

# The P-Block Elements (Group 13-14)

## Question1

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

**Assertion (A) : Melting point of Boron (2453 K) is unusually high in group 13 elements.**

**Reason (R) : Solid Boron has very strong crystalline lattice.**

**In the light of the above statements, choose the most appropriate answer from the options given below ;**

**[27-Jan-2024 Shift 1]**

**Options:**

A.

Both (A) and (R) are correct but (R) Is not the correct explanation of (A)

B.

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

C.

(A) is true but (R) is false

D.

(A) is false but (R) is true

**Answer: B**

**Solution:**

Solid Boron has very strong crystalline lattice so its melting point unusually high in group 13 elements

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## Question2

**Identify the incorrect pair from the following :**

**[29-Jan-2024 Shift 1]**

**Options:**

A.



Fluorspar-  $\text{BF}_3$

B.

Cryolite-  $\text{Na}_3\text{AlF}_6$

C.

Fluoroapatite-  $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$

D.

Carnallite-  $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

**Answer: A**

**Solution:**

Fluorspar is  $\text{CaF}_2$

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### Question3

Consider the oxides of group 14 elements  $\text{SiO}_2$ ,  $\text{GeO}_2$ ,  $\text{SnO}_2$ ,  $\text{PbO}_2$ ,  $\text{CO}$  and  $\text{GeO}$ . The amphoteric oxides are

[31-Jan-2024 Shift 1]

**Options:**

A.

$\text{GeO}$ ,  $\text{GeO}_2$

B.

$\text{SiO}_2$ ,  $\text{GeO}_2$

C.

$\text{SnO}_2$ ,  $\text{PbO}_2$

D.

$\text{SnO}_2$ ,  $\text{CO}$

**Answer: C**

**Solution:**

$\text{SnO}_2$  and  $\text{PbO}_2$  are amphoteric

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### Question4

Given below are two statements :

**Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.**

**Statement II:  $\text{AlCl}_3$  upon hydrolysis in acidified aqueous solution forms octahedral  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$  ion.**

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

**[31-Jan-2024 Shift 2]**

**Options:**

A.

Statement I is true but statement II is false

B.

Statement I is false but statement II is true

C.

Both statement I and statement II are false

D.

Both statement I and statement II are true

**Answer: D**

**Solution:**

In trivalent state most of the compounds being covalent are hydrolysed in water. Trichlorides on hydrolysis in water form tetrahedral  $[\text{M}(\text{OH})_4]^-$  species, the hybridisation state of element M is  $\text{sp}^3$ .

In case of aluminium, acidified aqueous solution forms octahedral  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$  ion.

## Question5

List - I Compound	List - II Use
(A) Carbon tetrachloride	(I) Paint remover
(B) Methylene chloride conditioners	(II) Refrigerators and air
(C) DDT	(III) Fire extinguisher
(D) Freons insecticide	(IV) Non Biodegradable

**Choose the correct answer from the options given below :**

**[1-Feb-2024 Shift 2]**

**Options:**

A.



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

B.

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

C.

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

D.

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

**Answer: B**

**Solution:**

$\text{CCl}_4$  used in fire extinguisher.  $\text{CH}_2\text{Cl}_2$  used as paint remover. Freons used in refrigerator and AC. DDT used as non Biodegradable insecticide.

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## Question6

**Given below are two statements:**

**Statement (I) :  $\text{SiO}_2$  and  $\text{GeO}_2$  are acidic while  $\text{SnO}$  and  $\text{PbO}$  are amphoteric in nature.**

**Statement (II) : Allotropic forms of carbon are due to property of catenation and  $p\pi - d\pi$  bond formation.**

**In the light of the above statements, choose the most appropriate answer from the options given below:**

**[1-Feb-2024 Shift 2]**

**Options:**

A.

Both Statement I and Statement II are false

B.

Both Statement I and Statement II are true

C.

Statement I is true but Statement II is false

D.

Statement I is false but Statement II is true

**Answer: C**

**Solution:**



SiO<sub>2</sub> and GeO<sub>2</sub> are acidic and SnO, PbO are amphoteric.

Carbon does not have d-orbitals so can not form pπ–dπ Bond with itself. Due to properties of catenation and pπ – pπ bond formation. carbon is able to show allotropic forms.

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## Question7

**Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R. Assertion A : Beryllium has less negative value of reduction potential compared to the other alkaline earth metals.**

**Reason R : Beryllium has large hydration energy due to small size of Be<sup>2+</sup> but relatively large value of atomization enthalpy.**

**In the light of the above statements, choose the most appropriate answer from the options given below.**

**[24-Jan-2023 Shift 2]**

**Options:**

- A. A is correct but R is not correct
- B. Both A and R are correct and R is the correct explanation of A.
- C. A is not correct but R is correct
- D. Both A and R are correct and R is NOT the correct explanation of A.

**Answer: B**

**Solution:**

**Solution:**

Be has less negative value compared to other AEM. However its reducing nature is due to large hydration energy associated with the small size of Be<sup>2+</sup> ion and relatively large value of the atomization enthalpy of metal.

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## Question8

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

**Assertion A :- Carbon forms two important oxides – CO and CO<sub>2</sub> . CO is neutral whereas CO<sub>2</sub> is acidic in nature.**

**Reason R :- CO<sub>2</sub> can combine with water in a limited way to form carbonic acid, while CO is sparingly soluble in water.**

**In the light of the above statements, choose the most appropriate answer from the options given below :-**

**[25-Jan-2023 Shift 2]**

**Options:**

- A. Both A and R are correct but R is NOT the correct explanation of A.



B. Both A and R are correct and R is the correct explanation of A.

C. A is not correct but R is correct.

D. A is correct but R is not correct.

**Answer: B**

**Solution:**

**Solution:**

The oxide which form acid on dissolving in water is acidic oxide.

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## Question9

**Given below are two statements:**

**Statement I : The decrease in first ionization enthalpy from B to Al is much larger than that from Al to Ga.**

**Statement II : The d orbitals in Ga are completely filled.**

**In the light of the above statements, choose the most appropriate answer from the options given below**

**[29-Jan-2023 Shift 2]**

**Options:**

A. Statement I is incorrect but statement II is correct.

B. Both the statements I and II are correct

C. Statement I is correct but statement II is incorrect

D. Both the statements I and II are incorrect

**Answer: A**

**Solution:**

The first ionization energies (as in NCERT) are as follows:

B : 801 kJ / mol

Al : 577 kJ / mol

Ga : 579 kJ / mol

Ga : [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>1</sup>

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## Question10

**Lithium aluminium hydride can be prepared from the reaction of**  
**[30-Jan-2023 Shift 1]**

**Options:**

A. LiCl and Al<sub>2</sub>H<sub>6</sub>



B. LiH and  $\text{Al}_2\text{Cl}_6$

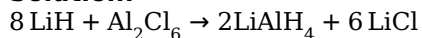
C. LiCl, Al and  $\text{H}_2$

D. LiH and  $\text{Al}(\text{OH})_3$

**Answer: B**

**Solution:**

**Solution:**



## Question11

**Boric acid is solid, whereas  $\text{BF}_3$  is gas at room temperature because of [30-Jan-2023 Shift 2]**

**Options:**

A. Strong ionic bond in Boric acid

B. Strong van der Waal's interaction in Boric acid

C. Strong hydrogen bond in Boric acid

D. Strong covalent bond in  $\text{BF}_3$

**Answer: C**

**Solution:**

**Solution:**

Boric acid has strong hydrogen bonding while  $\text{BF}_3$  does not. Therefore boric acid is solid.

