CHEMISTRY

BOOKS - DISHA PUBLICATION CHEMISTRY (HINGLISH)

The p-Block Elements (Group 13 and Group 14)

Jee Main 5 Years At A Glance

1. 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 firm $Cl_3X \leftarrow NH_3$ adduct, however, XCl_3 does not dimerize. X is :

A. B

B. Al

C. In

D. Ga

Answer: A

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

A. 33 and 25

B. 67 and 75

C. 50 and 75

D. 33 and 75

Answer: B

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3. 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

A. Zn

B. Ca

C. Al

D. Fe

Answer: C

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4. Which of the following are Lewis acids?

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: B::D

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5. 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

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

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6. Identify the reaction which does not liberatre hydrogen :

A. Reaction of lithium hydride with B_2H_6

B. Electrolysis of acidified water using Pt electrodes.

C. Reaction of zinc with aqueous alkali.

D. Allowing a solution of sodium in liquid ammonia to stand.

Answer: A

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7. In the following sets of reactants which two sets best exhibit the amphoteric characters of $Al_2O_3.xH_2O$?

Set 1: $Al_2O_3.xH_2O(s)$ and $OH^-(aq)$

Set 2: $Al_2O_3.xH_2O(s)$ and $H_2O(I)$

Set 3: $Al_2O_3.xH_2O(s)$ and $H^+(aq)$

Set 4: $Al_2O_3.xH_2O(s)$ and $NH_3(aq)$

A. 1 and 2

B. 1 and 3

C. 2 and 4

D. 3 and 4

Answer: B

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8. 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 :

A. Hydrofluorosilicic acid

B. Silica gel

C. Silicic acid

D. Calciumfluorosilicate

Answer: D

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9. Example of a three-dimensional silicate is:

A. Zeolites

B. Ultramarines

C. Feldspars

D. Beryls

Answer: C

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Exercise 1 Concept Builder Topicwise

1. In borax bead test which compound is formed ?

A. Ortho-borate

B. Meta-borate

C. Double oxide

D. Tetra-borate

Answer: B

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2. The liquefied metal expanding on soildification is

A. Ga

B. Al

C. Zn

D. In

Answer: A

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3. Amphoteric oxide among the following is

A. B_2O_3

B. Ga_2O_3

C. In_2O_3

D. TI_2O_3

Answer: B

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4. Which statement is not true about potas alum?

A. Its empirical formula is

$$Kal(SO_4)_2.12H_2O$$

B. Its aqueous solution is basic.

C. It is used in dycing industries.

D. All are correct.

Answer: A

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5. Select the incorrect statement for diborane

A. Boron is approximately sp^3 hybridized.

B. $B - H - B$ angle is 180°

C. There are two terminal B - H bonds for each boron atom.

D. There are only 12 bonding electrons.

Answer: B

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6. H_3BO_3 on heating up to 373 K yields

A. boric anhydride

B. orthoboric acid

C. metaboric acid

D. tetraboric acid

Answer: C

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7. Beryllium and aluminimum exhibit many properties which are similar . But, the two elements differ in

A. exhibiting maximum covalency in compounds.

B. exhibiting amphoteric nature in their oxides.

C. forming covalent halides.

D. forming polymeric hydrides.

Answer: A

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8. The hardest substance amongst the following is

A. Be_2C

B. titanium

C. SiC

D. B_4C

Answer: D

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9. Which of the following does not exist in free form?

A. BF_3

B. BCl_3

C. BBr_3

D. BH_3

Answer: D

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10. Aluminium vessels should not be washed with materials containing washing soda since

A. washing soda is expensive.

B. washing soda is easily decomposed.

C. washing soda reacts with auminium to form soluble aluminate.

D. washing soda reacts with aluminium to form insoluble aluminium oxide.

Answer: C

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11. Boric acid is polymeric due to :

A. its acidic nature.

B. the presence of hydrogen bonds.

C. its monobasic nature.

D. its geometry.

Answer: B

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12. In diborane

A. 4-bridged hydrogens and two terminal hydrogens are present.

B. 2- bridged hydrogens and four terminal hydrogens are present.

C. 3-bridged and three terminal hydrogens are present.

D. none of these.

Answer: B

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13. Diborane upon hydrolysis gives

