The P-Block Elements (Group 13-14)

Question1

A group 15 element forms $\mathrm{d}\pi-\mathrm{d}\pi$ bond with transition metals. It also forms hydride, which is a strongest base among the hydrides of other group members that form $d\pi-d\pi$ bond.

The atomic number of the element is _____ .

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Answer: 15

Solution:

Phosphorus, an element from group 15 of the periodic table, can form a $d\pi-d\pi$ bond with transition metals. Among the hydrides of group 15, phosphine (PH_3) is considered the strongest base, except for ammonia (NH_3).

Question2

The maximum covalency of a non-metallic group 15 element ' E ' with weakest $\mathrm{E}-\mathrm{E}$ bond is :

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Options:

A. 5

B. 3

C. 4

D. 6

Answer: C

Solution:

Among the group 15 elements (N, P, As, Sb, Bi), the lightest two (N and P) are commonly considered nonmetals. Of these, **nitrogen** (N) is known to have the **weakest single bond** to itself (N–N).

The **N–N** single-bond enthalpy ($\approx$ 160\,kJ/mol) is lower (weaker) than the **P–P** single-bond enthalpy ($\approx$ 200 \,kJ/mol).

Therefore, the "nonmetallic group 15 element with the weakest E–E bond" is **nitrogen**.

Maximum Covalency of Nitrogen

Although nitrogen typically forms **three** covalent bonds in neutral compounds (e.g., NH_3), it can expand to **four** bonds in certain cationic species such as ammonium NH_4^+ or NF_4^+. In such species, nitrogen has a formal positive charge but is still forming four covalent bonds.

Hence, the **maximum covalency** of nitrogen is **4**.

Answer: 4 (Option C).

Question3

The incorrect statement among the following is

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Options:

A. PH_3 shows lower proton affinity than NH_3.

B. SO_2 can act as an oxidizing agent, but not as a reducing agent.

C. NO_2 can dimerise easily.

D. PF_3 exists but NF_5 does not.

Answer: B

Solution:

PH_3 shows lower proton affinity than NH_3.

Ammonia (NH_3) has a more available lone pair on nitrogen than PH_3 on phosphorus due to smaller size and higher electronegativity. Thus, NH_3 is a stronger base and has a higher proton affinity than PH_3.

This statement is correct.

SO_2 can act as an oxidizing agent, but not as a reducing agent.

Sulfur dioxide (SO_2) is quite versatile in redox chemistry. In many reactions, it actually behaves as a reducing agent by being oxidized (e.g., to sulfate, where sulfur goes from +4 to +6 oxidation state). While under some conditions it may act as an oxidizing agent, it is well known and widely used for its reducing properties.

Hence, the claim that it "cannot act as a reducing agent" is incorrect.

NO_2 can dimerise easily.

Nitrogen dioxide (NO_2) is known to dimerise to form dinitrogen tetroxide (N_2O_4), especially at lower temperatures.

This statement is correct.

PF_3 exists but NF_5 does not.

Phosphorus trifluoride (PF_3) is a known stable compound. In contrast, a compound like nitrogen pentafluoride (NF_5) is not observed, largely due to the limitations of nitrogen's size and bonding capabilities in forming such a structure.

This statement is correct.

Based on the analysis, the incorrect statement is:

Option B.

Question4

The large difference between the melting and boiling points of oxygen and sulphur may be explained on the basis of

JEE Main 2025 (Online) 24th January Morning Shift

Options:

A. Atomicity

B. Electron gain enthalpy

C. Atomic size

D. Electronegativity

Answer: A

Solution:

The significant difference in the melting and boiling points of oxygen and sulfur can be explained by considering atomicity.

Oxygen exists as O_2 (Atomicity = 2).

Sulfur exists as S_8 (Atomicity = 8).

Due to sulfur's higher atomicity (forming S8 molecules), its melting and boiling points are considerably higher than those of oxygen.

Question5

The nature of oxide (TeO_2) and hydride (TeH_2) formed by Te , respectively are :

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Options:

A. Reducing and basic

B. Reducing and acidic

C. Oxidising and acidic

D. Oxidising and basic

Answer: C

Solution:

Tellurium dioxide (TeO_2) acts as an oxidizing agent. This is because it can accept electrons and be reduced from its +4 oxidation state to a lower oxidation state.

Tellurium hydride (TeH_2) is considered acidic. This is due to its relatively low bond dissociation energy, which makes it prone to breaking, releasing protons (H^+).

Question6

Given below are two statements :

Statement I : The N - N single bond is weaker and longer than that of P - P single bond.

Statement II : Compounds of group 15 elements in +3 oxidation states readily undergo disproportionation reactions.

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

JEE Main 2025 (Online) 3rd April Morning Shift

Options:

A. Statement I is false but Statement II is true

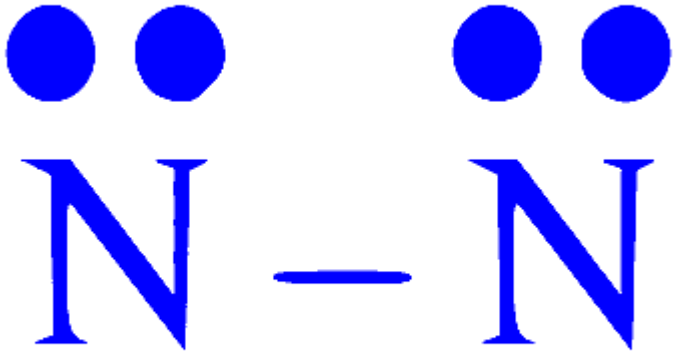
B. Both Statement I and Statement II are true