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## Question12

**The Lewis acid character of boron tri halides follows the order: [31-Jan-2023 Shift 2]**

**Options:**

A.  $\text{BBr}_3 > \text{BI}_3 > \text{BCl}_3 > \text{BF}_3$

B.  $\text{BCl}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BI}_3$

C.  $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3 > \text{BI}_3$

D.  $\text{BI}_3 > \text{BBr}_3 > \text{BCl}_3 > \text{BF}_3$

**Answer: D**



## Solution:

### Solution:

Extent of back bonding, reduces down the group leading to more Lewis acidic strength

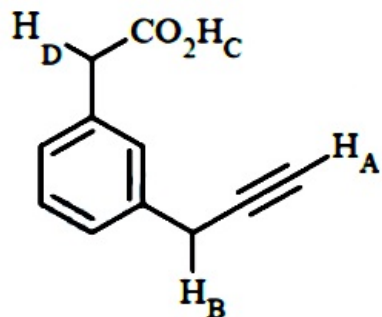
$\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3 > \text{BI}_3$  (extent of back bonding)

$(2p - 2p)(2p - 3p)(2p - 4p)(2p - 5p)$

$\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3 < \text{BI}_3$  (Lewis acidic nature)

## Question 13

What is the correct order of acidity of the protons marked A-D in the given compounds ?



[30-Jan-2023 Shift 1]

### Options:

A.  $\text{H}_C > \text{H}_D > \text{H}_B > \text{H}_A$

B.  $\text{H}_C > \text{H}_D > \text{H}_A > \text{H}_B$

C.  $\text{H}_D > \text{H}_C > \text{H}_B > \text{H}_A$

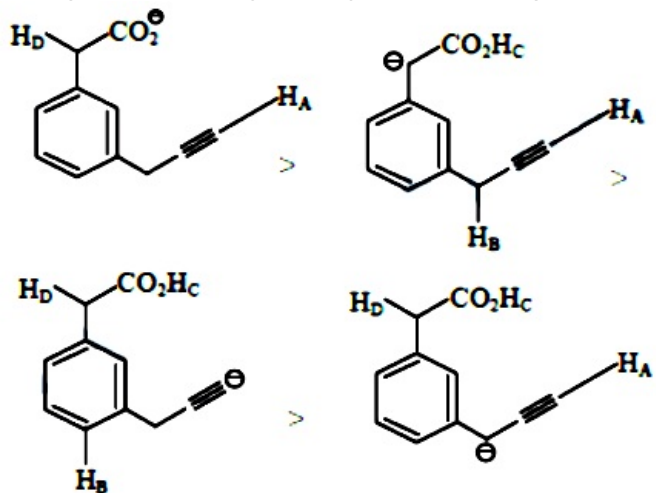
D.  $\text{H}_C > \text{H}_A > \text{H}_D > \text{H}_B$

Answer: B

## Solution:

### Solution:

Acidity of an acid depends upon the stability of its conjugate base





## Question14

The correct order of bond enthalpy ( $\text{kJ mol}^{-1}$ ) is :

[1-Feb-2023 Shift 2]

Options:

- A.  $\text{Si - Si} > \text{C - C} > \text{Sn - Sn} > \text{Ge - Ge}$
- B.  $\text{Si - Si} > \text{C - C} > \text{Ge - Ge} > \text{Sn - Sn}$
- C.  $\text{C - C} > \text{Si - Si} > \text{Sn - Sn} > \text{Ge - Ge}$
- D.  $\text{C - C} > \text{Si - Si} > \text{Ge - Ge} > \text{Sn - Sn}$

Answer: D

Solution:

(Bond enthalpy order

$\text{C - C} > \text{Si - Si} > \text{Ge - Ge} > \text{Sn - Sn}$ )

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## Question15

Structure of  $\text{BeCl}_2$  in solid state, vapour phase and at very high temperature respectively are :-

[6-Apr-2023 shift 2]

Options:

- A. Dimeric, Polymeric, Monomeric
- B. Polymeric, Dimeric, Monomeric
- C. Monomeric, Dimeric, Polymeric
- D. Polymeric, Monomeric, Dimeric

Answer: B

Solution:

Solution:

In solid state  $\text{BeCl}_2$  as polymer, in vapour state it form chloro-bridged dimer while above 1200K it is monomer.

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## Question16

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

[12-Apr-2023 shift 1]

Options:

- A. Both Statement I and Statement II are incorrect
- B. Statement I is incorrect but Statement II is correct
- C. Statement I is correct but Statement II is incorrect
- D. Both statement I and Statement II are correct

Answer: D

Solution:

Solution:

Boron has high melting point because small atomic size and very strong crystalline lattice and at form strong covalent bond with neighboring atoms.

## Question 17

Better method for preparation of  $\text{BeF}_2$ , among the following is

[13-Apr-2023 shift 2]

Options:

- A.  $\text{BeH}_2 + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$
- B.  $\text{Be} + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$
- C.  $(\text{NH}_4)_2\text{BeF}_4 \xrightarrow{\Delta} \text{BeF}_2$
- D.  $\text{BeO} + \text{C} + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$

Answer: C

Solution:

Solution:

As per NCERT (s block), the better method of preparation of  $\text{BeF}_2$  is heating  $(\text{NH}_4)_2\text{BeF}_4 \xrightarrow{\Delta} \text{BeF}_2 + \text{NH}_4\text{F}$

## Question 18

If the formula of Borax is  $\text{Na}_2\text{B}_4\text{O}_x(\text{OH})_y \cdot z\text{H}_2\text{O}$ , then  $x + y + z = \underline{\hspace{2cm}}$ .

[13-Apr-2023 shift 2]



**Answer: 17**

**Solution:**

**Solution:**

Formula of borax is  $\text{Na}_2\text{B}_4\text{O}_5(\text{OH})_4 \cdot 8\text{H}_2\text{O}$

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## Question19

**For a good quality cement, the ratio of silica to alumina is found to be [15-Apr-2023 shift 1]**

**Options:**

- A. 2
- B. 3
- C. 4.5
- D. 1.5

**Answer: B**

**Solution:**

**Solution:**

The ratio should be between 2.5 to 4 : 1  
so ans →3

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## Question20

**The most stable trihalide of nitrogen is: [24-Jun-2022-Shift-1]**

**Options:**

- A.  $\text{N F}_3$
- B.  $\text{N Cl}_3$
- C.  $\text{N Br}_3$
- D.  $\text{N I}_3$

**Answer: A**

**Solution:**

The stability of trihalides decreases down the group due to weakening of N – X bond and inability of N to accommodate large sized halogen atoms (Cl, Br, I) around it.

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## Question21

**Number of electron deficient molecules among the following  $\text{PH}_3$ ,  $\text{B}_2\text{H}_6$ ,  $\text{CCl}_4$ ,  $\text{NH}_3$ ,  $\text{LiH}$  and  $\text{BCl}_3$  is**

**[25-Jun-2022-Shift-1]**

**Options:**

- A. 0
- B. 1
- C. 2
- D. 3

**Answer: C**

**Solution:**

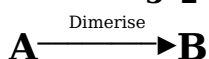
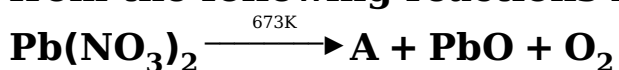
**Solution:**

Electron deficient species have less than 8 electrons (or two electrons for H ) in their valence (incomplete octet).  $\text{B}_2\text{H}_6$ ,  $\text{BCl}_3$  have incomplete octet.

