THE p-BLOCK ELEMENTS (GROUP 13 AND 14)

FACT/DEFINITION TYPE QUESTIONS

1. The non-metal oxides are ___x___ whereas metal oxides are ___y___ in nature.
(a) x = acidic or neutral, y = basic
(b) x = acidic, y = neutral
(c) x = basic, y = acidic
(d) x = neutral, y = basic

2. Which of the following is most abundant in the earth crust ?
(a) Boron (b) Aluminium
(c) Gallium (d) Thallium

3. Ionisation enthalpy (Δ_iH_1 kJ mol^{-1}) for the elements of Group 13 follows the order.
(a) B > Al > Ga > In > Tl (b) B < Al < Ga < In < Tl
(c) B < Al > Ga < In > Tl (d) B > Al < Ga > In < Tl

4. The relationship between first, second and third ionisation enthalpies of each group-13 element is
(a) $\Delta_iH_1 > \Delta_iH_2 > \Delta_iH_3$ (b) $\Delta_iH_1 < \Delta_iH_2 < \Delta_iH_3$
(c) $\Delta_iH_1 = \Delta_iH_2 > \Delta_iH_3$ (d) $\Delta_iH_3 > \Delta_iH_1 > \Delta_iH_2$

5. Which of the following properties of aluminium makes it useful for food packaging ?
(a) Good electrical conductivity
(b) Good thermal conductivity
(c) Low density
(d) Non toxicity

6. Which of the following is/are true regarding gallium?
(i) It has unusually low melting point (303 K).
(ii) It exist in liquid state during summer.
(iii) It has a high boiling point (2676 K).
The correct option is
(a) (i) and (ii) (b) (i) and (iii)
(c) (i), (ii) and (iii) (d) (ii) and (iii)

7. The element which shows least metallic character is
(a) Indium (b) Boron
(c) Aluminium (d) Gallium

8. Which one of the following has the lowest m.p.?
(a) B (b) Al
(c) Ga (d) Tl

9. Which of the following does not form M^{3+} ion?
(a) Boron (b) Aluminium
(c) Indium (d) Gallium

10. The group 13 element that is liquid during summer and used for measuring high temperature is
(a) Boron (b) Aluminium
(c) Gallium (d) Indium

11. Thallium 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

12. The exhibition of highest co-ordination number depends on the availability of vacant orbitals in the central atom. Which of the following elements is not likely to act as central atom in MF_6^{3-} ?
(a) B (b) Al
(c) Ga (d) In

13. Which out of the following compounds does not exist?
(a) BF_3 (b) $TlCl_3$
(c) $TlCl_5$ (d) Both (b) and (c)

14. Aluminium chloride is a/an
(a) Bronsted - Lowery acid (b) Arhenius acid
(c) Lewis acid (d) Lewis base

15. The strongest Lewis acid is
(a) BF_3 (b) BCl_3
(c) BBr_3 (d) BI_3

16. $AlCl_3$ on hydrolysis gives
(a) $Al_2O_3.H_2O$ (b) $Al(OH)_3$
(c) Al_2O_3 (d) $AlCl_3.6H_2O$

17. Which metal is protected by a layer of its own oxide?
(a) Al (b) Ag
(c) Au (d) Fe

18. Aluminium vessels should not be washed with materials containing washing soda because
(a) washing soda is expensive
(b) washing soda is easily decomposed
(c) washing soda reacts with aluminium to form soluble aluminate
(d) washing soda reacts with aluminium to form insoluble aluminium oxide

19. When Al is added to KOH solution
(a) no action takes place (b) oxygen is evolved
(c) water is produced (d) hydrogen is evolved

20. Which of the following does not react with aqueous NaOH?
(a) B (b) Al
(c) Ga (d) Tl

21. Amphoteric oxide among the following is
(a) B_2O_3 (b) Ga_2O_3
(c) In_2O_3 (d) Tl_2O_3

22. Boron forms covalent compound due to
(a) higher ionization energy
(b) lower ionization energy
(c) small size
(d) Both (a) and (c)

23. NH_3 and BF_3 form an adduct readily because they form
(a) a coordinate bond (b) a hydrogen bond
(c) an ionic bond (d) a covalent bond

24. The factor responsible for weak 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

25. In borax bead test which compound is formed?
(a) Ortho-borate (b) Meta-borate
(c) Double oxide (d) Tetra-borate

26. The formula of mineral borax is
(a) $Na_2B_4O_7$ (b) $Na_2B_4O_7.4H_2O$
(c) $Na_2B_4O_7.5H_2O$ (d) $Na_2B_4O_7.10H_2O$

27. Which of the following hydroxide is acidic?
(a) $Al(OH)_3$ (b) $Ca(OH)_3$
(c) $Tl(OH)_3$ (d) $B(OH)_3$

28. Orthoboric acid
(a) donate proton to form $H_2BO_3^-$
(b) accept proton of form $H_4BO_3^+$
(c) donate OH^- to form $H_2BO_2^+$
(d) accept OH^- to form $[B(OH)_4]^-$

29. H_3BO_3 on heating up to 373 K yields:
(a) boric anhydride (b) orthoboric acid
(c) metaboric acid (d) tetraboric acid

30. Boric acid is polymeric due to
(a) its acidic nature
(b) the presence of hydrogen bonds
(c) its monobasic nature
(d) its geometry

31. $B(OH)_3$ is
(a) monobasic acid (b) dibasic acid
(c) tribasic acid (d) triacidic base

32. Orthoboric acid when heated to red hot gives
(a) metaboric acid (b) pyroboric acid
(c) boron and water (d) boric anhydride

33. Which is false in case of boric acid H_3BO_3?
(a) It acts as a tribasic acid.
(b) It has a planar structure.
(c) It acts as a monobasic acid.
(d) It is soluble in hot water.

