aq)}]^+$

Question20

The suspension of slaked lime in water is known as (NEET- II 2016)

Options:

A. lime water

B. quick lime

C. milk of lime

D. aqueous solution of slaked lime.

Answer: C

Solution:

 $CaO + H_2O \rightarrow Ca(OH)_2 + Heat$ Quick lime Slaked lime This process is known as slaking of lime. The paste of lime in water (i.e.; suspension) is called **milk of lime** while the filtered and clear solution is known as lime water.

Question21

In context with beryllium, which one of the following statements is incorrect? (NEET- II 2016)

Options:

A. It is rendered passive by nitric acid.

B. It forms Be_2C .

C. Its salts rarely hydrolyse.

D. Its hydride is electron-deficient and polymeric.

Answer: C

Solution:

Solution: Beryllium salts are readily hydrolysed.

Question22

Which of the following statements is false? (NEET- I 2016)

Options:

A. Ca^{2+} ions are not important in maintaining the regular beating of the heart.

B. $M g^{2+}$ ions are important in the green parts of the plants.

C. $M g^{2+}$ ions form a complex with ATP.

D. Ca^{2+} ions are important in blood clotting.

Answer: A

Solution:

 Ca^{2+} ions are required to trigger the contraction of muscles and to maintain the regular beating of the heart.

Question23

The product obtained as a result of a reaction of nitrogen with CaC_2 is (NEET- I 2016)

Options:

A. CaCN ₃

B. Ca₂CN

C. Ca(CN) $_2$

D. CaCN

Answer: C

Solution:

Read Ca(CN)₂ as CaCN ₂ CaC₂ + N ₂ \rightarrow CaCN ₂ + C Nitrolim

Question24

20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide What will be the percentage purity of magnesium carbonate in the sample? (At. wt. of Mg = 24) (2015)

Options:

A. 96

B. 60

C. 84

D. 75

Answer: C

Solution:

 $M \underset{84g}{\text{gCO}_{3(s)}} \xrightarrow{\Delta} M \underset{40g}{\text{gO}_{(s)}} + CO_{2(g)}$ $84g \text{ of } M \underset{9}{\text{gCO}_{3}} \equiv 40g \text{ of } MgO$ $\therefore 20g \text{ of } M \underset{9}{\text{gCO}_{3}} \equiv \frac{40}{84} \times 20 = 9.52g \text{ of } MgO$ Actual yield = 8g of MgO $\therefore \% \text{ purity} = \frac{8}{9.52} \times 100 = 84\%$

Question25

On heating which of the following releases CO_2 most easily ? (2015)

Options:

A. N a_2CO_3

B. M gCO₃

C. $CaCO_3$

D. K₂CO₃

Answer: B

Solution:

Solution:

Stability of carbonates increases down the group with increase in the size of metal ion. Also the alkali metal carbonates are more stable than alkaline earth metal carbonates. Hence $M gCO_3$ is least stable and it releases CO_2 most easily

 $M gCO_3 \xrightarrow{\Delta} M gO + CO_2$

Question26

Solubility of the alkaline earth metal sulphates in water decreases in the sequence (2015 Cancelled)

A. Sr > Ca > Mg > BaB. Ba > Mg > Sr > CaC. Mg > Ca > Sr > BaD. Ca > Sr > Ba > Mg

Answer: C

Solution:

Solution: Solubility of alkaline earth metal sulphates decreases down the group because hydration energy decreases.

Question27

The function of "Sodium pump" is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump? (2015 Cancelled)

Options:

A. K ⁺

B. Fe^{2+}

C. Ca²⁺

D. $M g^{2+}$

Answer: A

Question28

In Castner-Kellner cell for production of sodium hydroxide (Karnataka NEET 2013)

Options:

- A. brine is electrolyzed using graphite electrodes
- B. molten sodium chloride is electrolysed
- C. sodium amalgam is formed at mercury cathode
- D. brine is electrolyzed with Pt electrodes.

Answer: C

Solution:

Solution:

In Castner-Kellner cell, sodium amalgam is formed at mercury cathode.