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## Question22

**The number of bridged oxygen atoms present in compound B formed from the following reactions is**



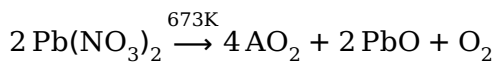
**[25-Jun-2022-Shift-2]**

**Options:**

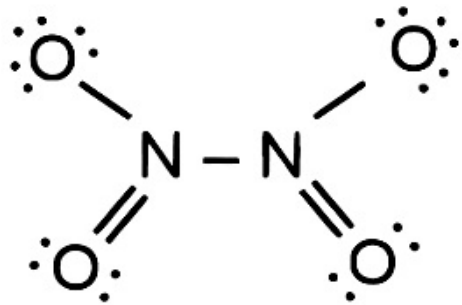
- A. 0
- B. 1
- C. 2
- D. 3

**Answer: A**

**Solution:**



Hence no bridged oxygen atom is present in  $\text{N}_2\text{O}_4$



Hence no bridged oxygen atom is present in  $\text{N}_2\text{O}_4$

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## Question23

**Choose the correct stability order of group 13 elements in their +1 oxidation state.**

**[26-Jun-2022-Shift-1]**

**Options:**

- A.  $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$
- B.  $\text{Tl} < \text{In} < \text{Ga} < \text{Al}$
- C.  $\text{Al} < \text{Ga} < \text{Tl} < \text{In}$
- D.  $\text{Al} < \text{Tl} < \text{Ga} < \text{In}$

**Answer: A**

**Solution:**

**Solution:**

Due to inert pair effect, stability of +3 oxidation state decreases and that of +1 oxidation state increases for (down the group) group 13 elements.

So, the correct order of stability of group 13 elements in their +1 oxidation state is  $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$ .

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## Question24

**Choose the most appropriate answer from the options given below :**



List-I (Metal)		List-II (Application)	
(A)	Cs	(I)	High temperature thermometer
(B)	Ga	(II)	Water repellent sprays
(C)	B	(III)	Photoelectric cells
(D)	Si	(IV)	Bullet proof vest

### [29-Jun-2022-Shift-1]

#### Options:

- A. (A)-(III), (B)-(I), (C)-(IV), (D)-(II)  
 B. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)  
 C. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)  
 D. (A) – (I), (B) – (IV), (C) – (II), (D) – (III)

**Answer: A**

#### Solution:

Caesium is used in devising photoelectric cells.  
 Boron fibres are used in making bullet-proof vest.  
 Silicones being surrounded by non-polar alkyl groups are water repelling in nature.  
 Gallium is less toxic and has a very high boiling point, so it is used in high temperature thermometers.

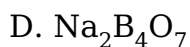
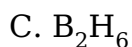
## Question25

**Aqueous solution of which of the following boron compounds will be strongly basic in nature?**

**[29-Jun-2022-Shift-2]**

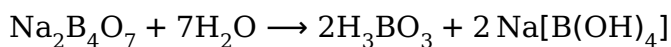
#### Options:

- A.  $\text{NaBH}_4$   
 B.  $\text{LiBH}_4$



**Answer: D**

**Solution:**



Aqueous solution of borax is buffer whose  $pH \approx 9$

Other compounds are less basic than this.

## Question 26

List I		List II	
(A)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(I)	$Cu$
(B)	$CO(g) + 3H_2(g) \rightarrow CH_4(g) + H_2O(g)$	(II)	$Cu/ZnO - Cr_2O_3$
(C)	$CO(g) + H_2(g) \rightarrow HCHO(g)$	(III)	$Fe_xO_y + K_2O + Al_2O_3$
(D)	$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$	(IV)	$Ni$

**Choose the correct answer from the options given below :  
[25-Jul-2022-Shift-1]**

**Options:**

A. (A) – (II), (B) – (IV), (C) – (I), (D) – (II)

B. (A) – (II), (B) – (I), (C) – (IV), (D) – (II)

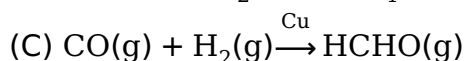
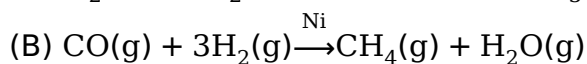
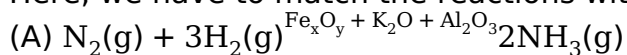
C. (A) – (II), (B) – (IV), (C) – (I), (D) – (I)

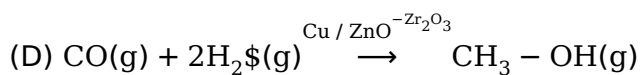
D. (A) – (II), (B) – (I), (C) – (IV), (D) – (I)

**Answer: C**

**Solution:**

Here, we have to match the reactions with their correct catalyst :





## Question27

The geometry around boron in the product ' B ' formed from the following reaction is



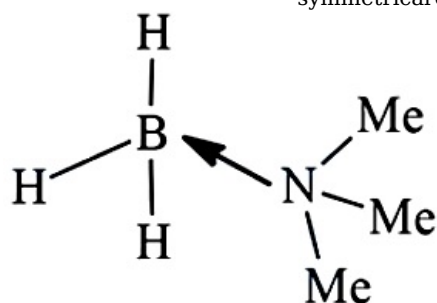
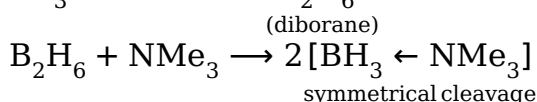
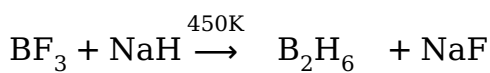
[25-Jul-2022-Shift-1]

Options:

- A. trigonal planar
- B. tetrahedral
- C. pyramidal
- D. square planar

Answer: B

Solution:



## Question28

Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are :

[26-Jul-2022-Shift-1]

Options:

- A.  $\text{B(OH)}_3$  and  $\text{NH}_3$



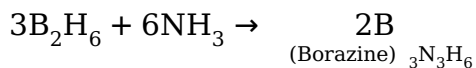
B.  $B_2H_6$  and  $NH_3$

C.  $B_2H_6$  and  $HN_3$

D.  $NH_3$  and  $B_2O_3$

**Answer: B**

**Solution:**



## Question29

**The metal that has very low melting point and its periodic position is closer to a metalloid is**  
**[26-Jul-2022-Shift-2]**

**Options:**

A. Al

B. Ga

C. Se

D. In

**Answer: B**

**Solution:**

Al  $\rightarrow$  933K  
Ga  $\rightarrow$  303K  
In  $\rightarrow$  430K  
Se  $\rightarrow$  490K

Among the given elements, Gallium has the lowest melting point, Gallium is also close to a metalloid

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## Question30

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

**Assertion : Boric acid is a weak acid.**

**Reason R : Boric acid is not able to release  $H^+$  ion on its own. It receives  $OH^-$  ion from water and releases  $H^+$  ion.**

**In the light of the above statements, choose the most appropriate answer from the options given below.**

**[26-Jul-2022-Shift-2]**



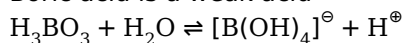
**Options:**

- A. Both A and R are true and R is the correct explanation of A.
- B. Both A and R are true 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: A**

**Solution:****Solution:**

Boric acid is a weak acid



Boric acid is not able to release  $\text{H}^+$  ion on its own. It receives  $\text{OH}^-$  ion from water and releases  $\text{H}^+$  ion as shown in the above reaction.

Hence, Both A and R are correct and R is the correct explanation of A.

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## Question31

Given below are two statements.

**Statement I: The chlorides of Be and Al have Cl-bridged structure. Both are soluble in organic solvents and act as Lewis bases.**

**Statement II: Hydroxides of Be and Al dissolve in excess alkali to give beryllate and aluminate ions.**

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

**[27-Jul-2022-Shift-1]**

**Options:**

- A. Both Statement I and Statement II are true.
- B. Both Statement I and Statement II are false.
- C. Statement I is true but Statement II is false.
- D. Statement I is false but Statement II is true.

**Answer: D**

**Solution:****Solution:**

$\text{Be}_2\text{Cl}_4$  is lewis acid and  $\text{Al}_2\text{Cl}_6$  has complete octet.

Be and Al are amphoteric metals therefore dissolve in acid as well as alkaline solution and form beryllate and aluminate ions in excess alkali.