34. BCl_3 does not exist as dimer but BH_3 exists as dimer (B_2H_6) because
(a) chlorine is more electronegative than hydrogen
(b) there is $p\pi$-$p\pi$ back bonding in BCl_3 but BH_3 does not contain such multiple bonding
(c) large sized chlorine atoms do not fit in between the small boron atoms where as small sized hydrogen atoms get fitted in between boron atoms
(d) None of the above

35. In reaction
$BF_3 + 3LiBH_4 \rightarrow 3LiF + X$; X is
(a) B_4H_{10} (b) B_2H_6
(c) BH_3 (d) B_3H_8

36. Inorganic benzene is
(a) $B_3H_3N_3$ (b) BH_3NH_3
(c) $B_3H_6N_3$ (d) $H_3B_3N_6$

37. The structure of diborane (B_2H_6) contains
(a) four 2c-2e bonds and four 3c-2e bonds
(b) two 2c-2e bonds and two 3c-3e bonds
(c) two 2c-2e bonds and four 3c-2e bonds
(d) four 2c-2e bonds and two 3c-2e bonds

38. 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

39. Diborane upon hydrolysis gives
(a) boric anhydride (b) metaboric acid
(c) orthoboric acid (d) boron oxide

40. Borazole is known as
(a) organic benzene (b) organic xylene
(c) inorganic benzene (d) inorganic xylene

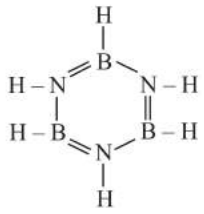
41. The compounds of boron and hydrogen are collectively called
(a) diboranes (b) borazoles
(c) boracits (d) boranes

42. The bonds present in borazole or inorganic benzene are
(a) $9\sigma, 6\pi$ (b) $12\sigma, 3\pi$
(c) $6\sigma, 9\pi$ (d) 15σ only

43. The two type of bonds present in B_2H_6 are covalent and
(a) ionic (b) co-ordinate
(c) hydrogen bridge bond (d) None of these

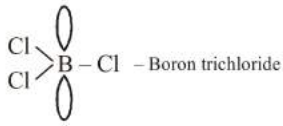
44. Reaction of diborane with ammonia gives initially
(a) $B_2H_6 \cdot NH_3$ (b) Borazole
(c) $B_2H_6 \cdot 3NH_3$ (d) $[BH_2(NH_3)_2]^+[BH_4]^-$

45. Which of the following compounds is not matched correctly with its structure?

(a)  – Borazine

(b)  – Diborane

(c)  – Aluminium chloride

(d)  – Boron trichloride

46. The electronic configuration of four different elements is given below. Identify the group 14 element among these

(a) $[He]\,2s^1$ (b) $[Ne]\,3s^2$

(c) $[Ne]\,3s^2 3p^2$ (d) $[Ne]\,3s^2 3p^5$

47. Which of the following is most electronegative?

(a) Pb (b) Si

(c) C (d) Sn

48. Which of the following isotope of carbon is radioactive?

(a) ^{12}C (b) ^{13}C

(c) ^{14}C (d) All of these

49. Carbon and silicon belong to group 14. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to

(a) large size of silicon

(b) more electropositive nature of silicon

(c) availability of *d*-orbitals in silicon

(d) Both (a) and (b)

50. The inert pair effect is most prominent in

(a) C (b) Pb

(c) Ge (d) Si

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

(a) Fe (b) Sn

(c) Pb (d) Si

52. Which of the following lead oxides is present in 'Sindhur'?

(a) PbO (b) PbO_2

(c) Pb_2O_3 (d) Pb_3O_4

53. Mark the oxide which is amphoteric in character

(a) CO_2 (b) SiO_2

(c) SnO_2 (d) CaO

54. Red lead is

(a) Pb_3O_4 (b) Pb_2O_3

(c) Pb_2O (d) PbO

55. The oxide of lead used in lead accumulators is

(a) PbO (b) Pb_2O_3

(c) Pb_3O_4 (d) PbO_2

56. Which of the following is/are not correctly matched ?

(i) GeO_2 – Acidic (ii) PbO_2– Amphoteric

(iii) CO – Neutral (iv) SiO_2 – Amphoteric

(a) (i) and (iv) (b) (iv) only

(c) (ii) only (d) (iii) only

57. Least thermally stable is

(a) CCl_4 (b) $SiCl_4$

(c) $GeCl_4$ (d) $GeBr_4$

58. 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-metallic

(d) carbon does not contain d-orbital

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

(a) CF_4 (b) CI_4

(c) CBr_4 (d) CCl_4

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

(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) $SiX_2 << GeX_2 << SnX_2 << PbX_2$.

61. Which of the following is not correct?

(a) $Ge(OH)_2$ is amphoteric

(b) $GeCl_2$ is more stable than $GeCl_4$

(c) GeO_2 is weakly acidic

(d) $GeCl_4$ in HCl forms $[GeCl_2]^{2-}$ ion

62. The main reason that $SiCl_4$ is easily hydrolysed as compared to CCl_4 is that

(a) Si-Si bond is weaker

(b) $SiCl_4$ can form hydrogen bonds

(c) $SiCl_4$ is covalent

(d) Si can extend its coordination number beyond four

63. Which halide is least stable and has doubtful existence

(a) CI_4 (b) GeI_4

(c) SnI_4 (d) PbI_4

64. PbF_4, $PbCl_4$ exist but $PbBr_4$ and PbI_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^-.

65. 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 ≈ Sn
(c) Si > C > Sn > Ge (d) Ge > Sn > Si > C

66. 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, respectively are
(a) 167, 180, 348 (b) 180, 167, 348
(c) 348, 167, 180 (d) 348, 180, 167

67. Lead pipes are readily corroded by
(a) H_2SO_4 (b) HCl
(c) CH_3COOH (d) pure water

68. Lead pipes are not suitable for drinking water because
(a) lead forms basic lead carbonate
(b) lead reacts with water containing air to form $Pb(OH)_2$
(c) a layer of lead dioxide is deposited over pipes
(d) lead reacts with air to form litharge

69. 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

70. The element that does not show catenation among the following p-block elements is
(a) carbon (b) silicon
(c) germanium (d) lead

71. How many six membered and five membered rings are present in fullerene?
(a) Six membered = 20, five membered = 10
(b) Six membered = 20, five membered = 12
(c) Six membered = 25, five membered = 10
(d) Six membered = 12, five membered = 25

72. Which of the following is the pure form of carbon ?
(a) Diamond
(b) Fullerene
(c) Graphite
(d) All three forms are equally pure