Question29

The ease of adsorption of the hydrated alkali metal ions on an ionexchange resins follows the order: (2012)

Options:

A. $Li^+ < K^+ < Na^+ < Rb^+$

B. $Rb^+ < K^+ < Na^+ < Li^+$

- C. K⁺ < N a⁺ < Rb⁺ < Li⁺
- D. N $a^+ < Li^+ < K^+ < Rb^+$

Answer: B

Solution:

Solution:

In order to explain the behaviour of an atom or ion or molecule, we must have an idea about its size. Atomic radius is the most common way of expressing the size of an atom and similarly the size of an ion is given by the ionic radius. As we move down in the group 1, the atomic size increases with the increase in the number of shells in the atoms. Similarly the ionic size also shows an increase as we move down the group. So, the order of size of the ions can be given as, L^{+} Smaller is the size of a cation, higher is the charge density on it and thus, higher is the number of water molecules that attach to it in an aqueous solution. As a result, the sizes of the hydrated ions follow the order, $R b^{+}$ Thus, this will also be the order for the ease of adsorption of the ions on ion exchange resins.

Question30

Which one of the alkali metals, forms only, the normal oxide, M $_2{\rm O}$ on heating in air ? (2012)

A. Rb

- B. K
- C. Li
- D. Na

Answer: C

Solution:

Solution:

When alkali metals heated in atmosphere of oxygen, the alkali metals ignite and form oxides. On combustion Li forms LiO_2 ; sodium gives the peroxide N a_2O_2 and potassium of rubidium give super oxide (M O_2)

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Question31

Match List-I with List-II for the compositions of substances and select the correct answer using the code given below.

List - I	List - II
(Substances)	(Composition)
(A) Plaster of Paris	(i) $CaSO_4 \cdot 2H_2O$
(B) Epsomite	(ii) $CaSO_4 \cdot \frac{1}{2}H_2O$
(C) Kieserite	(iii) $MgSO_4 \cdot 7H_2O$
(D) Gypsum	(iv) $MgSO_4 \cdot H_2O$
	(v) <i>CaSO</i> ₄

(2011 Mains)

Options:

A. (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)

B. (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

C. (A)-(i), (B)-(ii), (C)-(iii), (D)-(v)

D. (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

Answer: B

Solution:

Plaster of Paris - $CaSO_4 \cdot \frac{1}{2}H_2O$ Epsomite - $MgSO_4 \cdot 7H_2O$ Kieserite - $MgSO_4 \cdot H_2O$ Gypsum - $CaS_4 \cdot 2H_2O$

Question32

Which one of the following is present as an active ingredient in bleaching powder for bleaching action? (2011)

Options:

A. CaOCl₂

B. Ca(OCl)₂

C. CaO₂Cl

D. CaCl ₂

Answer: B

Solution:

Solution: Active ingredient in bleaching powder for bleaching action is $Ca(OCl)_2$

Question33

Which of the following compounds has the lowest melting point? (2011)

Options:

A. CaCl $_{\rm 2}$

B. $CaBr_2$

C. CaI $_2$

D. CaF $_{\rm 2}$

Answer: C

Solution:

As the covalent character in compound increases and ionic character decreases, melting point of the compound decreases. So, Cal $_2$ has the highest covalent character and lowest melting point.

Question34

The compound A on heating gives a colourless gas and a residue that is dissolved in water to obtain B. Excess of CO_2 is bubbled through

aqueous solution of B, C is formed which is recovered in the solid form. Solid C on gentle heating gives back A. The compound is (2010 Mains)

Options:

A. CaCO₃

B. N a_2CO_3

C. K ₂CO₃

D. $CaSO_4 \cdot 2H_2O$

Answer: A

Solution:

The reactions can be summarised as follows:

 $\begin{array}{l} A & \xrightarrow{\Delta} \\ A & \xrightarrow{\Delta} \\ \text{Residue} \\ + H_2O & \xrightarrow{\text{excess }CO_2} & \xrightarrow{\Delta} \\ + H_2O & \xrightarrow{\text{excess }CO_2} & \xrightarrow{\Delta} \\ \text{This is possible only when A is }CaCO_3. \text{ The reactions are as follows :} \\ CaCO_3 & \xrightarrow{\Delta} & CO_2 & + CaO_{(\text{residue})} \\ (A) & \xrightarrow{CO_2} & + CaO_{(\text{residue})} \\ CaO + H_2O & \xrightarrow{CO_2} & \xrightarrow{CO_2} \\ (B) & \xrightarrow{CO_2} & \xrightarrow{CO_2} & \xrightarrow{\Delta} \\ (C) & (A) & \xrightarrow{CO_3} & \xrightarrow{CO_3} \\ \end{array}$

Question35

Which one of the following compounds is a peroxide? (2010)

Options:

A. KO_2

B. BaO_2

C. $M nO_2$

D. N O_2

Answer: B

Solution:

Solution: BaO_2 has peroxide linkage

Question36

Property of the alkaline earth metals that increases with their atomic number (2010)

Options:

- A. Solubility of their hydroxides in water
- B. Solubility of their sulphates in water
- C. Ionization energy
- D. Electronegativity

Answer: A

Solution:

Solution:

The solubility of an ionic compound depends on two factors : (a) lattice energy, and (b) hydration energy In case of alkaline metal hydroxides, the lattice energy decreases as we move down the group. This decrease is more than the decrease in the hydration energy down the group.

Question37

Which of the following alkaline earth metal sulphates has hydration enthalpy higher than the lattice enthalpy? (2010)

Options:

A. CaSO₄

- B. BeSO₄
- C. BaSO₄
- D. $SrSO_4$

Answer: B

Solution:

Solution:

The hydration enthalpy of $BeSO_4$ is higher than its lattice energy. Within group 2, the hydration energy decreases down the group while lattice energy is almost the same

Question38

Which of the following oxides is not expected to react with sodium hydroxide? (2009)

Options:

- A. CaO
- B. SiO₂
- C. BeO
- $D. B_2O_3$

Answer: A

Solution:

Solution:

CaO being a basic oxide does not react with NaOH, however SiO_2 (acidic oxide), BeO (amphoteric oxide) and B_2O_3 (acidic oxide) react with NaOH.

Question39

In the case of alkali metals, the covalent character decreases in the order (2009)

Options:

A. MF > MCl > MBr > MI

B. MF > MCI > MI > MBr

C. MI > MBr > MCl > MF

D. MCl > MI > MBr > MF

Answer: C

Solution:

Solution:

Alkali metals are highly electropositive and halogens are electronegative. Thus for the halides of a given alkali metal, the covalent character decreases with increase inelectronegativity of halogens. ∴ Order of covalent character of halides is MI > MBr > MCI > MF

Question40

The alkali metals form salt-like hydrides by the direct synthesis at elevated temperature. The thermal stability of these hydrides decreases in which of the following orders? (2008)

Options:

A. NaH > LiH > KH > RbH > CsH

B. LiH > NaH > KH > RbH > CsH

C. CsH > RbH > KH > NaH > LiH

D. KH > NaH >LiH > CsH > RbH

Answer: B

Solution:

Solution:

The ionic character of the bonds in hydrides increases from LiH to CsH so thermal stability of these hydrides decreases in the order of LiH > NaH > KH > RbH > CsH

Question41

The sequence of ionic mobility in aqueous solution is (2008)

Options:

A. $Rb^+ > K^+ > Cs^+ > Na^+$

B. N $a^+ > K^+ > Rb^+ + Cs^+$ C. K⁺ > N $a^+ > Rb^+ > Cs^+$ D. Cs⁺ > Rb⁺ > K⁺ > N a^+

Answer: D

Solution:

Solution:

Smaller the size of cation, higher will be the hydration and its effective size will increase and hence mobility in aqueous solution will decrease. Hence, the correct sequence of ionic mobility in aqueous solution of the given cations is $Cs^+ > Rb^+ > K^+ > Na^+$

Question42

Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest pH? (2008)

Options:

A. M gCl $_2$

B. CaCl₂

C. SrCl₂

D. BaCl₂

Answer: D

Solution:

Solution:

Equimolar solutions of the given chlorides when prepared in water forms their respective hydroxides.Be(OH $)_2$ is amphoteric, but the hydroxides of other alkaline earth metals are basic. The basic strength increases down the group. Hence higher the basic character higher will be the pH

Question43

In which of the following the hydration energy is higher than the lattice energy? (2007)

Options:

A. M gSO₄

B. RaSO₄

C. SrSO₄

D. BaSO₄

Answer: A

Solution:

When hydration energy exceeds lattice energy, the compound becomes soluble in water. The solubility of alkaline earth metal sulphates decreases in the order $BeSO_4 > M gSO_4 > CaSO_4 > SrSO_4 > BaSO_4 > RaSO_4$ very high high sparingly soluble almost insoluble The solubilities of $BeSO_4$ and $M gSO_4$ are due to high energy of solvation of smaller Be^{2+} and $M g^{2+}$ ions

Question44

The correct order of increasing thermal stability of K_2CO_3 , $M gCO_3$, $CaCO_3$ and $BeCO_3$ is (2007)

Options:

A.

 $BeCO_3 < M gCO_3 < CaCO_3 < K_2CO_3$

Β.

 $\mathrm{M}\,\mathrm{gCO}_3 < \mathrm{BeCO}_3 < \mathrm{CaCO}_3 < \mathrm{K}\,_2\mathrm{CO}_3$

C.

 $K_2CO_3 < M gCO_3 < CaCO_3 < BeCO_3$

D.

 $BeCO_3 < M gCO_3 < K_2CO_3 < CaCO_3$

Answer: A

Solution:

Solution:

In all cases, for a particular set of e.g. Group 1 or Group2 compounds, the thermal stability increases down the group as the ionic radius of the cation increases, and its polarising power decreases.

Group 1 compounds tend to be more thermally stable than group 2 compounds because the cation has a smaller charge and a larger ionic radius, and so a lower polarising power, particularly when adjacent metals on the same period are

compared. Hence the order of increasing thermal stability of K $_2$ CO $_3$, M gCO $_3$, CaCO $_3$ and BeCO $_3$ is BeCO $_3$ < M gCO $_3$ < CaCO $_3$ < K $_2$ CO $_3$

.....

Question45

The correct order of the mobility of the alkali metal ions in aqueous solution is (2006)

Options:

A. $Rb^{+} > K^{+} > N a^{+} > Li^{+}$ B. $Li^{+} > N a^{+} > K^{+} > Rb^{+}$ C. $N a^{+} > K^{+} > Rb^{+} > Li^{+}$ D. $K^{+} > Rb^{+} > N a^{+} > Li^{+}$

Answer: A

Solution:

Solution:

The alkali metal ions exist as hydrated ions M⁺(H₂O)_x in the aqueous solution. The degree of hydration, however, decreases with the ionic size as we move from Li⁺ to Cs⁺. In other words, Li⁺ ion is most highly hydrated, e.g. $[\text{Li}(\text{H}_{2}\text{O})_{6}]^{+}$. Since the mobility of ion is inversely proportional to the size of their hydrated ions, therefore, amongst the alkali metal ions, lithium has the lowest ionic mobility. Rb_(aq)⁺ > K_(aq)⁺ > N a_(aq)⁺ > Li_(aq)⁺

Question46

The correct sequence of increasing covalent character is represented by (2005)

Options:

A. LiCl < N aCl < BeCl₂

- B. BeCl₂ < LiCl < N aCl
- C. N aCl < LiCl < BeCl $_2$
- D. BeCl $_2$ < N aCl < LiCl

Answer: C

Solution:

Covalent character in a compound is found by Fajan's Rule. **Fajan's Rule :** (i) Greater the size of the cation more will be the ionic character and (ii) Greater the size of anion more will be its covalent character and charge on the cation is dominant over the size of the cation. (iii) Greater the charge on the cation more will be its covalent character.