C. Both Statement I and Statement II are false

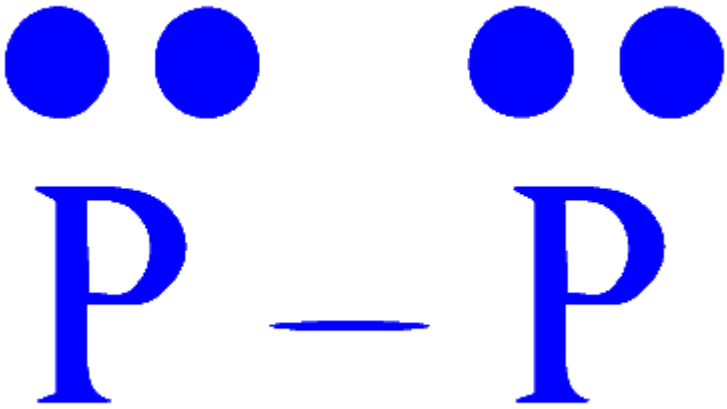
D. Statement I is true but Statement II is false

Answer: C

Solution:



single bond weaker than



due to more ℓp $-$ ℓp repulsion.

Bond length $\Rightarrow d_{p-p} > d_{\mathrm{N-N}}$(size $\uparrow$, B.L. $\uparrow$)

In group 15 elements only N \& P show disproportionation in +3 oxidation state, As, **Sb**& Bi have almost inert for disproportionation in +3 oxidation state.

So both statements are false.

Question7

Given below are the pairs of group 13 elements showing their relation in terms of atomic radius. $(\mathrm{B} < \mathrm{Al}), (\mathrm{Al} < \mathrm{Ga}), (\mathrm{Ga} < \mathrm{In})$ and $(\mathrm{In} < \mathrm{Tl})$Identify the elements present in the incorrect pair and in that pair find out the element (X) that has higher ionic radius $\left(\mathrm{M}^{3+}\right)$ than the other one. The atomic number of the element (X) is

JEE Main 2025 (Online) 4th April Morning Shift

Options:

A. 49

B. 81

C. 31

D. 13

Answer: C

Solution:

Size order

$$\mathrm{Al} > \mathrm{Ga}$$
$$\mathrm{Al}^{3+} < \mathrm{Ga}^{3+}$$

Atomic number of Ga is 31

Question8

Given below are two statements:

Statement I: Nitrogen forms oxides with +1 to +5 oxidation states due to the formation of $\mathrm{p}\pi - \mathrm{p}\pi$ bond with oxygen.

Statement II: Nitrogen does not form halides with +5 oxidation state due to the absence of d-orbital in it.

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

JEE Main 2025 (Online) 4th April Morning Shift

Options:

A. Both Statement I and Statement II are true

B. Statement I is true but Statement II is false

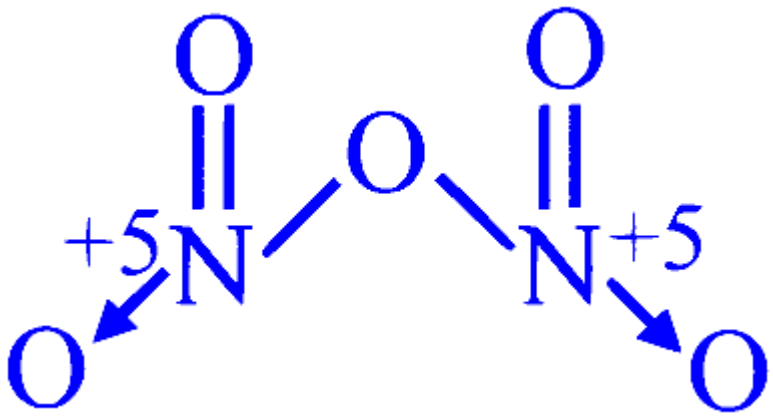
C. Statement I is false but Statement II are true

D. Both Statement I and Statement II are False

Answer: A

Solution:

In oxide of nitrogen it can achieve +5 oxidation state because it can form $p\pi - p\pi$ bond with oxygen e.g. N_2O_5



Nitrogen cannot form halide in +5 oxidation state because it does not contain d-orbital.

e.g. NX_5 does not exist

X = halide

Question9

Given below are two statements :

Statement (I) : The first ionisation enthalpy of group 14 elements is higher than the corresponding elements of group 13.

Statement (II) : Melting points and boiling points of group 13 elements are in general much higher than those of corresponding elements of group 14.

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

JEE Main 2025 (Online) 4th April Evening Shift

Options:

A. Statement I is correct but Statement II is incorrect

B. Both Statement I and Statement II are incorrect

C. Statement I is incorrect but Statement II is correct

D. Both Statement I and Statement II are correct

Answer: A

Solution:

Statement 1 is correct since left to right 1 E increases in general in periodic table.

Statement 2 is incorrect since M.P. of group 14 elements is more than group 13 elements.

Question10

The correct statements from the following are :

(A) Tl^{3+} is a powerful oxidising agent

(B) Al^{3+} does not get reduced easily

(C) Both Al^{3+} and Tl^{3+} are very stable in solution

(D) Tl^{1+} is more stable than Tl^{3+}

(E) Al^{3+} and Tl^{1+} are highly stable

Choose the correct answer from the options given below :

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Options:

A.

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

B.

(A), (C) and (D) only

C.

(A), (B), (C) and (E)

D.