73. Which one of the following is not an allotrope of carbon ?
(a) Carborundum (b) Diamond
(c) Soot (d) Graphite

74. Which of the following types of forces bind together the carbon atoms in diamond ?
(a) Ionic (b) Covalent
(c) Dipolar (d) van der Waal's

75. Carborundum is
(a) SiC (b) CaC_2
(c) Mg_2C_3 (d) None of these

76. Buckminster fullerene is
(a) pure graphite (b) C-60
(c) diamond (d) C-90

77. The hybridisation state of carbon in fullerene is
(a) sp (b) sp^2
(c) sp^3 (d) sp^3d

78. The number of carbon atoms in Buckminsterfullerene is
(a) 50 (b) 350
(c) 60 (d) 70

79. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite
(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 inter plate bonds
(d) is a non-crystalline substance

80. In graphite, electrons are
(a) localised on every third C-atom
(b) present in anti-bonding orbital
(c) localised on each C-atom
(d) spread out between the structure

81. The elements commonly used for making transistors are
(a) C and Si (b) Ga and In
(c) P and As (d) Si and Ge

82. The element which is exclusively applied as semi-conductor
(a) Au (b) Ge
(c) Pt (d) Si

83. Glass is a
(a) liquid
(b) solid
(c) supercooled liquid
(d) transparent organic polymer

84. Glass reacts with HF to produce
(a) SiF_4 (b) H_2SiF_6
(c) H_2SiO_3 (d) Na_3AlF_6

85. Producer gas is the mixture of
(a) $CO + N_2$ (b) $CO + H_2$
(c) CO + water vapours (d) $N_2 + CH_4$

86. Coal gas is a mixture of
(a) H_2O and CO (b) H_2, CO, N_2 and CH_4
(c) H_2 and CO (d) CH_4 and CO

87. Crystalline form of silica is called
(a) crystalline silicon (b) quartz
(c) rock (d) talc

88. Dry ice is
(a) solid SO_2 (b) solid NH_3
(c) solid O_2 (d) solid CO_2

89. 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

90. R_3SiCl on hydrolysis forms

(a) R_3SiOH (b) $R_3Si-O-SiR_3$

(c) $R_2Si=O$ (d) None of these

91. Which of the following statements is false?

(a) Water gas is a mixture of hydrogen and carbon monoxide

(b) Producer gas is a mixture of CO and nitrogen

(c) Water gas is a mixture of water vapour and hydrogen

(d) Natural gas consists of methane, ethane and gaseous hydrocarbons.

92. Which gas is essential constituent of almost all fuel gases ?

(a) CO_2 (b) N_2

(c) CO (d) H_2O

93. CO_2 is used for extinguishing fire because

(a) it has a relatively high critical temperature

(b) in solid state, it is called dry ice

(c) it is neither combustible nor a supporter of combustion

(d) it is a colourless gas

94. The correct statement with respect to CO is

(a) it combines with H_2O to give carbonic acid

(b) it reacts with haemoglobin in RBC

(c) it is powerful oxidising agent

(d) it is used to prepare aerated drinks

95. Producer gas, a fuel and also a source of nitrogen is obtained by

(a) passing a mixture of steam and air over incandescent coke.

(b) spraying oil into hot retorts.

(c) restricted supply of air through a bed of incandescent coke.

(d) passing steam over incandescent coke.

96. Which of the following shows bond in silicone :

(a) Si – Si – Si – Si (b) – Si – O – Si – O – Si

(c) Si – C – Si – C – Si (d) Si – C – Si – O – Si

97. Which of the following is formed on dehydration of formic acid with concentrated H_2SO_4 ?

(a) CO (b) CO_2

(c) CH_4 (d) H_2

98. _____ helps to maintain pH of blood between 7.26 to 7.42

(a) CO_2 (b) H_2CO_3

(c) CO_3^{2-} (d) H_2CO_3/HCO_3^-

99. Which of the following is not the crystalline form of silica?

(a) Quartz

(b) Cristobalite

(c) Tridymite

(d) All are crystalline form of silica.

100. Which of the following is used in surgical and cosmetic plants?

(a) Silicones (b) Silicates

(c) Silica (d) None of these

101. Which of the following is not a man-made silicate ?

(a) Glass (b) Cement

(c) Zeolites (d) All are man-made silicates

102. Which type of zeolite is used to convert alcohols directly into gasoline ?

(a) ZSM – 3 (b) ZSM – 5

(c) ZSM – 2 (d) All of these

STATEMENT TYPE QUESTIONS

103. Which of the following statement(s) is/are not correct ?

(i) Valence shell electronic configuration of p-block elements is $ns^2\ np^{1-6}$

(ii) Non metals and metalloids exist only in the p-block of the periodic table.

(iii) In boron, carbon and nitrogen families the group oxidation state is the most stable state for the lighter elements in the group.

(iv) For heavier elements in each group oxidation state two unit less than the group oxidation state becomes more stable due to inert pair effect

(a) (ii) only

(b) (ii), (iii) and (iv)

(c) (iii) and (iv)

(d) All given statements are correct

104. Which of the following sequence of T and F is correct for given statements. Here T represents 'True' and F represents 'False' statement.

(i) Aluminium forms $[AlF_6]^{3-}$ ion while boron forms only $[BF_4]^-$ ion due to presence of *d*-orbitals in aluminium.

(ii) The first member of a group differs from the heavier members in its ability to form pπ-pπ multiple bonds to itself and to other second row elements. While heavier member forms dπ-pπ bonds.

(iii) *d*-orbitals contribute more to the overall stability of molecules than pπ-pπ bonding of second row elements.

(a) TTT (b) FTF

(c) TTF (d) FTT

105. Which of the following statement(s) is/are incorrect ?

(i) Trichlorides on hydrolysis in water form tetrahedral $[M(OH)_4]^-$ species.

(ii) Hybridisation state of metal in tetrahedral species is sp^3.

(iii) Aluminium chloride in acidified aqueous solution forms $[Al(OH)_4]^-$ ion.

(a) (i) and (ii) (b) (ii) only

(c) (iii) only (d) (i) and (iii)

106. Which of the following statement(s) regarding BCl_3 and $AlCl_3$ is/are correct ?

(i) BCl_3 possess lower melting point than $AlCl_3$.

(ii) BCl_3 is more covalent in character than $AlCl_3$.