Hence, $BeCl_2 > LiCl > N aCl$ (In Covalent character).

Question47

A solid compound X on heating gives CO_2 gas and a residue. The residue mixed with water forms Y. On passing an excess of CO_2 through Y in water, a clear solution Z is obtained. On boiling Z, compound X is reformed. The compound X is (2004)

Options:

A. Ca(HCO_3)₂

B. CaCO₃

C. N a_2CO_3

D. K₂CO₃

Answer: B

Solution:

The given compound X must be $CaCO_3$. It can be explained by following reactions:

```
CaCO_{3} \xrightarrow{\Delta} CaO + CO_{2} \uparrow
(X)

CaO + H_{2}O \rightarrow Ca(OH)_{2}
(Y)

Ca(OH)_{2} + 2CO_{2} + H_{2}O \rightarrow Ca(H CO_{3})_{2}
(Z)

Ca(H CO_{3})_{2} \xrightarrow{\Delta} CaCO_{3} + CO_{2} \uparrow H_{2}O
(X)
```

Question48

In which of the following processes, fused sodium hydroxide is electrolysed at a 330°C temperature for extraction of sodium? (2000)

- A. Castner's process
- B. Down's process
- C. Cyanide process
- D. Both (b) and (c).

Answer: A

Solution:

Solution:

In Castner's process, for production of sodium metal, sodium hydroxide (NaOH) is electrolysed at temperature 330°C.

Question49

When a substance (A) reacts with water it produces a combustible gas (B) and a solution of substance (C) in water. When another substance (D) reacts with this solution of (C), it also produces the same gas (B) on warming but (D) can produce gas (B) on reaction with dilute sulphuric acid at room temperature. Substance (A) imparts a deep golden yellow colour to a smokeless flame of Bunsen burner. Then (A), (B), (C) and (D) respectively are (1998)

Options:

A. Ca, H $_2$, Ca(OH) $_2$, Sn

B. K , H $_{\rm 2}$, K OH , Al

C. N a, H $_2$, N aOH , Z n

D. CaC_2 , C_2H_2 , Ca(OH)₂, Fe

Answer: C

Solution:

Solution:

```
Only "Na' imparts golden colour to Bunsen flame, therefore, A = N a, B = H_2, C = N aOH, D = Z n 2N a + 2H_2O \rightarrow 2N aOH + H_2

(A) (C) (B)

Z n + 2N aOH \rightarrow N a_2Z nO_2 + H_2

(D) (C) (B)

Z n + H_2SO_4 \rightarrow Z nSO_4 + H_2

(D) (B)

(B)
```

C

Calcium is obtained by the (1997)

Options:

A. electrolysis of solution of calcium chloride in water

- B. electrolysis of molten anhydrous calcium chloride
- C. roasting of limestone
- D. reduction of calcium chloride with carbon.

Answer: B

Solution:

Solution:

Calcium is obtained by electrolysis of a fused mass consisting six parts calcium chloride and one part calcium fluoride at about 700°C $CaCl_2 \rightleftharpoons Ca^{2+} + 2Cl^{-}$ $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ $Ca^{2+} + 2e^{-} \rightarrow Ca$

Question51

Sodium is made by the electrolysis of a molten mixture of about 40%N aCl and 60%CaCl $_2$ because (1995)

Options:

- A. Ca^{++} can reduce N aCl to N a
- B. Ca^{++} can displace N a from N aCl
- C. CaCl₂ helps in conduction of electricity
- D. this mixture has a lower melting point than $N \mbox{ aCl}$.

Answer: D

Solution:

Solution:

Sodium is obtained by electrolytic reduction of its chloride. Melting point of chloride of sodium is high so in order to lower its melting point, calcium chloride is added to it.

The solubility in water of sulphate down the Be group is Be > Mg > Ca > Sr > Ba. This is due to (1995)

Options:

- A. decreasing lattice energy
- B. high heat of solvation for smaller ions like Be^{2+}
- C. increase in melting points
- D. increasing molecular weight.