---

## Question32



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

**Assertion (A) : Boron is unable to form  $\text{BF}_6^{3-}$ .**

**Reason (R) : Size of B is very small.**

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

**[27-Jul-2022-Shift-2]**

**Options:**

- A. Both (A) and (R) are true and (R) is the correct explanation of (A)
- B. Both (A) and (R) are true but (R) is not the correct explanation of (A)
- C. (A) is true but (R) is false
- D. (A) is false but (R) is true

**Answer: B**

**Solution:**

**Solution:**

The outer most shell of Boron is 2 and its maximum covalency is 4 .

Therefore, boron cannot form  $\text{BF}_6^{3-}$ .

Hence Assertion is correct

Boron is the first element of group-13 of modern periodic table. It is very small in size.

But it does not provide correct explanation of Assertion

---

## Question33

**When borax is heated with CoO on a platinum loop, blue coloured bead formed is largely due to**

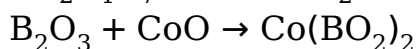
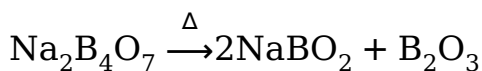
**[29-Jul-2022-Shift-2]**

**Options:**

- A.  $\text{B}_2\text{O}_3$
- B.  $\text{Co}(\text{BO}_2)_2$
- C.  $\text{CoB}_4\text{O}_7$
- D.  $\text{Co}[\text{B}_4\text{O}_5(\text{OH})_4]$

**Answer: B**

**Solution:**



## Question34

The correct statement about  $B_2H_6$  is  
[25 Feb 2021 Shift 1]

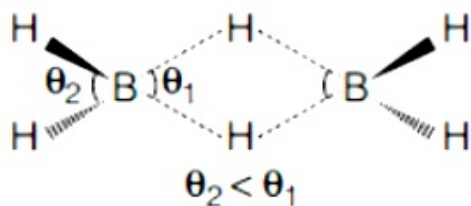
Options:

- A. all B-H-B angles are of  $120^\circ$
- B. the two B – H – B bonds are not of same length
- C. terminal B-H bonds have less p-character when compared to bridging bonds
- D. Its fragment,  $BH_3$ , behaves as a Lewis base

Answer: C

Solution:

Statement (c) is correct, whereas all other statements are incorrect.



Correct statements are as follows

- Both B-H-B bridge bond having same bond length.
- B-H-B bond angle is  $90^\circ$ .
- $BH_3$  is electron deficient species and therefore act as Lewis acid.

---

## Question35

Water does not produce CO on reacting with  
[25 Feb 2021 Shift 2]

Options:

- A.  $CH_4$
- B. C
- C.  $CO_2$
- D.  $C_3H_8$

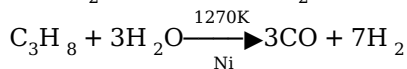
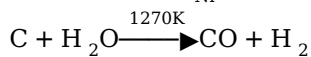
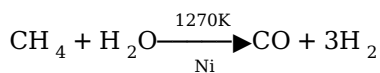
Answer: C

Solution:

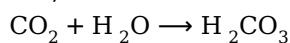
Solution:

Water (steam) can produce CO on reacting with  $CH_4$ , C and  $C_3H_8$  as,





But, water on reaction with  $\text{CO}_2$  produces carbonic acid ( $\text{H}_2\text{CO}_3$ ), not CO.

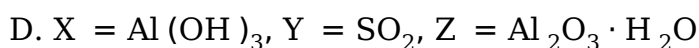
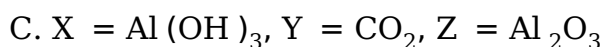
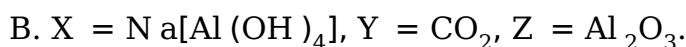
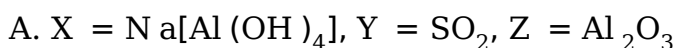


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## Question36

$\text{Al}_2\text{O}_3$  was leached with alkali to get X. The solution of X on passing of gas Y, forms Z. X, Y and Z respectively are:  
[24 Feb 2021 Shift 1]

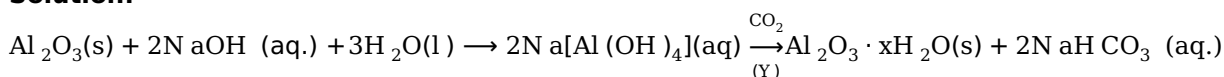
Options:



Answer: B

Solution:

Solution:



---

## Question37

Given below are two statements :

**Statement I : Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.**

**Statement II : Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame.**

**In the light of the above statements, choose the most appropriate answer from the options given below :**

[24 Feb 2021 Shift 1]

Options:

A. Statement I is true but Statement II is false

B. Both Statement I and Statement II are false

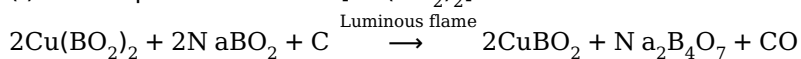
C. Statement I is false but Statement II is true

D. Both Statement I and Statement II are true

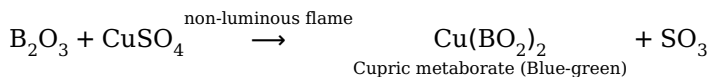
**Answer: B**

**Solution:**

(I) Blue cupric metaborate [ $\text{Cu}(\text{BO}_2)_2$ ] is reduced to colourless cuprous metaborate [ $\text{Cu}(\text{BO}_2)_2$ ] in a luminous flame.



(II) Cupric metaborate is obtained heating boric anhydride ( $\text{B}_2\text{O}_3$ ) and copper sulphate in a non luminous flame.



---

## Question38

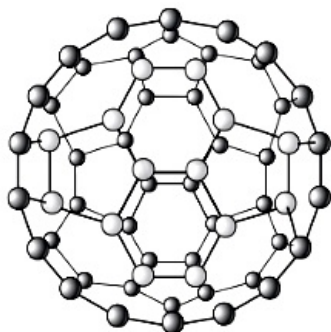
The incorrect statement regarding the structure of  $\text{C}_{60}$  is [16 Mar 2021 Shift 2]

**Options:**

- A. the six-membered rings are fused to both six and five-membered rings
- B. each carbon atom forms three sigma bonds
- C. the five-membered rings are fused only to six-membered rings
- D. it contains 12 six-membered rings and 24 five-membered rings

**Answer: D**

**Solution:**



$\text{C}_{60}$  molecule has a shape like soccer ball and called Buckminster fullerene. It is an allotrope of carbon. It contains twenty-six membered rings and twelve-five membered rings. A six membered ring is fused with six or five membered rings but a five membered ring can only fuse with six membered rings.

All the carbon atoms are equal and they undergo  $\text{sp}^2$ -hybridisation.

Each carbon atom forms three sigma bonds with other three carbon atoms.

So, statement (d) is wrong.

---

## Question39



Given below are the statements about diborane

(a) Diborane is prepared by the oxidation of  $\text{NaBH}_4$  with  $\text{I}_2$

(b) Each boron atom is in  $sp^2$  hybridized state

(c) Diborane has one bridged 3 centre-2-electron bond

(d) Diborane is a planar molecule

The option with correct statement(s) is -

[22 Jul 2021 Shift 2]

Options:

A. (c) and (d) only

B. (a) only

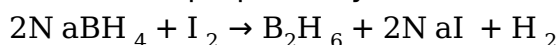
C. (c) only

D. (a) and (b) only

Answer: B

Solution:

Diborane is prepared by the reaction of  $\text{NaBH}_4$  with  $\text{I}_2$ .



In diborane, 'B' is  $sp^3$  hybrid, it is Non-planar and two 3c - 2e<sup>-</sup> bonds are present.

-----

## Question40

Which one of the following compounds of Group-14 elements is not known?

[25 Jul 2021 Shift 1]

Options:

A.  $[\text{GeCl}_6]^{2-}$

B.  $[\text{Sn}(\text{OH})_6]^{2-}$

C.  $[\text{SiCl}_6]^{2-}$

D.  $[\text{SiF}_6]^{2-}$

Answer: C

Solution:

$[\text{SiCl}_6]^{2-}$  does not exist due to steric crowding of surrounding atoms.