(a) Statement (i) is correct explanation for statement (ii).

(b) Statement (i) and (ii) both are incorrect

(c) Statement (i) and (ii) both are correct

(d) Statement (ii) is correct explanation for statement (i)

107. Which of the following statement(s) is/are incorrect ?

(i) Higher boranes are not flammable.

(ii) Boranes are hydrolysed by water to give orthoboric acid.

(iii) Boranes undergoes cleavage reactions with Lewis bases to give borane adducts.

(a) (i) only (b) (ii) and (iii)

(c) (iii) only (d) (i) and (ii)

108. Select the correct statements for diborane :

(i) Boron is approximately sp^3 hybridized

(ii) B – H – B angle is 180°

(iii) There are two terminal B – H bonds for each boron atom

(iv) There are only 12 bonding electrons

(a) (i), (ii) and (iv) (b) (i), (ii) and (iii)

(c) (ii), (iii) and (iv) (d) (i), (iii) and (iv)

109. Which of the following sequence of T and F is correct for given statements. Here T stands for the true and F stands for false statement.

(i) The tendency to show +2 oxidation state increase in the sequence Ge < Sn < Pb.

(ii) Tin in +2 state is a reducing agent.

(iii) Lead compounds in +2 state are strong oxidising agents.

(iv) In tetravalent state molecules of group 13 elements act as electrons donor species.

(a) TTTT (b) TTFF

(c) TTFT (d) TFFT

110. Which of the following statement(s) is / are incorrect for CO_2?

(i) In laboratory CO_2 is prepared by the action of dilute HCl on calcium carbonate

(ii) Carbon dioxide is a poisonous gas

(iii) Increase in carbon dioxide content in atmosphere lead to increase in green house effect.

(iv) CO_2 as dry ice is used as a refrigerant for ice cream and frozen food.

(a) (i) and (ii) (b) Only (ii)

(c) (i), (ii) and (iii) (d) (ii) and (iii)

111. Which of the following sequence of T and F is correct for given statements. Here T stands for true and F stands for false statement.

(i) Quartz is extensively used as a piezoelectric material.

(ii) Kieselghur is an amorphous form of silica which is used in filteration plants.

(iii) Silica does not react with halogens, dihydrogen and most of the acids and metals even at elevated temperature.

(a) TTT (b) TFF

(b) TFT (d) FFT

MATCHING TYPE QUESTIONS

112. Match the columns

	Column-I		Column-II
(A)	Borax-bead	(p)	Alum
(B)	Inorganic benzene	(q)	Diborane
(C)	Antiseptic	(r)	Metaborate
(D)	Bridged hydrogens	(s)	Borazole

(a) A – (p), B – (r), C – (q), D – (s)

(b) A – (r), B – (s), C – (p), D – (q)

(c) A – (s), B – (r), C – (p), D – (q)

(d) A – (q), B – (r), C – (s), D – (p)

113. Identify (i) to (v) in reactions (1) and (2) on the basis of your identification choose the correct code for matching Column-I with Column-II.

1. $Na_2B_4O_7.10H_2O \xrightarrow{\Delta}$ (i) $\xrightarrow{\Delta}$ (ii) + (iii)
2. $Na_2B_4O_7.7H_2O \longrightarrow$ (iv) + (v)

	Column-I		Column-II
(A)	(i)	(p)	H_3BO_3
(B)	(ii)	(q)	B_2O_3
(C)	(iii)	(r)	$NaBO_2$
(D)	(iv)	(s)	NaOH
(E)	(v)	(t)	$Na_2B_4O_7$

(a) A – (t), B – (s), C – (p), D – (q), E – (r)

(b) A – (r), B – (q), C – (s), D – (p), E – (t)

(c) A – (t), B – (r), C – (q), D – (p), E – (s)

(d) A – (t), B – (r), C – (s), D – (q), E – (p)

114. Match Column-I (Compound of boron) with Column-II (Use) and choose the correct option.

	Column-I		Column-II
(A)	Metal borides	(p)	Flux for soldering metals
(B)	Boron fibres	(q)	Bullet-proof vest
(C)	Borax	(r)	As a mild antiseptic
(D)	Boric acid	(s)	As control rods in nuclear industry

(a) A – (q), B – (s), C – (r), D – (p)

(b) A – (q), B – (s), C – (p), D – (r)

(c) A – (s), B – (q), C – (r), D – (p)

(d) A – (s), B – (q), C – (p), D – (r)

115. Match the columns

	Column-I		Column-II
(A)	Carbon	(p)	Metal
(B)	Silicon	(q)	Non-metal
(C)	Germanium	(r)	Metalloid
(D)	Tin		
(E)	Lead		

(a) A – (q), B – (q), C – (r), D – (p), E – (p)

(b) A – (q), B – (r), C – (r), D – (p), E – (p)

(c) A – (q), B – (r), C – (r), D – (p), E – (q)

(d) A – (q), B – (q), C – (q), D – (r), E – (p)

116. Match columns

Column-I	Column-II
(A) Graphite fibres	(p) Abrasive for sharpening hard tools
(B) Carbon black	(q) Formation of light weight composites.
(C) Charcoal	(r) Used in water filters to remove organic contaminators
(D) Diamond	(s) As filler in automobile tyres

(a) A – (s), B – (q), C – (r), D – (p)
(b) A – (q), B – (s), C – (r), D – (p)
(c) A – (q), B – (r), C – (s), D – (p)
(d) A – (p), B – (r), C – (s), D – (q)

117. Match the columns

Column-I	Column-II
(A) Borazole	(p) $CaSO_4 \cdot \frac{1}{2}H_2O$
(B) Plaster of Paris	(q) C_{60}
(C) Boric acid	(r) SiO_2
(D) Quartz	(s) $B_3N_3H_6$
(E) Buckminsterfullerene	(t) H_3BO_3

(a) A – (r); B – (p); C – (q); D – (t); E – (s)
(b) A – (p); B – (t); C – (r); D – (s); E – (q)
(c) A – (t); B – (q); C – (p); D – (r); E – (s)
(d) A – (s); B – (p); C – (t); D – (r); E – (q)

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

118. **Assertion :** Atomic radius of gallium is higher than that of aluminium
Reason : The presence of additional *d*-electron offer poor screening effect for the outer electrons from increased nuclear charge.