A. boric anhydride

B. metaboric acid

C. orthoboric acid

D. boron oxide

Answer: C

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14. In aluminates, the coordination number of Al is

A. 4

B. 6

C. 3

D. 1

Answer: B

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15. The $I.E_1$ among the group 13 member follows as

A. $B > Al < Ga < Tl$

B. $B > Al < Ga > Tl$

C. $B > Ga > Al > Tl$

D. $B > Ga < Al < Tl$

Answer: C

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16. The melting pt. of Group 13 follows the order

A. $B > Al > Ga > \text{In} > Tl$

B. $B > Al < Ga > \text{In} > Tl$

C. $B > Al > Tl > \text{In} > Ga$

D. $B > Al < Ga < \text{In} < Tl$

Answer: C

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17. In Gold Schmidt reaction, certain metallic oxides are reduced to the metallic state by heating with

A. metallic magnesium

B. metallic aluminium

C. metallic iron

D. sodium metal

Answer: B

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18. Anodised aluminium is:

A. Al obtained at anode.

B. Al prepared electrolytically

C. Alloy of Al containing 95% of Al

D. Al electrolytially coated with aluminium oxide.

Answer: B

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19. Thalium shows different oxidation states because

A. it is transition element.

B. of inert pair effect.

C. of its amphoteric character

D. of its higher reactivity.

Answer: B

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20. Reaction of diborane with ammonia gives initially

A. $B_2H_6.NH_3$

B. Borazole

C. $B_2H_6.3NH_3$

D. $\left[BH_2(NH_3)_2\right]^+[BH_4]^-$

Answer: D

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21. Maximum $p\pi - p\pi$ back bonding exists in

A. BCl_3

B. BF_3

C. BBr_3

D. BI_3

Answer: B

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22. H_3BO_3 is.

A. monobasic and weak Lewis acid.

B. monobasic and weak Bronsted acid.

C. monobasic and strong Lewis acid.

D. tribasic and weak Bronsted acid.

Answer: A

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23. $BX_3 + NH_3 \xrightarrow{B.T.} BX_3 \cdot NH_3$+Heat of adduct formation (ΔH)

The numberical value of ΔH is found to be maximum for:

A. BF_3

B. BCl_3

C. BBr_3

D. BI_3

Answer: D

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24. The form of BN which is hard as diamond is

A. hexagonal form

B. cubic form with ZnS structure

C. Both of these

D. none of these

Answer: B

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25. Which metal is protected by layer of its own oxide ?

A. Al

B. Ag

C. In

D. Fe

Answer: A

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26. What is not true about borax ?

A. Molecular formula is $Na_2B_4O_710H_2O$

B. Crystallic borax contains tetranuclear unit of $\left[B_4O_5(OH)_4\right]^{2-}$.

C. It hydrolyses to give an acidic solution.

D. White crystalline solid.

Answer: C

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27. The chief impurity present in bauxite is

A. SiO_2

B. Fe_2O_3

C. K_2SO_4

D. NaF

Answer: B

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28. In which of the following molecules is hydrogen bridge bond present ?

A. Water

B. Inorganic benzene

C. Diborane

D. Methanol

Answer: C

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29. Boron nitride is isoelectronic with

A. C_2

B. B_2

C. N_2

D. O_2

Answer: A

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30. The stability of monohalides of group 13 elements

A. increases down the group.

B. decreases down the group.

C. first increases and then decreases.

D. first decreases and then increases.

Answer: A

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31. Aluminium becomes passive in

A. Cr_2O_3

B. conc. HNO_3

C. $HClO_4$

D. all of the above

Answer: B

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32. Aluminium carbide on hydrolysis produces

A. acetylene gas

B. methane gas

C. carbon dioxide gas

D. all of the above

Answer: B

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1. In graphite, electrons are

A. localised on every third C-atom.

B. present in anti-bonding orbital.

C. localised on cach C-atom.

D. spread out between the structure

Answer: D

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2. Glass reacts with HF to produces

A. SiF_4

B. H_2SiF_6

C. H_2SiO_3

D. Na_3AIF_6

Answer: B

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3. The elements commonly used for making transistors are :