(B), (D) and (E) only

Answer: A

Solution:

(i) True: Tl^{1+} is more stable than Tl^{3+} due to the inert pair effect. Therefore, Tl^{3+} acts as a powerful oxidizing agent.

(ii) True: The standard reduction potential for $Al^{3+/Al}$ is -1.66 V, indicating that Al^{3+} is difficult to reduce and thus highly stable.

(iii) False: Tl^{3+} is not stable in solution.

(iv) True: Tl^{1+} is more stable than Tl^{3+}.

(v) True: Both Al^{3+} and Tl^{1+} are highly stable in their respective oxidation states.

Question11

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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Question12

Identify the incorrect pair from the following :

[29-Jan-2024 Shift 1]

Options:

A.

Fluorspar- BF_3

B.

Cryolite- Na_3AlF_6

C.

Fluoroapatite- $3Ca_3(PO_4)_2 \cdot CaF_2$

D.

Carnallite- $KCl \cdot MgCl_2 \cdot 6H_2O$

Answer: A

Solution:

Fluorspar is CaF_2

Question13

Consider the oxides of group 14 elements SiO_2, GeO_2, SnO_2, PbO_2, CO and GeO. The amphoteric oxides are

[31-Jan-2024 Shift 1]

Options:

A.

GeO, GeO_2

B.

SiO_2, GeO_2

C.

SnO_2, PbO_2

D.

SnO_2, CO

Answer: C

Solution:

SnO_2 and PbO_2 are amphoteric

Question14

Given below are two statements :

Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.
Statement II: $AlCl_3$ upon hydrolysis in acidified aqueous solution forms octahedral $[Al(H_2O)_6]^{3+}$ 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 $[M(OH)_4]^-$ species, the hybridisation state of element M is sp^3.

In case of aluminium, acidified aqueous solution forms octahedral $[Al(H_2O)_6]^{3+}$ ion.

Question15

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:

CCl_4 used in fire extinguisher. CH_2Cl_2 used as paint remover. Freons used in refrigerator and AC. DDT used as non Biodegradable insecticide.

Question16

Given below are two statements:

Statement (I) : SiO_2 and GeO_2 are acidic while SnO and PbO are amphoteric in nature.
Statement (II) : Allotropic forms of carbon are due to property of catenation and pπ − dπ 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_2 and GeO_2 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.

Question17

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^{2+} 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 it's reducing nature is due to large hydration energy associated with the small size of Be^{2+} ion and relatively large value of the atomization enthalpy of metal.

Question18

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_2 . CO is neutral whereas CO_2 is acidic in nature.
Reason R :- CO_2 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.

Question19

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:

Solution:
The first ionization energies (as in NCERT) are as follows:
B : 801 kJ/mol
Al : 577 kJ/mol
Ga : 579 kJ/mol
Ga : $[Ar]3d^{10}4\ s^2 4p^1$

Question20

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

Options:

A. LiCl and Al_2H_6

B. LiH and Al_2Cl_6

C. LiCl, Al and H_2

D. LiH and $Al(OH)_3$

Answer: B

Solution:

Solution:
$8\,LiH + Al_2Cl_6 \rightarrow 2LiAlH_4 + 6\,LiCl$

Question21

Boric acid in solid, whereas 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 BF_3

Answer: C

Solution:

Solution:
Boric acid has strong hydrogen bonding while BF_3 does not. Therefore boric acid is solid.

Question22

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

Options:

A. $BBr_3 > BI_3 > BCI_3 > BF_3$

B. $BCl_3 > BF_3 > BBr_3 > BI_3$

C. $BF_3 > BCl_3 > BBr_3 > BI_3$

D. $BI_3 > BBr_3 > BCl_3 > BF_3$

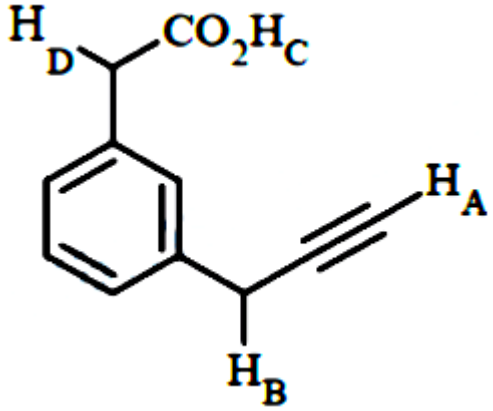
Answer: D

Solution:

Solution:
Extent of back bonding, reduces down the group leading to more Lewis acidic strength
$BF_3 > BCl_3 > BBr_3 > BI_3$ (extent of back bonding)
$(2p-2p)(2p-3p)(2p-4p)(2p-5p)$
$BF_3 < BCl_3 < BBr_3 < BI_3$ (lewis acidic nature)

Question23

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



[30-Jan-2023 Shift 1]

Options:

A. $H_C > H_D > H_B > H_A$

B. $H_C > H_D > H_A > H_B$

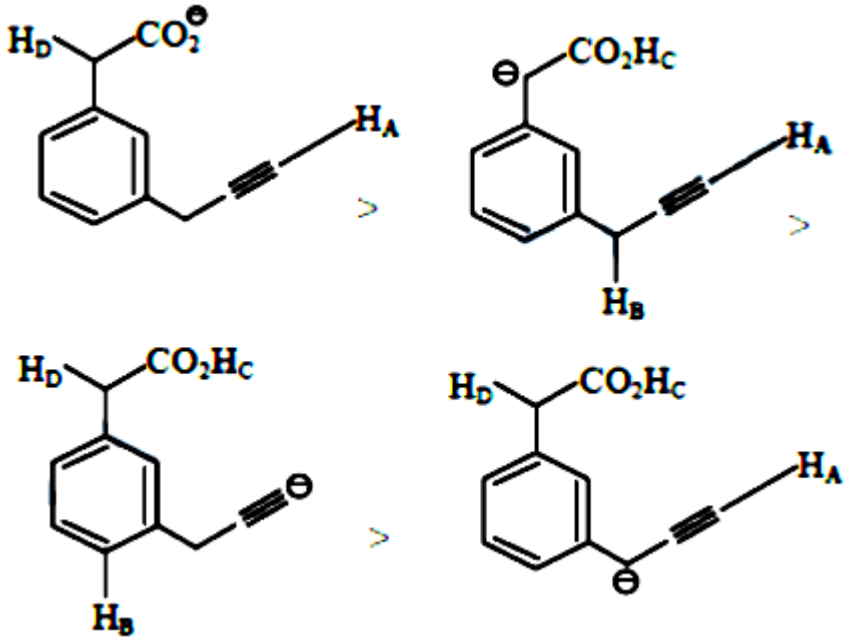
C. $H_D > H_C > H_B > H_A$

D. $H_C > H_A > H_D > H_B$

Answer: B

Solution:

Solution:
acidity of an acid depends upon the stability of its conjugate base



Question24

The correct order of bond enthalpy ($kJ\ mol^{-1}$) is : [1-Feb-2023 Shift 2]

Options:

A. $Si - Si > C - C > Sn - Sn > Ge - Ge$

B. $Si - Si > C - C > Ge - Ge > Sn - Sn$

C. $C - C > Si - Si > Sn - Sn > Ge - Ge$

D. $C - C > Si - Si > Ge - Ge > Sn - Sn$

Answer: D

Solution:

Solution:
(Bond enthalpy order
$C - C > Si - Si > Ge - Ge > Sn - Sn$)

Question25

Structure of $BeCl_2$ 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 $BeCl_2$ as polymer, in vapour state it form chloro-bridged dimer while above $1200K$ it is monomer.

Question26

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 neighbonzing. Atoms:

Question27

Better method for preparation of BeF_2, among the following is
[13-Apr-2023 shift 2]

Options:

A. $BeH_2 + F_2 \xrightarrow{\Delta} BeF_2$

B. $Be + F_2 \xrightarrow{\Delta} BeF_2$

C. $(NH_4)_2BeF_4 \xrightarrow{\Delta} BeF_2$

D. $BeO + C + F_2 \xrightarrow{\Delta} BeF_2$

Answer: C

Solution:

Solution:
As per NCERT (s block), the better method of preparation of BeF_2 is heating $(NH_4)_2BeF_4$

$(NH_4)_2BeF_4 \xrightarrow{\Delta} BeF_2 + NH_4F$

Question28

If the formula of Borax is $Na_2B_4O_x(OH)_y . zH_2O$, then x + y + z = _____.
[13-Apr-2023 shift 2]

Answer: 17

Solution:

Solution:
Formula of borax is $Na_2B_4O_5(OH)_4 \cdot 8H_2O$

Question29

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

Question30

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

Options:

A. NF_3

B. NCl_3

C. NBr_3

D. NI_3

Answer: A

Solution:

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, l) around it.

Question31

Number of electron deficient molecules among the following PH_3, B_2H_6, CCl_4, NH_3, LiH and 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).
B_2H_6, BCl_3 have incomplete octet.

Question32

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

$$Pb(NO_3)_2 \xrightarrow{673K} A + PbO + O_2$$

$$A \xrightarrow{\text{Dimerise}} B$$

[25-Jun-2022-Shift-2]

Options:

A. 0

B. 1

C. 2

D. 3

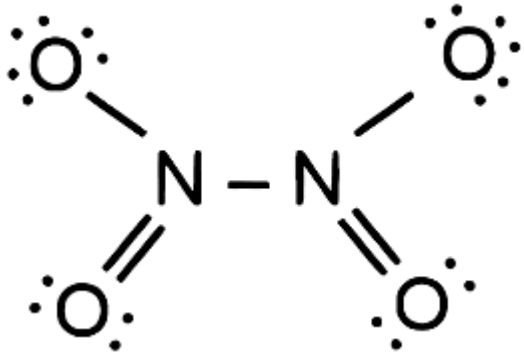
Answer: A

Solution:

Solution:

$2\,Pb(NO_3)_2 \xrightarrow{673K} 4\,AO_2 + 2\,PbO + O_2$

Hence no bridged oxygen atom is present in N_2O_4



Hence no bridged oxygen atom is present in N_2O_4

Question33

Choose the correct stability order of group 13 elements in their +1 oxidation state.
[26-Jun-2022-Shift-1]

Options:

A. Al < Ga < ln < Tl

B. TI < In < Ga < Al

C. Al < Ga < Tl < ln

D. Al < Tl < Ga < 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 Al < Ga < In < TI.

Question34

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:

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.

Question35

Aqueous solution of which of the following boron compounds will be strongly basic in nature?
[29-Jun-2022-Shift-2]

Options:

A. $NaBH_4$

B. $LiBH_4$

C. B_2H_6

D. $Na_2B_4O_7$

Answer: D

Solution:

Solution:
$Na_2B_4O_7 + 7H_2O \longrightarrow 2H_3BO_3 + 2\,Na[B(OH)_4]$
Aqueous solution of borax is buffer whose $pH \simeq 9$
Other compounds are less basic than this.