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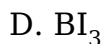
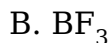


## Question41

In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected?

[27 Aug 2021 Shift 1]

Options:



Answer: B

Solution:

Solution:

Smaller the halide atom, more effective is back donation of an electron pair from halide atom. So, correct answer is  $\text{BF}_3$ .

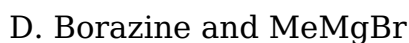
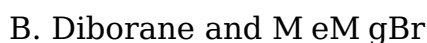
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## Question42

The reaction of  $\text{H}_3\text{N}_3\text{B}_3\text{Cl}_3$  (A) with  $\text{LiBH}_4$  in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to  $\text{H}_3\text{N}_3\text{B}_3(\text{Me})_3$ . Compounds (B) and (C) respectively, are:

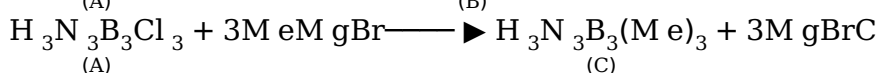
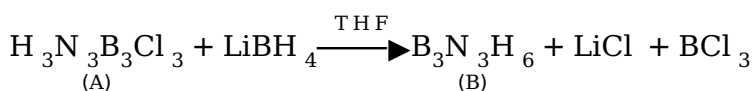
[Jan. 09, 2020 (II)]

Options:



Answer: D

Solution:



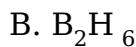
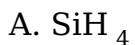


## Question43

The hydride that is NOT electron deficient is:

[Jan. 11, 2019 (II)]

Options:



Answer: A

Solution:

$\text{SiH}_4$ : Electron precise hydride

$\text{B}_2\text{H}_6$ ,  $\text{GaH}_3$  and  $\text{AlH}_3$  are electron deficient

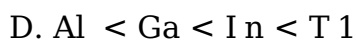
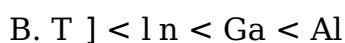
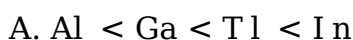
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## Question44

The relative stability of +1 oxidation state of group 13 elements follows the order:

[Jan. 11, 2019 (II)]

Options:



Answer: D

Solution:

Due to inert pair effect, the stability of +1 oxidation state increases down the group. Thus, correct order of stability is  $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$

---

## Question45

The electronegativity of aluminium is similar to:

[Jan. 10, 2019 (I)]



**Options:**

- A. Carbon
- B. Beryllium
- C. Boron
- D. Lithium

**Answer: B**

**Solution:**

**Solution:**

Be and Al show diagonal relationship due to which these two elements have similar electronegativity.

---

## Question46

**The number of 2 -centre- 2 -electron and 3 -centre-2-electron bonds in  $B_2H_6$ , respectively, are:**

**[Jan. 10, 2019 (II)]**

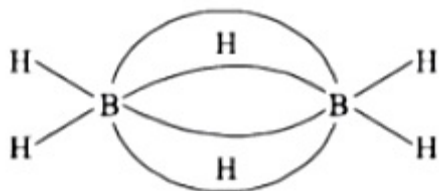
**Options:**

- A. 2 and 1
- B. 4 and 2
- C. 2 and 2
- D. 2 and 4

**Answer: B**

**Solution:**

Structure of  $B_2H_6$  :



$\therefore$  No. of 2 -centre- 2 electron bonds = 4,  
No. of 3 -centre- 2 electron bonds = 2.

---

## Question47

**Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and +3 oxidation states. This is due to:**

**[Jan. 9, 2019(I)]**

**Options:**



- A. inert pair effect
- B. diagonal relationship
- C. lattice effect
- D. lanthanoid contraction

**Answer: A**

**Solution:**

**Solution:**

Due to the inert pair effect, thallium exists in more than one oxidation state. Also, for thallium +1 oxidation state is more stable than +3 oxidation state.

---

## Question48

**The element that does NOT show catenation is:  
[Jan. 12, 2019 (II)]**

**Options:**

- A. Ge
- B. Si
- C. Sn
- D. Pb

**Answer: D**

**Solution:**

**Solution:**

Catenation power of the elements decreases as we move down in the group. Therefore, Pb does not show catenation property.

---

## Question49

**The element that shows greater ability to form  $p\pi - p\pi$  multiple bonds,  
is :  
[Jan. 12, 2019 (II)]**

**Options:**

- A. Sn
- B. C
- C. Ge
- D. Si



**Answer: B**

**Solution:**

**Solution:**

Due to the small size of carbon atom, effective lateral overlapping between 2p and 2p occurs.

---

## Question50

**The chloride that CANNOT get hydrolysed is :  
[Jan. 11, 2019 (I)]**

**Options:**

A.  $\text{PbCl}_4$

B.  $\text{CCl}_4$

C.  $\text{SnCl}_4$

D.  $\text{SiCl}_4$

**Answer: B**

**Solution:**

**Solution:**

$\text{CCl}_4$  cannot be hydrolysed due to absence of d orbitals at carbon atom.

---

## Question51

**Correct statements among 'A' to 'D' regarding silicones are:**

**(A) They are polymers with hydrophobic character.**

**(B) They are biocompatible.**

**(C) In general, they have high thermal stability and low dielectric strength.**

**(D) Usually, they are resistant to oxidation and used as greases.**

**[Jan. 9, 2019 (I)]**

**Options:**

A. (A), (B), (C) and (D)

B. (A), (B) and (C) only

C. (A) and (B) only

D. (A), (B) and (D) only

**Answer: D**



## Solution:

### Solution:

Silicones are polymers containing Si–O–Si linkages with strong hydrophobic character. Generally, they exhibit high thermal stability with high dielectric strength. Silicon greases are resistant to oxidation which are commonly used for greasing purposes.

---

## Question52

**C<sub>60</sub>, an allotrope of carbon contains:**

**[April 9, 2019 (I)]**

### Options:

- A. 12 hexagons and 20 pentagons.
- B. 18 hexagons and 14 pentagons.
- C. 16 hexagons and 16 pentagons.
- D. 20 hexagons and 12 pentagons.

**Answer: D**

### Solution:

#### Solution:

Fullerene (C<sub>60</sub>) contains 20 hexagons (six membered) rings and 12 pentagons (five membered rings):

---

## Question53

**The correct statements among I to III regarding group 13 element oxides are,**

**(I) Boron trioxide is acidic.**

**(II) Oxides of aluminium and gallium are amphoteric.**

**(III) Oxides of indium and thallium are basic.**

**[April 9, 2019 (II)]**

### Options:

- A. (I) and (II) only
- B. (I), (II) and (III)
- C. (I) and (III) only
- D. (II) and (III) only

**Answer: B**

### Solution:



- (I)  $B_2O_3$  – Acidic oxide  
(II)  $Al_2O_3$  &  $Ga_2O_3$  – Amphoteric oxide  
(III)  $In_2O_3$  &  $Tl_2O$  – Basic oxide
- 

## Question54

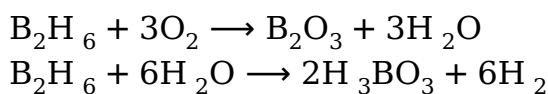
**Diborane ( $B_2H_6$ ) reacts independently with  $O_2$  and  $H_2O$  to produce, respectively;**  
**[April 8, 2019 (I)]**

**Options:**

- A.  $B_2O_3$  and  $H_3BO_3$   
B.  $B_2O_3$  and  $[BH_4]^-$   
C.  $H_3BO_3$  and  $B_2O_3$   
D.  $HBO_2$  and  $H_3BO_3$

**Answer: A**

**Solution:**

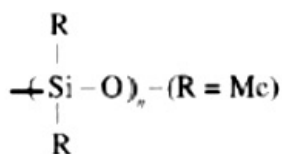


## Question55

**The basic structural unit of feldspar, zeolites, mica, and asbestos is :**  
**[April 12, 2019 (I)]**

**Options:**

- A.  $(SiO_3)^2$   
B.  $SiO_2$   
C.  $(SiO_4)^4$   
D.