119. **Assertion :** Boron is metalloid.
Reason : Boron shows metallic nature.

120. **Assertion :** The use of aluminium and its compounds for domestic purposes is now reduced considerably.
Reason : The highly toxic nature of aluminium is the responsible factor.

121. **Assertion :** Pb^{4+} compounds are stronger oxidizing agents than Sn^{4+} compounds.
Reason : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'.

122. **Assertion :** PbI_4 of lead does not exist.
Reason : Pb–I bond initially formed during the reaction does not release enough energy to unpair $6s^2$ electrons.

123. **Assertion :** Graphite is thermodynamically most stable allotrope of carbon.
Reason : $\Delta_f H^{\ominus}$ of graphite is taken as zero.

CRITICAL THINKING TYPE QUESTIONS

124. The liquefied metal which expands on solidification is :
(a) Ga (b) Al
(c) Zn (d) In

125. What is *x* in the following reaction?
$Al(s) + NaOH\ (aq) + H_2O\ (l) \rightarrow x + H_2(g)$
(a) $Na_2[Al(OH)_4]^-$ (b) $Na^+[Al(OH)_4]^-$
(c) $Na_2[Al(OH)_6]^-$ (d) $Na^+[Al(OH)_6]^-$

126. Which among the following oxides react with alkali?
B_2O_3, Al_2O_3 and Tl_2O
(a) B_2O_3 and Al_2O_3 (b) Al_2O_3 and Tl_2O
(c) Only B_2O_3 (d) B_2O_3 and Tl_2O

127. White fumes appeared around the bottle of anhydrous aluminium chloride is due to _____
(a) Cl_2 gas
(b) moist HCl
(c) condensation of aluminium chloride vapours
(d) None of these

128. What is the oxidation state and hybridisation of boron in compound formed when BCl_3 undergoes reaction with the water?
(a) 3, sp^2d (b) 3, sp^3
(c) 4, sp^3 (d) 3, sp^2d

129. Which is not correct?
(a) Al acts as a reducing agent
(b) Al does not react with steam even at higher temperature
(c) Al forms a number of alloys with other metals
(d) Al is ionic in all its compounds

130. Which one of the following is the correct statement?
(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) $B_2H_6.2NH_3$ is known as 'inorganic benzene'

131. BF_3 is used as a catalyst in several industrial processes due to its
(a) strong reducing nature
(b) weak reducing action
(c) strong Lewis acid nature
(d) weak Lewis acid character

132. What is the colour obtained when borax is heated in a Bunsen burner flame with CoO?
(a) Blue (b) Black
(c) Green (d) Violet

133. 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

134. The hybridisation of boron atom in orthoboric acid is
(a) sp (b) sp^2
(c) sp^3 (d) sp^3d

135. Which is not the use of orthoboric acid?
(a) As an antiseptic and eye wash.
(b) In glass industry.
(c) In glazes for pottery.
(d) In borax - bead test.

136. Which of the following reaction shows production of diborane on industrial scale ?
(a) $4BF_3 + 3LiAlH_4 \longrightarrow 2B_2H_6 + 3LiF + 3AlF_3$
(b) $2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$
(c) $2BF_3 + 6NaH \xrightarrow{450K} B_2H_6 + 6NaF$
(d) Both (b) and (c)

137. Identify the statement that is not correct as far as structure of diborane is concerned
(a) There are two bridging hydrogen atoms and four terminal hydrogen atoms in diborane
(b) Each boron atom forms four bonds in diborane
(c) The hydrogen atoms are not in the same plane in diborane
(d) All, B – H bonds in diborane are similar

138. Which of the following structure is similar to graphite?
(a) B (b) B_4C
(c) B_2H_6 (d) BN

139. A compound X, of boron reacts with NH_3 on heating to give another compound Y which is called inorganic benzene. The compound X can be prepared by treating BF_3 with lithium aluminium hydride. The compounds X and Y are represented by the formulas.
(a) B_2H_6, $B_3N_3H_6$ (b) B_2O_3, $B_3N_3H_6$
(c) BF_3, $B_3N_3H_6$ (d) $B_3N_3H_6$, B_2H_6

140. The product/s formed when diborane is hydrolysed is/are
(a) B_2O_3 and H_3BO_3 (b) B_2O_3 only
(c) H_3BO_3 and H_2 (d) H_3BO_3 only

141. Which of the following species exists (A) $[SiF_6]^{2-}$, (B) $[GeCl_6]^{2-}$ and (C) $[CCl_6]^{2-}$?
(a) (A) and (B) (b) (B) and (C)
(c) Only (C) (d) (A) and (C)

142. Ge(II)compounds are powerful reducing agents whereas Pb(IV)compounds are strong oxidants .It is because
(a) Pb is more electropositive than Ge
(b) ionization potential of lead 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 effect in lead than in Ge

143. Which of the following statements is not correct ?
(a) Fullerene is formed by condensation of vapourised C^n small molecules consists of mainly C_{60}.
(b) In fullerene a six membered ring can only fuse with five membered ring and a five membered ring can only fuse with six membered rings.
(c) All carbon atoms are sp^2 hybridised in fullerene
(d) All the above are correct.

144. The element that does not form a monoxide is
(a) lead (b) tin
(c) germanium (d) silicon

145. A group 14 element is oxidised to form corresponding oxide which is gaseous in nature, when dissolved in water pH of the water decreases further addition of group 2 hydroxides leads to precipitation. This oxide can be
(a) GeO_2 (b) CO
(c) CO_2 (d) SnO_2

146. Which among the following can act as reducing agent (A)$SnCl_2$, (B)CO and (C)$PbCl_2$?
(a) (A) and (B) (b) (B) and (C)
(c) (C) and (A) (d) Only (B)

147. Lead is not affected by dil. HCl in cold because
(a) Pb is less electronegative than H
(b) PbO film is formed which resists chemical attack by acid
(c) $PbCl_2$ protective coating gets formed on Pb surface
(d) PbO_2 film is always present on Pb surface, which resist chemical attack

148. The percentage of s-character of the hybrid orbitals of carbon in graphite and diamond are respectively
(a) 33, 25 (b) 50, 50
(c) 67, 25 (d) 33, 67

149. What is the hybridisations of carbon atoms present in diamond, graphite and fullerene respectively ?
(a) sp^3,sp^2 and sp^2 (b) sp^2,sp^3 and sp^2
(c) sp^2,sp^2 and sp^3 (d) sp^3,sp^3 and sp^2

150. Which one of the following allotropic forms of carbon is isomorphous with crystalline silicon?
(a) Graphite (b) Coal
(c) Coke (d) Diamond

151. Which one of the following statements about the zeolites is false ?
(a) They are used as cation exchangers
(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

152. Which of the following attacks glass
(a) HCl (b) HF
(c) HI (d) HBr

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (a) The non – metal oxides are acidic or neutral whereas metal oxides are basic in nature.