Question36

	List I		List II
(A)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(I)	Cu
(B)	$CO(g) + 3H_3(g) \rightarrow CH_4(g) + H_2O(g)$	(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:

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

(A) $N_2(g) + 3H_2(g) \xrightarrow{Fe_xO_y + K_2O + Al_2O_3} 2NH_3(g)$

(B) $CO(g) + 3H_2(g) \xrightarrow{Ni} CH_4(g) + H_2O(g)$

(C) $CO(g) + H_2(g) \xrightarrow{Cu} HCHO(g)$

(D) $CO(g) + 2H_2\$(g) \xrightarrow{Cu/ZnO^{-Zr_2O_3}} CH_3 - OH(g)$

Question37

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

$$BF_3 + NaH \xrightarrow{450K} A + NaF$$

$$A + NMe_3 \rightarrow B$$

[25-Jul-2022-Shift-1]

Options:

A. trigonal planar

B. tetrahedral

C. pyramidal

D. square planar

Answer: B

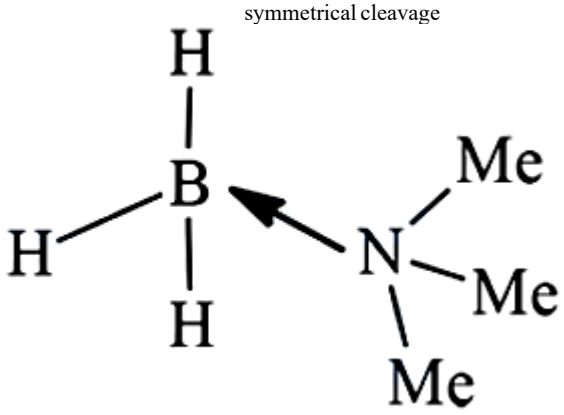
Solution:

Solution:

$$BF_3 + NaH \xrightarrow{450K} \underset{\text{(diborane)}}{B_2H_6} + NaF$$

$$B_2H_6 + NMe_3 \longrightarrow 2[BH_3 \leftarrow NMe_3]$$

symmetrical cleavage



Question38

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. $B(OH)_3$ and 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:

Solution:
$3B_2H_6 + 6NH_3 \rightarrow \underset{\text{(Borazine)}}{2B_3N_3H_6}$

Question39

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:

Solution:
Al → 933K
Ga → 303K
In → 430K
Se → 490K
Among the given elements, Gallium has the lowest melting point, Gallium is also close to a metalloid

---

Question40

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
$H_3BO_3 + H_2O \rightleftharpoons [B(OH)_4]^{\ominus} + H^{\oplus}$
Boric acid is not able to release H^+ion on its own. It receives OH^-ion from water and releases H^+ion as shown in the above reaction.
Hence, Both A and R are correct and R is the correct explanation of A.

Question41

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:
Be_2Cl_4 is lewis acid and Al_2Cl_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.

Question42

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 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 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

Question43

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. B_2O_3

B. $CO(BO_2)_2$

C. CoB_4O_7

D. $Co[B_4O_5(OH)_4]$

Answer: B

Solution:

Solution:
$Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$
$B_2O_3 + CoO \rightarrow Co(BO_2)_2$

Question44

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

Options:

A. all B-H-B angles are of 120°

B. the two $B-H-B$ bonds are not of same length

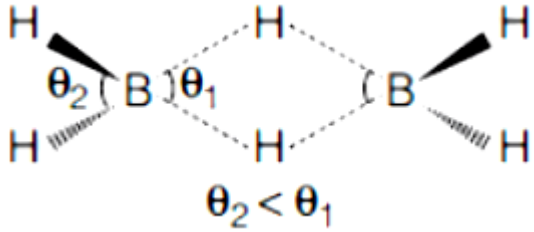
C. terminal B-H bonds have less p-character when compared to bridging bonds

D. Its fragment, BH_3, behaves as a Lewis base

Answer: C

Solution:

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°.
- BH_3 is electron deficient species and therefore act as Lewis acid.

Question45

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,

$$CH_4 + H_2O \xrightarrow[Ni]{1270K} CO + 3H_2$$

$$C + H_2O \xrightarrow{1270K} CO + H_2$$

$$C_3H_8 + 3H_2O \xrightarrow[Ni]{1270K} 3CO + 7H_2$$

But, water on reaction with CO_2 produces carbonic acid (H_2CO_3), not CO.

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

Question46

Al_2O_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:

A. $X = Na[Al(OH)_4]$, $Y = SO_2$, $Z = Al_2O_3$

B. $X = Na[Al(OH)_4]$, $Y = CO_2$, $Z = Al_2O_3$.

C. $X = Al(OH)_3$, $Y = CO_2$, $Z = Al_2O_3$

D. $X = Al(OH)_3$, $Y = SO_2$, $Z = Al_2O_3 \cdot H_2O$

Answer: B

Solution:

Solution:

$$Al_2O_3(s) + 2NaOH\ (aq.) + 3H_2O(l) \longrightarrow 2Na[Al(OH)_4](aq) \xrightarrow[(Y)]{CO_2} Al_2O_3 \cdot xH_2O(s) + 2NaHCO_3\ (aq.)$$

Question47

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:

Solution:
(I) Blue cupric metaborate $[Cu(BO_2)_2]$ is reduced to colourless cuprous metaborate $[Cu(BO_2)_2]$ in a luminous flame.

$$2Cu(BO_2)_2 + 2NaBO_2 + C \xrightarrow{\text{Luminous flame}} 2CuBO_2 + Na_2B_4O_7 + CO$$