**Answer: C**

**Solution:**



These are examples of silicates, the basic unit of each of them is  $\text{SiO}_4^{4-}$  ion.

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## Question56

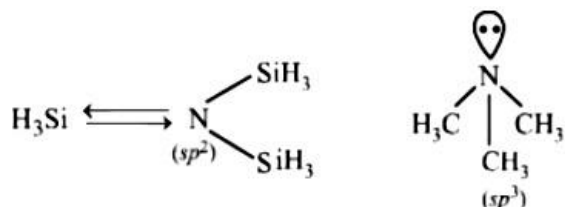
The correct statement among the following is:  
[April 12, 2019 (I)]

Options:

- A.  $(\text{SiH}_3)_3\text{N}$  is planar and less basic than  $(\text{CH}_3)_3\text{N}$ .
- B.  $(\text{SiH}_3)_3\text{N}$  is pyramidal and more basic than  $(\text{CH}_3)_3\text{N}$ .
- C.  $(\text{SiH}_3)_3\text{N}$  is pyramidal and less basic than  $(\text{CH}_3)_3\text{N}$ .
- D.  $(\text{SiH}_3)_3\text{N}$  is planar and more basic than  $(\text{CH}_3)_3\text{N}$ .

Answer: A

Solution:



Due to back bonding of lone pair electrons of nitrogen into vacant d-orbitals of Si, trisilylamine  $(\text{SiH}_3)_3\text{N}$  is planar. In trimethylamine  $(\text{CH}_3)_3\text{N}$ , there is no back bonding and hence it is more basic.

---

## Question57

The C – C bond length is maximum in :  
[April 12, 2019 (II)]

Options:

- A. graphite
- B.  $\text{C}_{70}$
- C.  $\text{C}_{60}$
- D. diamond

Answer: D

Solution:

Carbon-carbon bond length is maximum in diamond because diamond has all single bonds while graphite,  $C_{70}$  and  $C_{60}$  have single and double bonds.

Carbon allotrope	C – C bond length
Diamond	154 pm
Graphite	141.5 pm
$C_{60}$	138.3pm and 143.5pm
$C_{70}$	eight type of bond lengths from 0.137pm to 0.146pm.

## Question58

The correct order of catenation is:  
[April 10, 2019 (I)]

Options:

- A.  $C > Sn > Si \approx Ge$
- B.  $C > Si > Ge \approx Sn$
- C.  $Si > Sn > C > Ge$
- D.  $Ge > Sn > Si > C$

Answer: B

Solution:

The catenation property among 14<sup>th</sup> group elements is based on bond enthalpy value of bond between the same element. The decreasing order of bond enthalpy values is in(kJ / mol )

∴ Decreasing order of catenation is

$C > Si > Ge \approx Sn$

## Question59

The amorphous form of silica is:  
[April 9, 2019 (II)]

Options:

- A. Tridymite





- B. Kieselguhr
- C. Cristobalite
- D. Quartz

**Answer: B**

**Solution:**

Quartz, tridymite and cristobalite are crystalline forms of silica, while kieselguhr is an amorphous form of silica.

## Question60

When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is:

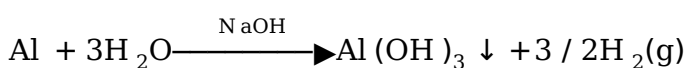
[2018]

**Options:**

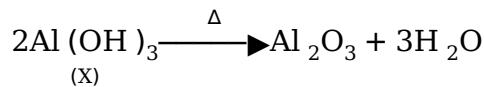
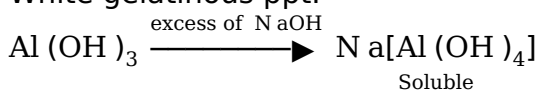
- A. Zn
- B. Ca
- C. Al
- D. Fe

**Answer: C**

**Solution:**



White gelatinous ppt.



$\text{Al}_2\text{O}_3$  is used as adsorbent in chromatography. Thus, metal 'M' is Al.

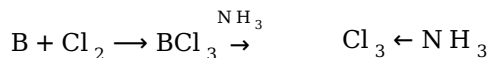
## Question61

A group 13 element 'X' reacts with chlorine gas to produce a compound  $\text{XCl}_3$ .  $\text{XCl}_3$  is electron deficient and easily reacts with  $\text{NH}_3$  to form  $\text{Cl}_3\text{X} \leftarrow \text{NH}_3$  adduct, however,  $\text{XCl}_3$  does not dimerize. X is:

[Online April 16,2018]

**Options:**

- A. B
- B. Al
- C. In
- D. Ga

**Answer: A****Solution:**

[does not dimerise due to (pπ - pπ) back bonding]

adduct

$BCl_3$  is electron deficient but it does not form dimer like Al, Ga or In because its electron deficiency is complemented by the formation of co-ordinate bond between lone pair of electron of chlorine and empty unhybridised p-orbital of boron forming pπ - pπ bonding.

**Question62**

**Which of the following are Lewis acids?  
[2018]**

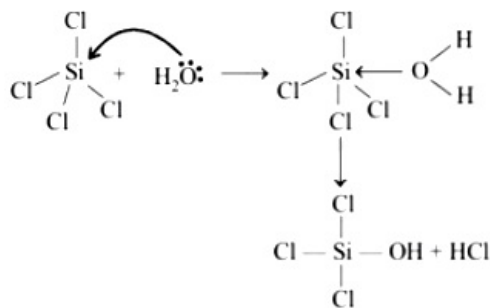
**Options:**

- A.  $PH_3$  and  $BCl_3$
- B.  $AlCl_3$  and  $SiCl_4$
- C.  $PH_3$  and  $SiCl_4$
- D.  $BCl_3$  and  $AlCl_3$

**Answer: 0****Solution:**

$BCl_3$  and  $AlCl_3$ , both have vacant p-orbital and incomplete octet, thus they behave as Lewis acids.  $SiCl_4$  can accept lone pair of electron in d-orbital of silicon, hence it can act as Lewis acid.

Although the most suitable answer is (d). However, both options (b) and (d) can be considered as correct answers. e.g. hydrolysis of  $SiCl_4$



i.e., option (b)  $AlCl_3$  and  $SiCl_4$  is also correct.

## Question63

**In graphite and diamond, the percentage of p -characters of the hybrid orbitals in hybridisation are respectively:**

**[Online April 15, 2018 (I)]**

**Options:**

- A. 33 and 25
- B. 67 and 75
- C. 50 and 75
- D. 33 and 75

**Answer: B**

**Solution:**

$$\% \text{ of p - in graphite (sp}^2\text{)} = \frac{2}{3} \times 100 = 67\%$$

$$\% \text{ of p - in diamond (sp}^3\text{)} = \frac{3}{4} \times 100 = 75\%$$

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## Question64

**Identify the reaction which does not liberate hydrogen:**

**[Online April 10, 2016]**

**Options:**

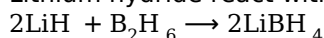
- A. Reaction of lithium hydride with  $B_2H_6$ .
- B. Electrolysis of acidified water using P t electrodes
- C. Reaction of zinc with aqueous alkali
- D. Allowing a solution of sodium in liquid ammonia to stand

**Answer: A**

**Solution:**

**Solution:**

Lithium hydride react with diborane to produce lithiumborohydride.



---

## Question65



Match the items in Column I with its main use listed in Column II:

Column I	Column II
(A) Silica gel	(i) Transistor
(B) Silicon	(ii) Ion-exchanger
(C) Silicone	(iii) Drying agent
(D) Silicate	(iv) Sealant

[Online April 9,2016]

Options:

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

Answer: A

Solution:

Solution:

A - Silica gel packets are used to absorb moisture and keep things dry i.e. as drying agent.