A. C and Si

B. Ga and In

C. P and As

D. Si and Ge

Answer: D

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4. Be_2C and Al_4C_3 are called

A. ethanides

B. methanides

C. carbonides

D. acetylides

Answer: B

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5. Silicon dioxide is formed by the reaction of

A. $SiCl_4 + H_2O$

B. $SiO_2 + HF$

C. $SiO_2 + NaOH$

D. $SiCl_4 + NaOH$

Answer: A

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6. In silica (SiO_2), each silicon atom is bonded to

A. two oxygen atoms

B. four oxygen atoms.

C. one silicon and two oxygen atoms.

D. one silicon and three oxygen atoms

Answer: B

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7. The inert pair effect is most prominent in

A. C

B. Pb

C. Ge

D. Si

Answer: B

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8. Unlike the other elements of its group carbon and silicon does not form MX_2 type molecules because

A. energetically this is not possible.

B. carbon undergoes catenation.

C. it is non-metallie.

D. carbon does not contain d-orbital.

Answer: A

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9. Which of the following statements about the zeolites is false?

A. They are used as cation exehangers.

B. They have open structure which enables them to take up small molecules.

C. Zeolites are aluminosilicates having three dimensional network.

D. None of the above.

Answer: D

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10. Lead pipes are not suitable for drinking water because

A. a layer of lead dioxide is deposited over pipes.

B. lead reacts with air to form litharge.

C. lead reacts with water containing air to form $Pb(OH)_2$.

D. lead forms basic lead carbonate.

Answer: C

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11. Catenation i.e., linking of similar atoms depends on size and electronic configuration of atoms. The tendency of catenation in group 14 elements follows the order.

A. $C > Si > Ge > Sn$

B. $C > \ > Si > Ge \approx Sn$

C. $Si > C > Sn > Ge$

D. $Ge > Sn > Si > C$

Answer: B

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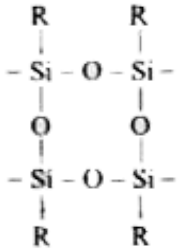
12. On controlled hydrolysis and condensation, R_3SiCl yields

A. $R_3Si - O - SiR_3$

B. $(R_3Si - O - SiR_3)_n$

C. R_3SiOH

D. 

Answer: A

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13. The most stable +2 oxidation state is exhibited by

A. Ge

B. Sn

C. Pb

D. Si

Answer: C

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14. The catenation tendency of C, Si, and Ge is in the order $Ge < Si < C$. The bond energies (in $kJmol^{-1}$) of $C - C -$, $Si - Si$, and $Ge - Ge$ bonds, respectively, are

A. 167, 180, 348

B. 180, 167, 348

C. 348, 167, 180

D. 348, 180, 167

Answer: D

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15. Ge (II) compounds are powerful reducing agents whereas Pb(IV) compound are strong oxidants. It can be due to

A. Pb is more electropositive than Ge.

B. ionization potential of lcad is less than that of Ge.

C. ionic radii of Pb^{2+} and Pb^{4+} are larger than those of Ge^{2+} and Ge^{4+}.

D. of more pronounced inert pair efect in lead than in Ge.

Answer: D

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16. Which of the following halides is the most stable ?

A. CF_4

B. CI_4

C. CBr_4

D. CCl_4

Answer: A

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17. $PbF_4, PbCl_4$ exist but $PbBr_4$ do not exist because of

A. large size of Br^- and I^-

B. strong oxidising character of Pb^{4+}

C. strong reducing character of Pb^{4+}

D. low electronegativity of Br^- and I^-

Answer: B

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18. The element that does not form a monoxide is

A. lead

B. tin

C. germanium

D. silicon

Answer: D

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19. Pyrosilicate ion is

A. SiO_2^{2-}

B. SiO_4^{2-}

C. $Si_2O_6^{7-}$

D. $Si_2O_7^{6-}$

Answer: D

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20. Lead pipes are readily corroded by

A. H_2SO_4

B. HCl

C. CH_3COOH

D. pure water

Answer: C

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21. Which halide is least stable and has doubtful existence

A. Cl_4

B. Gel_4

C. Snl_4

D. Pbl_4

Answer: D

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22. Which does not exist

A. $[SnCl_6]^{2-}$

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

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

D. $[CCl_6]^{2-}$

Answer: D

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23. The reducing power of divalent species decreases in the order:

A. $Ge > Sn > Pb$

B. $Sn > Ge > Pb$

C. $Pb > Sn > Ge$

D. None of these

Answer: A

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24. Mg_2C_3 possess which of the following characteristics?