Answer: B

Solution:

Solution:

As we move down the group from $BeSO_4$ to $BaSO_4$ the enthalpy of hydration of the positive ion becomes smaller due to increase in ionic size. Salts of heavier metal ions are less soluble than those of lighter ions.

Question53

Identify the correct statement. (1995)

Options:

- A. Plaster of Paris can be obtained by hydration of gypsum.
- B. Plaster of Paris is obtained by partial oxidation of gypsum.
- C. Gypsum contains a lower percentage of calcium than Plaster of Paris.
- D. Gypsum is obtained by heating Plaster of Paris.

Answer: C

Solution:

Solution:

Gypsum is CaSO $_4$ ·2H $_2$ O and Plaster of Paris is (CaSO $_4$) $_2$ ·H $_2$ O. Therefore gypsum contains a lower percentage of calcium than Plaster of Paris.

C

Which of the following is known as fusion mixture? (1994)

Options:

- A. Mixture of N a_2CO_3 + N aH CO₃
- B. N $a_2CO_3 \cdot 10H_2O$
- C. Mixture of K $_2$ CO $_3$ + N a $_2$ CO $_3$
- D. N aH CO_3

Answer: C

Solution:

Solution: K $_2 \rm CO_3$ and N $a_2 \rm CO_3$ mixture is called as fusion mixture.

Question55

All the following substances react with water. The pair that gives the same gaseous product is (1994)

Options:

A. K and KO_2

- B. N a and N $\rm a_2O_2$
- C. Ca and CaH $_{\rm 2}$
- D. Ba and BaO_2 .

Answer: C

Solution:

The pair which gives the same gaseous product is Ca and CaH $_2$. Ca + 2H $_2$ O \rightarrow Ca(OH) $_2$ + H $_2$ CaH $_2$ + 2H $_2$ O \rightarrow Ca(OH) $_2$ + 2H $_2$ Whereas, K gives H $_2$ while KO $_2$ gives O $_2$ and H $_2$ O $_2$ 2K + 2H $_2$ O \rightarrow 2K OH + H $_2$ 2K O $_2$ + 2H $_2$ O \rightarrow 2K OH + O $_2$ + H $_2$ O $_2$ Similarly, Na gives H₂, while N a_2O_2 gives H₂ O_2 . 2N a + 2H₂O \rightarrow 2N aOH + H₂ N a_2O_2 + 2H₂O \rightarrow 2N aOH + H₂ O_2 Likewise Ba gives H₂ while BaO₂ gives H₂ O_2 . Ba + 2H₂O \rightarrow Ba(OH)₂ + H₂ BaO₂ + 2H₂O \rightarrow Ba(OH)₂ + H₂O₂

Question56

Among the following oxides, the one which is most basic is (1994)

Options:

A. Z nO

B. M gO

C. Al $_2O_3$

D. N $_2O_5$

Answer: B

Solution:

Solution: Al $_2\mathrm{O}_3$ and Z nO are amphoteric. N $_2\mathrm{O}_5$ is strongly acidic.

Question57

Which of the following metal ions play an important role in muscle contraction? (1994)

Options:

A. K ⁺

B. N a⁺

C. $M g^{2+}$

D. Ca²⁺

Answer: D

Solution:

Calcium is an essential element for the contraction of muscles. In the presence of calcium ions and energy from ATP, actin and myosin (contractile proteins) interact forming actomyosin which causes contraction of muscles.

Question58

Which of the following statement is false? (1994)

Options:

A. Strontium decomposes water readily than beryllium.

B. Barium carbonate melts at a higher temperature than calcium carbonate.

C. Barium hydroxide is more soluble in water than magnesium hydroxide.

D. Beryllium hydroxide is more basic than barium hydroxide.

Answer: D

Solution:

Solution: Beryllium hydroxide although amphoteric, is however less basic than barium hydroxide.

Question59

Which one of the following has minimum value of cation\/anion ratio? (1993)

Options:

A. N aCl

B. KCl

C. M gCl₂

D. CaF $_2$

Answer: C

Solution:

Solution:

The order of ionic size for given ions will be $K^+ > Ca^{2+} > Mg^{2+}$ and that of $Cl^- > F^-$ Therefore, Mg^{2+}/Cl^- has minimum value of cation/anion ratio.