B - Silicon is a semiconductor and is used in transistors.

C - Silicone is used as sealant.

D - Silicates are widely used in ion-exchange beds in domestic and commercial water purification, softening, and other applications.

## Question 66

**Assertion :** Among the carbon allotropes, diamond is an insulator, whereas, graphite is a good conductor of electricity.

**Reason :** Hybridization of carbon in diamond and graphite are  $sp^3$  and  $sp^2$ , respectively.

[Online April 10, 2016]

Options:

- A. Both assertion and reason are correct, but the reason is not the correct explanation for the assertion  
B. Both assertion and reason are correct, and the reason is the correct explanation for the assertion  
C. Both assertion and reason are incorrect  
D. Assertion is incorrect statement, but the reason is correct.

Answer: B



## Solution:

### Solution:

In diamond, each C -atom is covalently bonded to four other C-atoms to give a tetrahedral unit, so it shows  $sp^3$  hybridisation. Therefore, each C-atom forms four sigma bonds with neighbouring C-atoms. In diamond each C-atom utilizes its four unpaired electrons in bond formation. These bonding electrons are localized. Due to this reason diamond is a bad conductor of electricity. In graphite each C-atom is covalently bonded to three C-atoms to give trigonal geometry. Each C-atom in graphite is  $sp^2$  -hybridized. Three out of four valence electrons of each C-atom are used in bond formation while the fourth electron is free to move in the structure of graphite. Due to this reason graphite is a good conductor of electricity.

---

## Question67

**In the following sets of reactants which two sets best exhibit the amphoteric characters of  $Al_2O_3 \cdot xH_2O$ ?**

**Set 1 :  $Al_2O_3 \cdot xH_2O(s)$  and  $OH^-(aq)$**

**Set 2 :  $Al_2O_3 \cdot xH_2O(s)$  and  $H_2O(l)$**

**Set 3 :  $Al_2O_3 \cdot xH_2O(s)$  and  $H^+(aq)$**

**Set 4 :  $Al_2O_3 \cdot xH_2O(s)$  and  $NH_3(aq)$**

**[Online April 9, 2014]**

### Options:

A. 1 and 2

B. 1 and 3

C. 2 and 4

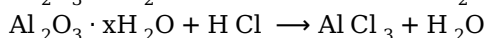
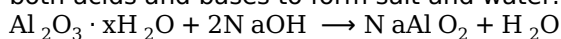
D. 3 and 4

**Answer: B**

### Solution:

#### Solution:

Aluminium oxide is amphoteric oxide because it shows the properties of the both acidic and basic oxides. It reacts with both acids and bases to form salt and water.



## Question68

**The gas evolved on heating  $CaF_2$  and  $SiO_2$  with concentrated  $H_2SO_4$ , on hydrolysis gives a white gelatinous precipitate. The precipitate is:**

**[Online April 9, 2014]**

### Options:

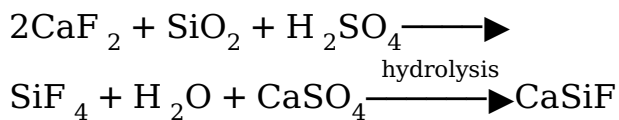
A. hydrofluosilicic acid



- B. silica gel
- C. silicic acid
- D. calciumfluorosilicate

**Answer: D**

**Solution:**



## Question69

**Example of a three-dimensional silicate is:  
[Online April 19, 2014]**

**Options:**

- A. Zeolites
- B. Ultramarines
- C. Feldspars
- D. Beryls

**Answer: C**

**Solution:**

**Solution:**

The feldspars are most abundant aluminosilicate minerals in the Earth surface. The silicon atoms and aluminium atoms occupy the centres of interlinked tetrahedra of  $\text{SiO}_4^{4-}$  and  $\text{AlO}_4^{5-}$ . These tetrahedra connect at each corner to other tetrahedra forming an intricate, three dimensional, negatively charged framework. The sodium cations sit within the voids in this structure.

## Question70

**Identify the incorrect statement:  
[Online April 23, 2013]**

**Options:**

- A. In  $(\text{Si}_3\text{O}_9)^{6-}$ , tetrahedral  $\text{SiO}_4$  units share two oxygen atoms.
- B. Trialkylechlorosilane on hydrolysis gives  $\text{R}_3\text{SiOH}$ .
- C.  $\text{SiCl}_4$  undergoes hydrolysis to give  $\text{H}_4\text{SiO}_4$ .

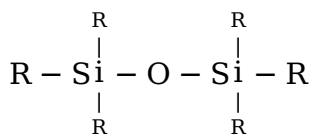


D.  $(\text{Si}_3\text{O}_9)^{6-}$  has cyclic structure.

**Answer: B**

**Solution:**

The hydrolysis of trialkylchlorosilane,  $\text{R}_3\text{SiCl}$  yields dimer:



## Question71

The catenation tendency of C, Si and Ge is in the order  $\text{Ge} < \text{Si} < \text{C}$ . The bond energies (in  $\text{kJ mol}^{-1}$ ) of C – C Si – Si and Ge – Ge bonds are respectively;

[Online April 25, 2013]

**Options:**

- A. 348, 297, 260
- B. 297, 348, 260
- C. 348, 260, 297
- D. 260, 297, 348

**Answer: A**

**Solution:**

**Solution:**

The linking of identical atoms with each other to form long chains is called catenation. However, this property decreases from carbon to lead. Decrease of this property is associated with M-M bond energy, which decreases from carbon to lead.

---

## Question72

In view of the signs of  $\Delta_r G^\circ$  for the following reactions:



which oxidation states are more characteristics for lead and tin ?  
[2011RS]

**Options:**

- A. For lead +2, for tin + 2
- B. For lead +4, for tin +4



C. For lead +2, for tin +4

D. For lead +4, for tin +2

**Answer: C**

**Solution:**

Negative  $\Delta_f G^\circ$  value indicates that +2 oxidation state is more stable for  $\text{Pb}^{2+}$ . Also it is supported by inert pair effect that +2 oxidation state is more stable for Pb and +4 oxidation state is more stable for Sn.  
i.e.  $\text{Sn}^{2+} < \text{Pb}^{2+}$ ,  $\text{Sn}^{4+} > \text{Pb}^{4+}$

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## Question73

**Which one of the following is the correct statement?  
[2008]**

**Options:**

A. Boric acid is a protonic acid

B. Beryllium exhibits coordination number of six

C. Chlorides of both beryllium and aluminium have bridged structures in solid phase

D.  $\text{B}_2\text{H}_6 \cdot 2\text{N H}_3$  is known as 'inorganic benzene'

**Answer: C**

**Solution:**

The correct formula of inorganic benzene is  $\text{B}_3\text{N}_3\text{H}_6$  so (d) is incorrect statement

Boric acid ( $\text{H}_3\text{BO}_3$  or  $\begin{array}{c} \text{OH} \\ | \\ \text{B} - \text{OH} \\ | \\ \text{OH} \end{array}$ ) is a Lewis acid so (a) is incorrect statement.

The coordination number exhibited by beryllium is 4 and not 6 so statement (b) is also incorrect. Both  $\text{BeCl}_2$  and  $\text{Al Cl}_3$  exhibit bridged structures in solid state, so (c) is correct statement.