A. Is called magnesium allylide.

B. It contain Mg^{2+} and C_3^{4-} ions.

C. It on hydrolysis gives propyne.

D. All of these

Answer: D

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25. Carbon suboxide (C_3O_2)

A. is a foul smelling gas.

B. is obtained by dehydrating malonic acid with P_2O_5

C. is a linear molecule.

D. all the above are correct.

Answer: D

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26. The basic structural unit of silicates is

A. SiO_4^{4-}

B. SiO_3^{2-}

C. SiO_4^{2-}

D. SiO

Answer: A

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27. When Sn is treated with conc. HNO_3

A. it is converted into stannous nitrate.

B. it is converted into stannic nitrate.

C. it is converted into metastannic acid.

D. it becomes passive.

Answer: C

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28. The anion, $(Si_6O_{18})^{12-}$ is present in

A. pyroxene

B. beryl

C. mica

D. albite

Answer: B

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Exercise 2 Concept Applicator

1. Aqueous solution of orthoboric acid can be titrated against sodium hydroxide using phenolphthalein indicator only in presence of

A. trans-glycerol

B. catechol

C. cis-glycerol

D. both (b) and (c)

Answer: D

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2. Which of the following statements about anhydrous aluminium chloride is correct?

A. It fumes in moist air.

B. It exists as dimer both in the vapour state below $350^{\circ}C$ and in non-polar solvents.

C. It is prepared by heating Al_2O_3 in a stream of sulphur chloride (S_2Cl_2) vapours and chlorine.

D. All of these

Answer: D

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3. Which of the following statements about H_3BO_3 is not correct ?

A. It is a strong tribasic acid.

B. It is prepared by acidifying an aqueous solution of borax.

C. It has a layer structure in which planar BO_3, units are joined by hydrogen bonds.

D. It does not act as proton donor but acts as a Lewis acid by accepting a lone pair of electrons.

Answer: A

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4. Which one of the following is correct statement ?

A. The hydroxide of aluminium is more acidic than that of boron.

B. The hydroxide of boron is basic, while that of aluminium is amphoteric.

C. The hydroxide of boron is acidic, while that of aluminium is amphoteric.

D. The hydroxide of boron and aluminium are amphoteric.

Answer: C

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5. The main factor responsible for waek acidic nature of $B-F$ bonds in BF_3 is

A. large electronegativity of fluorine.

B. three centred two electron bonds in BF_3

C. $p\pi-d\pi$ back bonding

D. $p\pi-p\pi$ back bonding

Answer: D

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6. An aqueous solution of $FeSO_4$, $Al_2(SO_4)_3$ and chrome alum is heated with excess of Na_2O_3 and filtered. The material obtained are :

A. a colourless filtrate and a green residue.

B. a yellow filtrate and a green residue.

C. a yellow filtrate and a brown residue

D. a green filtrate and a brown residue.

Answer: C

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7. Which reaction cannot give anhydrous $AlCl_3$:

A. Passing dry Cl_2 over heated aluminium powder

B. Heating a mixture of alumina and coke in a current of dry Cl_2.

C. Passing dry HCl over heated aluminium powder.

D. Heating of $AlCl_3.6H_2O$

Answer: D

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8. Which of the following is true ?

A. Minute quantities of boron are used in hardening of steel.

B. Boron is also a trace clement in plants and serves as significant nutrient factor.

C. Boron occupies the top rank of all elements as absorber.

D. All of the above are true.

Answer: D

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9. The stability of $+1$ oxidation state increases in the sequence :

A. $Tl < \text{In} < Ga < Al$

B. $\text{In} < Tl < Ga < Al$

C. $Ga < \text{In} < Al < Tl$

D. $Al < Ga < \text{In} < Tl$

Answer: D

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10. Boron does not form B^{3+} ions because

A. Energy required to form B^{3+} ion is very high which will not be compensated by lattice enthalpies of hydration enthalpies of such ion.