Which of the following has largest size? (1993)

Options:

A. Na

B. Na⁺

C. Na⁻

D. Can't be predicted.

Answer: C

Solution:

Solution: The cations are always smaller than the neutral atom and anions are always larger in size $N a^- > N a > N a^+$

Question61

Which compound will show the highest lattice energy? (1993)

Options:

A. RbF

B. CsF

C. NaF

D. KF

Answer: C

Solution:

Solution:

With the same anion, smaller the size of the cation, higher is the lattice energy. Therefore, NaF will show the highest lattice energy among the given compounds.

Question62

0

Strongest bond is in between (1993)

Options:

A. CsF

B. N aCl

C. both (a) and (b)

D. none of the above.

Answer: A

Solution:

Solution:

According to Fajan rules, ionic character increases with increase in size of the cation, (Cs > Rb > K > N a) and with decrease in size of the anion (F > Cl > Br > I). Thus, CsF has higher ionic character than N aCl and hence bond in CsF is stronger than in N aCl.

Question63

Compared with the alkaline earth metals, the alkali metals exhibit (1993)

Options:

A. smaller ionic radii

B. highest boiling points

C. greater hardness

D. lower ionization energies.

Answer: D

Solution:

Solution:

The alkali metals are larger in size and have smaller nuclear charge thus they have lower ionization energy in comparison to alkaline earth metals.

Question64

Electronic configuration of calcium atom may be written as (1992)

A. [Ne] 4p²

B. [Ar]4s²

C. [Ne] 4s²

D. [Ar]4p²

Answer: B

Solution:

 $_{20}$ Ca \rightarrow 1s², 2s²2p⁶, 3s²3p⁶, 4s² $_{18}$ Ar \rightarrow 1s², 2s²2p⁶, 3s²3p⁶ Hence, $_{20}$ Ca \rightarrow [Ar]4s²

Question65

Which one of the following substance is used in the laboratory for fast drying of neutral gases? (1992)

Options:

A. Phosphorus pentoxide

B. Active charcoal

C. Anhydrous calcium chloride

D. N a₃PO₄

Answer: A

Solution:

Solution: P_2O_5 absorbs moisture much readily than anhydrous CaCl $_2$.

Question66

Washing soda has formula (1990)

A. N $a_2CO_3.7H_2O$

B. N $a_2CO_3 \cdot 10H_2O$

C. N $a_2 CO_3 \cdot 3H_2O$

D. N a_2CO_3

Answer: B

Solution:

Solution: N $a_2 CO_3 \cdot 10 H \ _2O$ is washing soda.

Question67

Which one of the following properties of alkali metals increases in magnitude as the atomic number rises? (1989)

Options:

A. Ionic radius

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B. Melting point
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- C. Electronegativity
- D. First ionization energy

Answer: A

Solution:

Solution:

In a group, ionic radius increases with increase in atomic number whereas the m.pt. decreases down in a group due to weakening of metallic bond. Similarly, electronegativity and the ionization energy also decreases down the group.

Question68

Which of the following atoms will have the smallest size? (1989)

- A. Mg
- B. Na
- C. Be
- D. Li

Answer: C

Solution:

The atomic size decreases within a period from left to right, therefore Li > Be and Na > Mg. The size increases in a group from top to bottom. Hence, the size of Na is greater than Li. Overall order N a > Mg > Li > Be. Thus, Be has smallest size.

Question69

Bleaching powder is obtained by the action of chlorine gas and (1988)

Options:

A. dilute solution of Ca(OH $)_2$

B. concentrated solution of Ca(OH $)_2$

C. dry CaO

D. dry slaked lime.

Answer: D

Solution:

Cl $_2$ gas reacts with dry slaked lime, Ca(OH) $_2$ to give bleaching powder. Ca(OH) $_2$ + Cl $_2 \xrightarrow{\Delta}$ CaOCl $_2$ + H $_2$ O