2. (b) Aluminium does not occur in the free state in nature but is most abundant metal in the earth's crust.

3. (d)

4. (b) The order of ionisation enthalpies, as expected, is $\Delta_i H_1 < \Delta_i H_2 < \Delta_i H_3$.

5. (c) Due to the low density of aluminium it is useful for food packaging.

6. (c) **7. (b)**

8. (c) The m.p decreases from B to Ga , hence gallium (Ga) has least m.p. (303 K) among group of 13 element.

9. (a) Due to its small size and high ionization energy boron does not form B^{3+} ion.

10. (c) Gallium is remarkable for its unusually low M.P. (29.7°C).

11. (b) Thallium shows different (+1 and +3) oxidation states because of inert pair effect.

12. (a)

13. (c) Because Tl^{+5} does not exist

14. (c)

15. (d) The order of strength of Lewis acid character for boron halides is, $BF_3 < BCl_3 < BBr_3 < BI_3$ (due to back bonding)

16. (b) **17. (a)** **18. (c)**

19. (d) $2KOH + 2Al + 2H_2O \rightarrow 2KAlO_2 + 3H_2$

20. (a)

21. (b) Down the group basic character of oxides increases.

B_2O_3 - Acidc
Al_2O_3 - Amphoteric
Ga_2O_3 - Amphoteric
In_2O_3 - Basic
Tl_2O_3 - Basic

22. (d) **23. (a)**

24. (d) It is $p\pi - p\pi$ back bonding involving B and F. The smaller atoms show more back bonding.

25. (b) $Na_2B_4O_7.10H_2O \xrightarrow[-10H_2O]{\Delta} Na_2B_4O_7$

$$\underset{\text{anhydrous}}{Na_2B_4O_7} \xrightarrow{\Delta} \underset{\text{sod. metaborate}}{2NaBO_2} + \underset{\text{Boric anhydride}}{B_2O_3}$$

$$CuO + B_2O_3 \longrightarrow \underset{\text{cupric meta borate(Blue beed)}}{Cu(BO_2)_2}$$

26. (d)

27. (d) $B(OH)_3$ is acid because it can take OH^- ions.

H_3BO_3 or $B(OH)_3 + OH^- \rightarrow B(OH)_4^-$

28. (d) H_3BO_3 acts as a Lewis acid and accepts OH^- ions to form $[B(OH)_4]^-$

29. (c) H_3BO_3 on heating at 373K yields metaboric acid (HBO_2)

$$H_3BO_3 \xrightarrow[\Delta]{373K} \underset{\substack{\text{metaboric acid}\\\text{(orthorombic form)}}}{HBO_2} + H_2O$$

30. (b) In Boric acid each B atom is sp^2 hybridized and contains BO_3^{3-} units which are held together by hydrogen bonds.

31. (a)

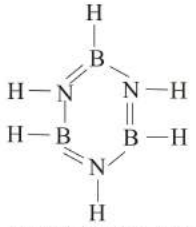
32. (b) $H_3BO_3 \xrightarrow{100°C} HBO_2 \xrightarrow{160°C}$

$$H_2B_4O_7 + H_2O \longrightarrow 2B_2O_3 + H_2O$$

33. (a) H_3BO_3 is monobasic acid.

34. (c) **35. (b)**

36. (c)

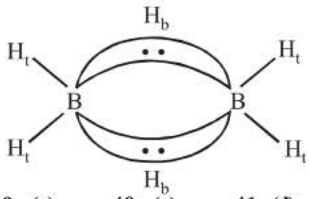


Inorganic benzene, $B_3N_3H_6$

It is isoelectronic with benzene.

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

Structure of B_2H_6 :

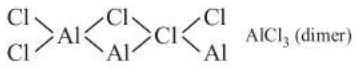


38. (b) **39. (c)** **40. (c)** **41. (d)** **42. (b)**

43. (c) B_2H_6 contains hydrogen bridge bonds. These are one electron bonds also known as banana bonds.

44. (d) $B_2H_6 + NH_3 \xrightarrow[\text{low temperature}]{\text{excess } NH_3} B_2H_6.2NH_3$

Diborane with ammonia gives $B_2H_6.2NH_3$ that is formulated as $[BH_2(NH_3)]^+[BH_4]^-$ which when heated to 473K decomposes to give borazole.

45. **(c)**  $AlCl_3$ (dimer)

46. **(c)** Valence shell electronic configuration of group 14 elements is ns^2p^2.

47. **(c)** Electronegativity decreases down the group.

48. **(c)** ^{14}C is a radioactive isotope with half life of 5770 years and used for radiocarbon dating.

49. **(c)** Due to non-availability of vacant *d*-orbitals, it cannot exceed its coordination number more than four. Thus carbon never forms complexes e.g., $[CCl_6]^{2-}$ deos not exist but $[SiCl_6]^{2-}$ exists.

50. **(b)** The inert pair effect is most prominent in the heavier members of the group. Inert pair effect increases as we move the group down the group.

51. **(c)** Inert pair effect increases down the group. Hence for Pb^{2+}, O.S. is most stable.

52. **(d)** Pb_3O_4 is also known as Sindhur.

53. **(c)** CO_2, SiO_2 are acidic, CaO is basic and SnO_2 is amphoteric.

54. **(a)** Red lead is Pb_3O_4. It is a mixed oxide of Pb (II) and Pb (IV). It acts as a powerful oxidising agent.

55. **(d)** PbO_2 is a strong oxidising agent and is produced in situ in lead storage batteries. The anode is oxidized to PbO_2 and cathode is reduced to spongy Pb.