B. Boron is a non-metal.

C. Boron is a metalloid.

D. None of the above.

Answer: A

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11. The number of isomers possible for disubstituted borazine, $B_3N_3H_4X_2$ is

A. 3

B. 4

C. 6

D. 5

Answer: B

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12. How can the following reaction be made to proceed in forward direction ?

$B(OH)_3 + NaOH \Leftrightarrow Na\left[B(OH)_4\right].$

A. By addition of cis-1, 2-diol

B. Addition of borax

C. Addition of trans-1, 2-diol

D. Addition of Na_2HPO_4

Answer: A

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13. When excess of $NaOH$ solution is added in potash alum the product is.

A. a bluish precipitate

B. clear solution

C. white precipitate

D. greenish precipitate

Answer: B

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14. The structure of boron nitride resembles that of

A. boric acid

B. graphite

C. borazine

D. borazole

Answer: B

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15. To a piece of charcoal, sulphuric acid is added. Then:

A. There is no reaction.

B. Water gas is formed.

C. SO_2 and CO_2 are evolved

D. CO and SO_2 are evolved

Answer: C

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16. Carbon and silicon belong to group IV. The maximum coordination number of carbon in commonly occuring compounds is four whereas that of silicon is six. This is due to

A. large size of silicon.

B. more electropositive nature of silicon.

C. ailability of d-orbitals in silicon.

D. both (a) and (b).

Answer: C

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17. 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

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 temperatures.

D. an interaction with water vapours contained in the humid air

Answer: B

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18. Which one of the following allotropic forms of carbon is isomorphous with crystalline silicon?

A. Graphite

B. Coal

C. Coke

D. Diamond

Answer: D

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19. The structure and hybridization of $Si(CH_3)_4$ is

A. Bent, sp

B. Trigonal, sp^2

C. Octahedral, d^2sp^3

D. Tetrahedral, sp^3

Answer: D

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20. A solid element (symbol Y) conducts electricity and forms two chlorides YCln (a colourless volatile liquid) and $YC\ln-2$ (a colourless solid). To which one of the following groups of the periodic table does Y belong ?

A. 13

B. 14

C. 15

D. 16

Answer: B

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21. On addition of excess of sodium hydroxide solution to stannous chloride solution, we obtain

A. $Sn(OH)_2$

B. $SnO_2 . H_2O$

C. Na_2SnO_2

D. None of these

Answer: C

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22. Name the gas that can readily decolourise acidified $KMnO_4$ solution:

A. bicarbonate

B. carbonate

C. Oxalate

D. acetate

Answer: C

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23. Identify the incorrect statement

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

B. Trialkylchlorosilane 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

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24. 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 :

A. hydrofluorosilicic acid

B. silica gel

C. silicic acid

D. calciumfuorosilicate

Answer: D

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25. In silicon dioxide :

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

B. Each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms.

C. Silicon atom is bounded to two oxygen atoms.

D. There are double bonds between silicon and oxygen atoms.

Answer: A

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26. Of the following types of glass, the one with the smallest coefficient of thermal expansion is :

A. safety glass

B. pyrex glass

C. soft glass

D. soda lime glass

Answer: B

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27. Number and type of bonds between two carbon atoms in CaC_2 are :

A. One sigma and one pi bond.

B. One sigma and two pi bonds.

C. One sigma and one half pi bond.

D. One sigma bond.

Answer: B

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28. The gas A is bubbled through lime water , a while precipitate is formed . This precipitate dissolved on prolonged bubbling the same gas. On heating this solution, the white precipitate reappears with the evolution of gas B . The gases A and B respectively are

A. CO and CO

B. CO_2 and CO

C. CO and CO_2

D. CO_2 and CO_2

Answer: D

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29. The straight chain polymer (silicones) is formed by

A. hydrolysis of CH_3SiCl_3, followed by condensation polymerisation.

B. hydrolysis of $(CH_3)_4, Si$ by addition polymerisation.

C. hydrolysis of $(CH_3)_2$, $SiCl_2$, followed by condensation polymerisation

D. hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation.

Answer: C

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30. In silicon dioxide

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

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