(II) Cupric metaborate is obatined heating boric anhydride (B_2O_3) and copper sulphate in a non luminous flame.

$$B_2O_3 + CuSO_4 \xrightarrow{\text{non-luminous flame}} \underset{\text{Cupric metaborate (Blue-green)}}{Cu(BO_2)_2} + SO_3$$

Question48

The incorrect statement regarding the structure of 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

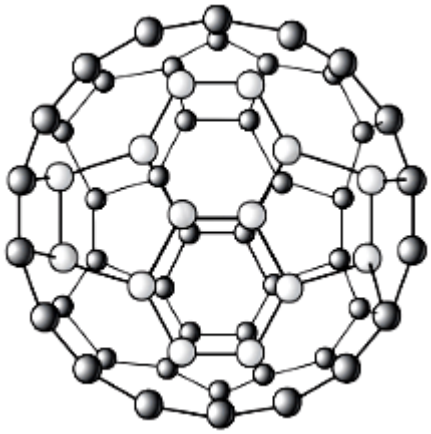
C. the five-membered rings are fused only to six-membered rings

D. it contains 12 six-membered rings and 24 five-membered rings

Answer: D

Solution:

Solution:



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 sp^2-hybridisation.
Each carbon atom forms three sigma bonds with other three carbon atoms.
So, statement (d) is wrong.

Question49

Given below are the statements about diborane
(a) Diborane is prepared by the oxidation of $NaBH_4$ with 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:

Solution:
Diborane is prepared by the reaction of $NaBH_4$ with I_2.
$2NaBH_4 + I_2 \rightarrow B_2H_6 + 2NaI + H_2$
In diborane, 'B' is sp^3 hybrid, it is Non-planar and two $3c-2e^-$ bonds are present.

Question50

Which one of the following compounds of Group-14 elements is not known?
[25 Jul 2021 Shift 1]

Options:

A. $[GeCl_6]^{2-}$

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

C. $[SiCl_6]^{2-}$

D. $[SiF_6]^{2-}$

Answer: C

Solution:

Solution:
$[SiCl_6]^{2-}$ does not exist due to steric crowding of surrounding atoms.

Question51

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:

A. BCl_3

B. BF_3

C. BBr_3

D. BI_3

Answer: B

Solution:

Solution:
Smaller the halide atom, more effective is back donation of an electron pair from halide atom.
So, correct answer is BF_3.

Question52

The reaction of $H_3N_3B_3Cl_3$(A) with $LiBH_4$ in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $H_3N_3B_3(Me)_3$. Compounds (B) and (C) respectively, are: [Jan. 09, 2020 (II)]

Options:

A. Borazine and MeBr

B. Diborane and MeMgBr

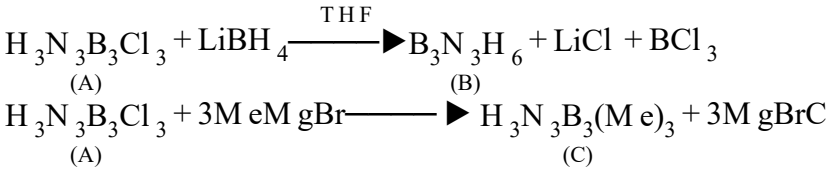
C. Boron nitride and MeBr

D. Borazine and MeMgBr

Answer: D

Solution:

Solution:



Question53

The hydride that is NOT electron deficient is:
[Jan. 11, 2019 (II)]

Options:

A. SiH_4

B. B_2H_6

C. GaH_3

D. AlH_3

Answer: A

Solution:

Solution:
SiH_4: Electron precise hydride
B_2H_6, GaH_3 and AlH_3 are electron deficient

Question54

The relative stability of +1 oxidation state of group 13 elements follows the order:
[Jan. 11, 2019 (II)]

Options:

A. Al < Ga < Tl < In

B. Tl < In < Ga < Al

C. Ga < Al < In < Tl

D. Al < Ga < I n < T l

Answer: D

Solution:

Solution:
Due to inert pair effect, the stability of +1 oxidation state increases down the group.
Thus, correct order of stability is Al < Ga < I n < T l

Question55

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.

Question56

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

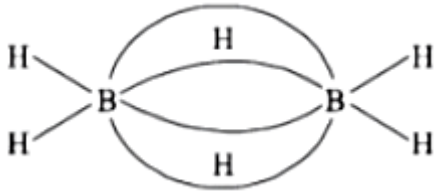
C. 2 and 2

D. 2 and 4

Answer: B

Solution:

Solution:
Structure of B_2H_6 :



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

Question57

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.

Question58

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.

Question59

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.

Question60

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

Options:

A. $PbCl_4$

B. CCl_4

C. $SnCl_4$

D. $SiCl_4$

Answer: B

Solution:

Solution:
CCl_4 cannot be hydrolysed due to absence of d orbitals at carbon atom.

Question61

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.

Question62

C_{60}, 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_{60}) contains 20 hexagons (six membered) rings and 12 pentagons (five membered rings):

Question63

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:

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

Question64

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:

Solution:
$B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$
$B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 6H_2$

Question65

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

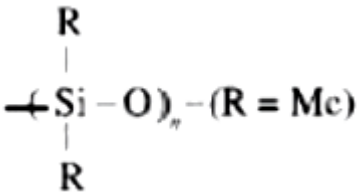
Options:

A. $(SiO_3)^2$

B. SiO_2

C. $(SiO_4)^4$

D.



Answer: C

Solution:

Solution:
These are examples of silicates, the basic unit of each of them is SiO_4^{4-} ion.