---

## Question74

**Among the following substituted silanes, which one will give rise to cross linked silicone polymer on hydrolysis is  
[2008]**

**Options:**

A.  $\text{R}_4\text{Si}$

B.  $\text{R}_2\text{SiCl}_2$





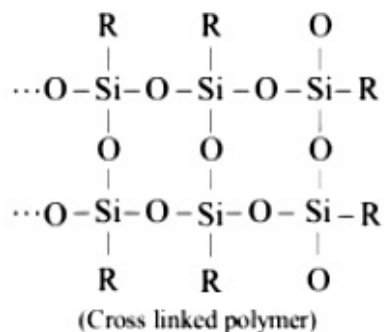
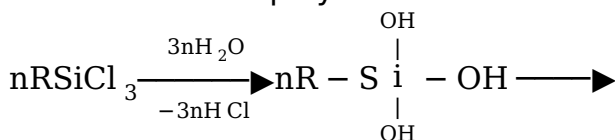
C.  $\text{RSiCl}_3$

D.  $\text{R}_3\text{SiCl}$

**Answer: C**

**Solution:**

The cross linked polymers will be formed by  $\text{RSiCl}_3$ ,



## Question 75

The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence  
[2007]

**Options:**

A.  $\text{PbX}_2 < < \text{SnX}_2 < < \text{GeX}_2 < < \text{SiX}_2$

B.  $\text{GeX}_2 < < \text{SiX}_2 < < \text{SnX}_2 < \text{PbX}_2$

C.  $\text{SiX}_2 < < \text{GeX}_2 < < \text{PbX}_2 < < \text{SnX}_2$

D.  $\text{SiX}_2 < \text{GeX}_2 < < \text{SnX}_2 < < \text{PbX}_2$

**Answer: D**

**Solution:**

**Solution:**

Reluctance of valence shell electrons to participate in bonding is called inert pair effect. The stability of lower oxidation state (+2 for group 14 elements) increases on going down the group. So the correct order is  $\text{SiX}_2 < \text{GeX}_2 < \text{SnX}_2 < \text{PbX}_2$

## Question 76

A metal, M forms chlorides in its +2 and +4 oxidation states. Which of the following statements about these chlorides is correct?  
[2006]



**Options:**

- A.  $MCl_2$  is more ionic than  $MCl_4$
- B.  $MCl_2$  is more easily hydrolysed than  $MCl_4$
- C.  $MCl_2$  is more volatile than  $MCl_4$
- D.  $MCl_2$  is more soluble in anhydrous ethanol than  $MCl_4$

**Answer: A**

**Solution:****Solution:**

Metal atom in the lower oxidation state forms ionic bond whereas in the higher oxidation state forms covalent bond, because higher oxidation state means small size and high polarizing power and hence greater the covalent character. So,  $MCl_2$  is more ionic than  $MCl_4$ .

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## Question77

**Heating an aqueous solution of aluminum chloride to dryness will give [2005]**

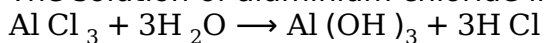
**Options:**

- A.  $Al(OH)Cl_2$
- B.  $Al_2O_3$
- C.  $Al_2Cl_6$
- D.  $AlCl_3$

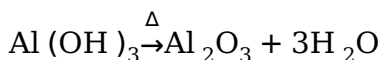
**Answer: B**

**Solution:**

The solution of aluminium chloride in water is acidic due to hydrolysis.



On heating till dryness,  $Al(OH)_3$  is converted into  $Al_2O_3$ .



## Question78

**The structure of diborane ( $B_2H_6$ ) contains [2005]**

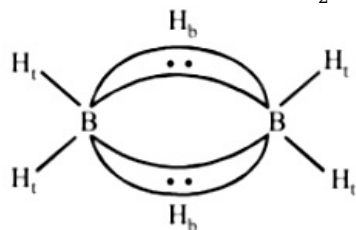
**Options:**

- A. four 2c – 2e bonds and four 3c – 2e bonds
- B. two 2c – 2e bonds and two 3c – 3e bonds
- C. two 2c – 2c bonds and four 3c – 2c bonds
- D. four 2c – 2e bonds and two 3c – 2e bonds

**Answer: D**

**Solution:**

In diborane structure of  $B_2H_6$ , there are four 2c – 2e bonds and two 3c – 2e bonds (see structure of diborane).



$H_t$  = terminal hydrogen

$H_b$  = bridging hydrogen

## Question79

### In silicon dioxide [2005]

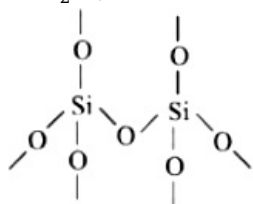
**Options:**

- A. there are double bonds between silicon and oxygen atoms
- B. silicon atom is bonded to two oxygen atoms
- C. each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms
- D. each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms.

**Answer: D**

**Solution:**

In  $SiO_2$  (quartz), each of O -atom is shared between two  $SiO_4^{4-}$  tetrahedra.



## Question80

**Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in [2004]**

**Options:**

- A. forming covalent halides
- B. forming polymeric hydrides
- C. exhibiting maximum covalency in compounds
- D. exhibiting amphoteric nature in their oxides

**Answer: C**

**Solution:**

**Solution:**

The maximum valency of beryllium is +2, while that of aluminium it is +3.

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## Question81

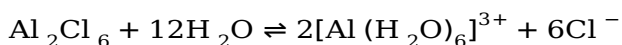
**Aluminium chloride exists as dimer,  $\text{Al}_2\text{Cl}_6$  in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives [2004]**

**Options:**

- A.  $[\text{Al}(\text{OH})_6]^{3-} + 3\text{HCl}$
- B.  $[\text{Al}(\text{H}_2\text{O})_6]^{3+} + 3\text{Cl}^-$
- C.  $\text{Al}^{3+} + 3\text{Cl}^-$
- D.  $\text{Al}_2\text{O}_3 + 6\text{HCl}$

**Answer: B**

**Solution:**



## Question82

**The soldiers of Napoleon army while at Alps during freezing winter**



**suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to [2004]**

**Options:**

- A. a change in the partial pressure of oxygen in the air
- B. a change in the crystalline structure of tin
- C. an interaction with nitrogen of the air at very low temperature
- D. an interaction with water vapour contained in the humid air

**Answer: B**

**Solution:**

**Solution:**

Grey tin  $\rightleftharpoons$  white tin

Grey tin is brittle and crumbles down to powder in very cold climate

The conversion of grey tin to white tin is accompanied by increase in volume., This is known as tin plaque or tin disease.

---

## Question83

**Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite [2003]**

**Options:**

- A. is an allotropic form of diamond
- B. has molecules of variable molecular masses like polymers
- C. has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds
- D. is a non-crystalline substance

**Answer: C**

**Solution:**

**Solution:**

In graphite, carbon is  $sp^2$  hybridized. Each carbon is thus linked to three other carbon atoms forming hexagonal rings. Since only three electrons of each carbon are used in making hexagonal ring, fourth electron of each carbon is free to move. This makes graphite a good conductor of heat and electricity. Further graphite has a two dimensional sheet like structure. These various sheets are held together by van der Waal's force of attraction which makes it difficult to melt. Further due to these weak forces of attraction, one layer can slip over the other. Which makes graphite soft and a good lubricating agent.

---

## Question84



## Glass is a [2003]

### Options:

- A. super-cooled liquid
- B. gel
- C. polymeric mixture
- D. micro-crystalline solid

**Answer: A**

### Solution:

#### Solution:

Glass is a translucent or transparent amorphous supercooled solid solution or we can say super cooled liquid of silicates and borates having a general formula  $R_2O \cdot M O \cdot 6SiO_2$ , where  $R = Na$  or  $K$  and  $M = Ca, Ba, Z$  nor  $Pb$ .

---

## Question85

**For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be**  
[2003]

### Options:

- A. tin
- B. sodium
- C. magnesium
- D. mercury

**Answer: D**

### Solution:

#### Solution:

It is mercury because it exists as liquid at room temperature.

---

## Question86

**Alum helps in purifying water by**  
[2002]

### Options:

- A. forming Si complex with clay partiles



B. sulphate part which combines with the dirt and removes it

C. coagulaing the mud particles

D. making mud water soluble.

**Answer: C**

**Solution:**

Alum furnishes  $Al^{3+}$  ions which bring about coagulation of negatively charged clay particles, bacteria etc.

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