56. **(b)** SiO_2 is acidic oxide.

57. **(d)** The thermal stability of tetrahalides decreases in order $CX_4 > SiX_4 > GeX_4 > SnX_4$ and in terms of same metal with different halides is in order of $MF_4 > MCl_4 > MBr_4 > MI_4$.

58. **(a)** The stability of dihalides (MX_2) increases down the group. Except C and Si, the other members form dihalides.

59. **(a)** Since bond energy of C-F >C-Cl > C-Br > C-I

Hence CF_4 is most stable.

60. **(d)** Reluctance of valence shell electrons to participate in bonding is called inert pair effect. The stability of lower oxidation state (+2 for group 14 element) increases on going down the group. So the correct order is $SiX_2 < GeX_2 < SnX_2 < PbX_2$

61. **(b)** Ge^{4+} is more stable than Ge^{2+}. Hence $GeCl_4$ is more stable than $GeCl_2$

62. **(d)** Carbon halides are not hydrolysed due to absence of *d*-orbitals. On the other hand $SiCl_4$ is easily hydrolysed due to the availability of *d*-orbitals in Si.

$SiX_4 + 2H_2O \rightarrow SiO_2 + 4HX$

63. **(d)** In nature Pb^{4+} is strong oxidant and I^- is strong reductant. Hence PbI_4 cannot exist.

64. **(b)** F and Cl are more oxidising in nature and can achieve Pb in (IV) O.S. but Br_2 and I_2 can not achieve Pb in (IV) O.S. secondly Pb^{4+} is strong in oxidising nature and in its presence, Br^- and I^- can not exist.

65. **(b)**

66. **(d)** The more the bond energy, the more is the catenation.

67. **(c)** Lead pipes are readily corroded by water containing organic acids.

68. **(b)** $2Pb + 2H_2O + O_2 \rightarrow 2Pb(OH)_2$

69. **(a)** The stability of +2 O.S. follows the order

$Pb^{2+} > Sn^{2+} > Ge^{2+}$

Hence reducing power $Ge > Sn > Pb$

70. **(d)** The order of tendency of catenation for elements of C family is

$C >> Si > Ge \approx Sn > Pb$

71. **(b)** Fullerene contains twenty six membered rings and twelve five membered rings.

72. **(b)** Fullerenes are the only pure form of carbon because they have smooth structure without having dangling bonds.

73. **(a)** Carborundum is chemically SiC. It is not an allotrope of carbon.

74. **(b)** In diamond each carbon atom is sp^3 hybridized and thus forms covalent bonds with four other carbon atoms lying at the corners of a regular tetrahedron.

75. **(a)**

76. **(b)** Buckminster fullerene is C_{60}. The molecule has shape of soccer ball.

77. **(b)** In fullerene each carbon atom is bonded to three other carbon atoms and is sp^2 hybridised.

78. **(c)** Buckminster fullerene has the formula C_{60} and is made from interlocking hexagonal and pentagonal rings of C-atoms.

79. **(c)**

80. **(d)** In graphite, each carbon is sp^2 -hybridized and the single occupied unhybridized p-orbitals of C-atoms overlap side wise to give π-electron cloud which is delocalized and thus the electrons are spread out between the structure.

81. **(d)** Si and Ge are semiconductors and are used in making transistors.

82. **(b)** Both Ge and Si are extensively used as semiconductors. Semiconductors are solids where there is only a small difference in energy, called band gap, between the filled valency band of electrons and a conduction band since the band gap of Ge is less than Si, it is a better element to be used as semiconductor.

83. **(c)** Glass is a super cooled liquid.

84. **(b)** $6HF + SiO_2 \rightarrow H_2SiF_6 + 2H_2O$

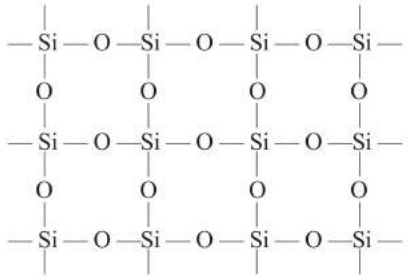
85. **(a)** Producer gas is a fuel gas and is mixture of CO and N_2.

86. **(b)** Coal gas is a mixture of $H_2 + CO + N_2 + CH_4$

87. **(b)** Quartz is crystalline form of silica.

88. **(d)**

89. **(b)** In silica (SiO_2); each Si atom is surrounded by four oxygen atom.



Structure of SiO_2

Only Si – O bonds exist and no Si = O.

90. **(b)** $R_3SiCl + HOH \rightarrow R_3SiOH + HCl$

$R_3SiOH + HOSiR_3 \rightarrow R_3Si-O-SiR_3 + H_2O$

91. **(a)** Water gas is $CO + H_2$

92. **(c)** CO is essential constituent of almost all fuel gases.

93. **(c)** CO_2 is incombustible and non supporter of combustion.

94. **(b)** CO react with haemoglobin, forms carboxy haemoglobin and stopes the supply of O_2

95. **(c)** Producer gas is mixture of $CO + N_2$. It is prepared by incomplete combustion of coal in limited supply of air.

96. **(b)** Silicone has Si – O – Si – O – Si linkage.

97. **(a)** $HCOOH \xrightarrow[\text{conc. } H_2SO_4]{373K} H_2O + CO$

98. **(d)** H_2CO_3/HCO_3^- buffer system help to maintain pH of blood between 7.26 to 7.42.

99. **(d)** Quartz, Cristobalite and Tridymite are crystalline form of silica.

100. **(a)** Being biocompatible silicones are used in surgical and cosmetic plants.

101. **(c)** Zeolite is not a man-made silicate.

102. **(b)** ZSM – 5 type of zeolite is used to convert alcohols directly into gasoline.

STATEMENT TYPE QUESTIONS

103. **(d)** All the given statements are correct.

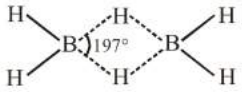
104. **(c)** *d*-orbitals are of higher energy than the p-orbitals, they contribute less to the overall stability of molecules than pπ-pπ bonding of the second row elements.

105. **(c)** Aluminium chloride in acidified aqueous solution forms octahedral $[Al(H_2O)_6]^{3+}$ ion.

106. **(d)** BCl_3 is a covalent compound hence lower melting point.