Question66

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

Options:

A. $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$.

B. $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$.

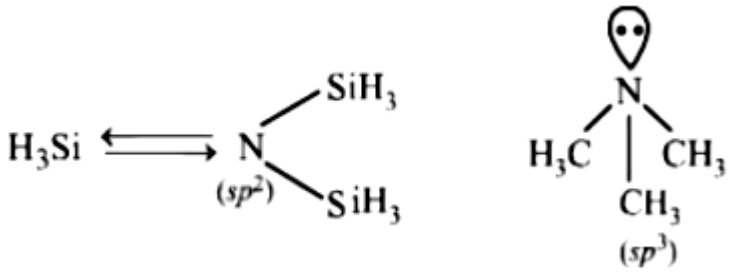
C. $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$.

D. $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$.

Answer: A

Solution:

Solution:



Due to back bonding of lone pair electrons of nitrogen into vacant d -orbitals of Si, trisilylamine $(SiH_3)_3N$ is planar. In trimethylamine $(CH_3)_3N$, there is no back bonding and hence it is more basic.

Question67

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

Options:

A. graphite

B. C_{70}

C. C_{60}

D. diamond

Answer: D

Solution:

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 $0.146pm$.

Question68

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

Options:

A. C > Sn > Si ≈ Ge

B. C > Si > Ge ≈ Sn

C. Si > Sn > C > Ge

D. Ge > Sn > Si > C

Answer: B

Solution:

Solution:
The catenation property among 14^{th} group elements is based on bond enthalpy value of bond between the same element. The decreasing order of bond enthalpy values is $\text{in}(\text{kJ}/\text{mol})$
∴ Decreasing order of catenation is
C > Si > Ge ≈ Sn

Question69

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

Options:

A. Tridymite

B. Kieselguhr

C. Cristobalite

D. Quartz

Answer: B

Solution:

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

Question70

When metal ' M ' is treated with N aOH , 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. Z n

B. Ca

C. Al

D. Fe

Answer: C

Solution:

Solution:

$$Al + 3H_2O \xrightarrow{NaOH} Al(OH)_3 \downarrow + 3/2 H_2(g)$$

White gelatinous ppt.

$$Al(OH)_3 \xrightarrow{\text{excess of } NaOH} \underset{\text{Soluble}}{Na[Al(OH)_4]}$$

$$\underset{(X)}{2Al(OH)_3} \xrightarrow{\Delta} Al_2O_3 + 3H_2O$$

Al_2O_3 is used as adsorbent in chromatography. Thus, metal 'M' is Al.

Question71

A group 13 element 'X'reacts with chlorine gas to produce a compound XCl_3. XCl_3 is electron deficient and easily reacts with NH_3 to form $Cl_3X \leftarrow NH_3$ adduct, however, XCl_3 does not dimerize.X is:
[Online April 16,2018]

Options:

A. B

B. Al

C. In

D. Ga

Answer: A

Solution:

Solution:

$$\underset{\text{[does not dimerise due to}(p\pi - p\pi)\text{ back bonding]}}{B + Cl_2 \longrightarrow BCl_3} \xrightarrow{NH_3} \underset{\text{adduct}}{Cl_3 \leftarrow NH_3}$$

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

Question72

Which of the following are Lewis acids?
[2018]

Options:

A. PH_3 and BCl_3

B. $AlCl_3$ and $SiCl_4$

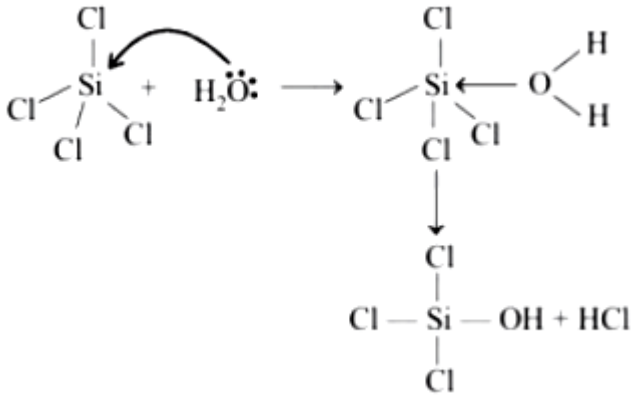
C. PH_3 and $SiCl_4$

D. BCl_3 and $AlCl_3$

Answer: 0

Solution:

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.

Question73

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:

Solution:
% of p - in graphite $(sp^2) = \frac{2}{3} \times 100 = 67\%$
% of p - in diamond $(sp^3) = \frac{3}{4} \times 100 = 75\%$

Question74

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.
$2LiH + B_2H_6 \longrightarrow 2LiBH_4$

Question75

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 domesticand commercial water purification, softening, and other applications.

Question76

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.

Question77

In the following sets of reactants which two sets best exhibit the amphoteric characters of Al_2O_3, 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.

$$Al_2O_3 \cdot xH_2O + 2NaOH \longrightarrow NaAlO_2 + H_2O$$

$$Al_2O_3 \cdot xH_2O + HCl \longrightarrow AlCl_3 + H_2O$$

Question78

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:

Solution:

$$2CaF_2 + SiO_2 + H_2SO_4 \longrightarrow$$

$$SiF_4 + H_2O + CaSO_4 \xrightarrow{\text{hydrolysis}} CaSiF$$

Question79

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 SiO_4^{4-} and AlO_4^{5-}. These tetrahedra connect at each corner to other tetrahedra forming an intricate, three dimesional, negatively charged framework. The sodium cations sit within the voids in this structure.

Question80

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

Options:

A. In $(Si_3O_9)^{6-}$, tetrahedral SiO_4 units share two oxygen atoms.

B. Trialkylehlorosilane on hydrolysis gives R_3SiOH .

C. $SiCl_4$ undergoes hydrolysis to give H_4SiO_4.

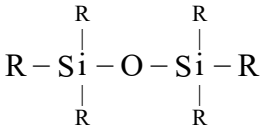
D. $(Si_3O_9)^{6-}$ has cyclic structure.

Answer: B

Solution:

Solution:

The hydrolysis of trialkylchlorosilane, R_3 SiCl yields dimer:



Question81

The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in 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.

Question82

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

$PbO_2 + Pb \rightarrow 2PbO, \quad \Delta_r G^o < 0$

$SnO_2 + Sn \rightarrow 2SnO, \quad \Delta_r G^0 > 0$

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:

Solution:
Negative $\Delta_r G^\circ$ value indicates that $+2$ oxidation state is more stable for 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.$Sn^{2+} < Pb^{2+}$, $Sn^{4+} > Pb^{4+}$

Question83

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. $B_2H_6 \cdot 2NH_3$ is known as 'inorganic benzene'

Answer: C

Solution:

Solution:
The correct formula of inorganic benzene is $B_3N_3H_6$ so (d) is incorrect statement

Boric acid (H_3BO_3 or $\begin{matrix} & OH & \\ & | & \\ B & - & OH \\ & | & \\ & OH & \end{matrix}$) 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 $BeCl_2$ and $Al Cl_3$ exhibit bridged structures in solid state, so (c) is correct statement.

Question84

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

Options:

A. R_4Si

B. R_2SiCl_2

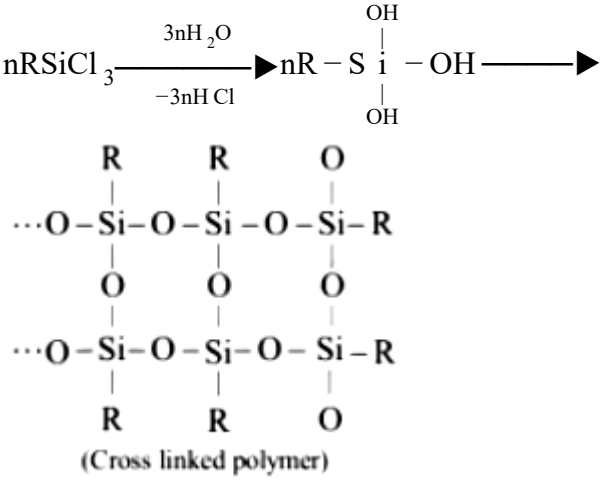
C. $RSiCl_3$

D. R_3SiCl

Answer: C

Solution:

Solution:
The cross linked polymers will be formed by $RSiCl$,



Question85

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

[2007]

Options:

A. $PbX_2 << SnX_2 << GeX_2 << SiX_2$

B. $GeX_2 << SiX_2 << SnX_2 < PbX_2$

C. $SiX_2 << GeX_2 << PbX_2 << SnX_2$

D. $SiX_2 < GeX_2 << SnX_2 << PbX_2$

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
$SiX_2 < GeX_2 < SnX_2 < PbX_2$

Question86

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.

Question87

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:

Solution:
The solution of aluminium chloride in water is acidic due to hydrolysis.
$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl$
On heating till dryness, $Al(OH)_3$ is converted into Al_2O_3.
$Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$

Question88

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

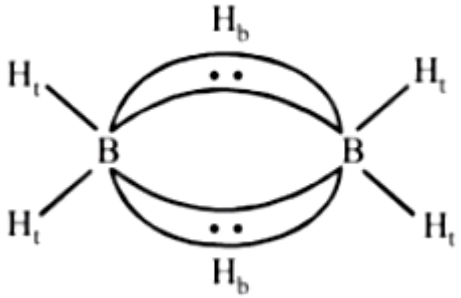
C. two $2c-2c$ bonds and four $3c-2c$ bonds

D. four $2c-2e$ bonds and two $3c-2e$ bonds

Answer: D

Solution:

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

Question89

In silicon dioxide
[2005]

Options:

A. there are double bonds between silicon and oxygen atoms

B. silicon atom is bonded to two oxygen atoms

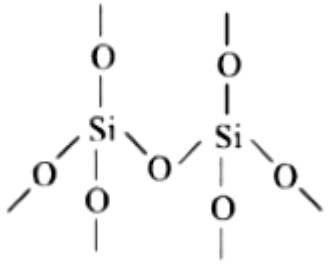
C. each silicon atom is surrounded bytwo oxygen atoms and each oxygen atom is bonded to two silicon atoms

D. each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms.

Answer: D

Solution:

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



Question90

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 $+3$.

Question91

Aluminium chloride exists as dimer, Al_2Cl_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. $[Al(OH)_6]^{3-} + 3HCl$

B. $[Al(H_2O)_6]^{3+} + 3Cl^-$

C. $Al^{3+} + 3Cl^-$

D. $Al_2O_3 + 6HCl$

Answer: B

Solution:

Solution:
$Al_2Cl_6 + 12H_2O \rightleftharpoons 2[Al(H_2O)_6]^{3+} + 6Cl^-$

Question92

The soldiers of Napolean 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 acompained by increase in volume., This is knwon as tin plaque or tin disease.

Question93

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.

Question94

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 . M O.6SiO_2. where R = N a or K and M = Ca, Ba, Z nor Pb.

Question95

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.

Question96

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:

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