107. **(a)** Higher boranes are also spontaneously flammable in air.

108. **(d)**



B is sp^3 hybridized

Only 12 bonding electrons available

BHB angle is 97° not 180°.

109. **(b)** Lead compounds in +4 state are strong oxidising agents. In tetravalent state the number of electrons around the central atom in a molecule is eight. Being electron precise molecules, they are normally not expected to act as electron acceptor or electron donor species.

110. **(b)** Carbon dioxide is not a poisonous gas.

111. **(a)** All the given statements are true.

MATCHING TYPE QUESTIONS

112. **(b)**

113. **(c)** $Na_2B_4O_7.10H_2O \xrightarrow{\Delta} \underset{\text{(i)}}{Na_2B_4O_7} \xrightarrow{\Delta} \underset{\text{(ii)}}{2NaBO_2} + \underset{\text{(iii)}}{B_2O_3}$

$Na_2B_4O_7 + 7H_2O \longrightarrow \underset{\text{(iv)}}{4H_3BO_3} + \underset{\text{(v)}}{2NaOH}$

114. **(d)**

115. **(a)** Carbon and silicon are non-metals. Germanium is a metalloid. Tin and lead are metals.

116. **(b)** **117.** **(d)**

ASSERTION-REASON TYPE QUESTIONS

118. **(c)** Atomic radius of gallium is less than that of aluminium.

119. **(c)** Boron is metalloid. Thus assertion is correct. Metalloids possess, metallic as well as non-metallic nature. Hence, reason is false.

120. **(a)** The use of aluminium and its compounds for domestic purposes is now reduced considerably because of their toxic nature.

121. **(c)** Assertion is true because lower oxidation state becomes more & more stable for heavier elements in *p*-block due to inert pair effect. Hence Reason is false.

122. **(a)** PbI_4 does not exist because Pb–I bond initially formed during the reaction does not release enough energy to unpair $6s^2$ electrons and excite one of them to higher orbital to have four unpaired electrons around lead atom.

123. **(a)**

CRITICAL THINKING TYPE QUESTIONS

124. (a) Gallium (Ga) is soft , silvery metal. Its melting point is 30°C. This metal expands by 3.1% when it solidifies and hence, it should not be stored in glass or metal containers.

125. (b) $2Al(s) + 2NaOH(aq) + 6H_2O(l) \rightarrow 2Na^+[Al(OH)_4]^-(aq) + 3H_2(g)$

126. (a) B_2O_3 is acidic and Al_2O_3 is amphoteric.

127. (b) Anhydrous aluminium chloride gets partially hydrolysed with atmospheric moisture to liberate HCl gas. Moist HCl appears white in colour.

128. (b) BCl_3 forms $[B(OH)_4]^-$ in which B is sp^3 hybridized and have +3 oxidation state.

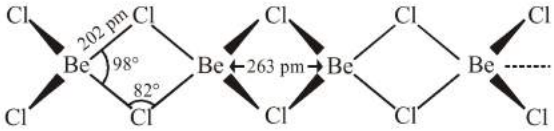
129. (d) Al in its compounds forms covalent bonds.

130. (c) The correct formula of inorganic benzene is $B_3N_3H_6$ so (d) is incorrect statement

Boric acid (H_3BO_3 or $B(OH)_3$) is a lewis acid so (a) is incorrect statement.

The coordination number exhibited by beryllium is 4 and not 6 so statement (b) is incorrect.

Both $BeCl_2$ and $AlCl_3$ exhibit bridged structures in solid state so (c) is correct statement.



131. (d)

132. (a) When borax is heated in a Bunsen burner flame with CoO on a loop of platinum wire a blue coloured $Co(BO_2)_2$ bead is formed.

133. (a) H_3BO_3 is a weak monobasic acid.

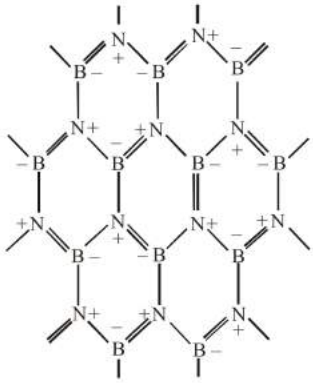
134. (b) The hybridizations of B in H_3BO_3 is sp^2

135. (d) Borax on heating gives B_2O_3 and $NaBO_2$ which is glassy mass and used for borax-bead test.

136. (c) Diborane is produced on industrial scale by the reaction of BF_3 with sodium hydride.

137. (d)

138. (d) Boron nitride (BN) is known as inorganic graphite. The most stable form is hexagonal one. It has layered structure similar to graphite.



139. (a)

140. (c) When diborane is hydrolysed one can get both orthoboric acid and H_2.

$B_2H_6 + 6H_2O \rightarrow 2H_3BO_3 + 6H_2$

141. (a) Carbon does not contain *d*-orbital hence it cannot expand its octet.

142. (d) Ge(II) tends to acquire Ge (IV) state by loss of electrons. Hence it is reducing in nature. Pb (IV) tends to acquire Pb (II) O.S. by gain of electrons. Hence it is oxidising in nature. This is due to inert pair effect.

143. (b) In fullerene a six membered ring can fuse with five as well as with six membered ring while a five membered ring can only fuse with a six membered ring.

144. (d) Silicon does not form mono oxide.

145. (c) CO_2 forms carbonic acid H_2CO_3, when dissolved in water, CO is neutral, whereas other two GeO_2 and SnO_2 are solids.

146. (a) Lead in +2 oxidation is stable while Sn and C are both stable in +4 oxidation.

147. (c) Pb with dil HCl forms protective coating of $PbCl_2$

148. (a) Graphite sp^3, $\therefore$ % s character = 33%

Diamond sp^3, $\therefore$ % s character = 25%

149. (a)

150. (d) Diamond and crystalline silicon are isomorphous.

151. (d)

152. (b) Glass being a mixture of sodium and calcium silicates reacts with hydrofluoric acid forming sodium and calcium fluorosilicates respectively.

$Na_2SiO_3 + 6HF \rightarrow Na_2SiF_6 + 3H_2O$

$CaSiO_3 + 6HF \rightarrow CaSiF_6 + 3H_2O$

The etching of glass is based on these reactions.