Assertion and Reason

1	b	2	b	3	a	4	a	5	a
6	c	7	b	8	e	9	a	10	a
11	e	12	a	13	a	14	a	15	a
16	c	17	b	18	c	19	d	20	d
21	a	22	b	23	d	24	d	25	b
26	d	27	c	28	c	29	a	30	a
31	a	32	c	33	b	34	a	35	a
36	b	37	a	38	b	39	b	40	b
41	a	42	c	43	a	44	d	45	c
46	a	47	d	48	b	49	d	50	a
51	e	52	b	53	d	54	b	55	c
56	a	57	a	58	a	59	d	60	b
61	a	62	b	63	c	64	b		

AS Answers and Solutions

Alkali metals

1. (b) Element — Na — K

IE_1 — 496 — 419

IE_2 — 4562 — 3051

Sodium has higher I.E. because of smaller atomic size.

2. (c) Alkali metals are highly reactive metals. They react with

Alcohol – $2C_2H_5OH + 2K \rightarrow 2C_2H_5OK + H_2$

Water – $2K + 2H_2O \rightarrow 2KOH + H_2$

Ammonia – $K + (x+y)NH_3 \rightarrow \underset{\text{Ammoniated cation}}{[K(NH_3)_x]^+} + \underset{\text{Ammoniated electron}}{[e(NH_3)_y]^-}$

But they do not react with kerosene.

4. (b) After removal of an electron the effective nuclear charge per electron increases hence the size decreases.

5. (a) Alkali metals valence shell configuration $= ns^1$

6. (b)

Element –	Li	Na	K	Rb	Cs
Ionic radius (pm) –	76	102	138	152	167

as the atomic no. increases the no. of shells increases hence, atomic radius increases.

7. (c) On moving down the group electropositive character increases.

8. (a) Carnellite – $KCl.\ MgCl_2.\ 6H_2O$

Cryolite – Na_3AlF_6

Bauxite – $(Al_2O_3.2H_2O)$

Dolomite – $MgCO_3.\ CaCO_3$

10. (d)

Element –	Li	Na	K	Rb
Atomic radius (pm) –	152	186	227	248

12. (b) Li is much softer than the other group 1 metals. Actually Li is harder then other alkali metals

13. (a) $Cu^{+2} + 2e^- \rightarrow Cu\ ,\ E^o = +0.34\ V$

$Mg^{+2} + 2e^- \rightarrow Mg\ ,\ E^o = -2.37\ V$

$Na^+ + e^- \rightarrow Na\ ,\ E^o = -2.71\ V$

14. (d) Anhydrous form of Na_2CO_3 does not decompose on heating even to redness. It is a amorphous powder called soda ash.

17. (c) Fehling's solution is a mixture of Alk. $CuSO_4 + Na - K$ tartarate (Rochelle salt)

19. (b) $2K + 2HCl \rightarrow 2KCl + H_2$ (violent reaction).

20. (b) Although lattice energy of $LiCl$ higher than $NaCl$ but $LiCl$ is covalent in nature and $NaCl$ ionic there after, the melting point decreases as we move $NaCl$ because the lattice energy decreases as a size of alkali metal atom increases (lattice energy $\propto$ melting point of alkali metal halide)

22. (b) It form calcium and magnesium complex with EDTA salt.

24. (a) $\underset{\text{Down the group basic character increases}}{\underrightarrow{LiOH < NaOH < KOH < RbOH}}$

25. (d) $\underset{\text{washing powder}}{Na_2CO_3 . 10H_2O} \xrightarrow{\Delta} Na_2CO_3 . H_2O \xrightarrow{\Delta} Na_2CO_3 + H_2O \uparrow$

26. (b) Na_2CO_3, K_2CO_3 and $(NH_4)_2CO_3$ are soluble in water because hydration energy is more than lattice energy

29. (c) $K_2SO_4.Al_2(SO_4)_3.24H_2O$ potash alum it is a double salt.

31. (d) It is a colourless gas.

32. (a) $\underset{\substack{\text{(Salt of strong}\\ \text{base \& weak}\\ \text{acid)}}}{NaHCO_3} \rightarrow Na^+ + \underset{\downarrow}{HCO_3^-} \rightarrow OH^- + CO_2$

33. (b) $FeSO_4.(NH_4)_2SO_4.6H_2O$ Mohr's salt.

35. (d) $Ca^{+2} > Na^+ > Mg^{+2} > Al^{+3}$

36. (b) $Li^+ + e^- \rightarrow Li\ ,\ E^o = -3.05\ V$

$K^+ + e^- \rightarrow K\ ,\ E^o = -2.93\ V$

$Ca^{+2} + 2e^- \rightarrow Ca\ ,\ E^o = -2.87\ V$

37. (a) Because their valence electrons are present in s- orbitals.

38. (a) $6Li + N_2 \rightarrow 2Li_3N$ Lithium nitride.

39. (d) Li, Na, K are lighter than water but Rb is heavier than water.

42. (c) $KF + HF \rightarrow KHF_2 \rightleftharpoons K^+ + HF_2^-$

43. (b) $Cs > Rb > K > Na > Li$

Metallic character decreasing order.

45. (d) $2Rb + 2H_2O \rightarrow 2RbOH + H_2$

$\underrightarrow{Li < Na < K < Rb < Cs}$

As we go down the group reactivity with H_2O increases.

48. (b) Atomic number $11 \rightarrow Na \rightarrow Na_2O$

$Na_2O + H_2O \rightarrow \underset{\text{(base)}}{2NaOH}$

51. (d) Generally ionic character decreasing from $LiCl$ to $NaCl$.

52. (c) In castner process Na metal is made of anode.

55. (a) Fajan's rule is applied.

57. (a) Small atomic and ionic size leads to high electronegativity and hydration energy. Small atomic and ionic size leads to high electronegativity and hydration energy.

58. (c) Mohr salt is $(FeSO_4)(NH_4)_2SO_4.6H_2O$.

60. (a) Sodium thiosulphate is a reducing agent which convert metalic silver into silver salt.

64. (a) In alkali metal group elements alkali means plant ash.

67. (d) $2Na + 2NH_3 \xrightarrow{\text{heat}} 2NaNH_2 + H_2$

68. (a,b) $2Na + \frac{1}{2}O_2 \xrightarrow{\text{moist air}} Na_2O$

$Na_2O + 2H_2O \longrightarrow 2NaOH + H_2$.

69. (d) $2KClO_3 \rightarrow 2KCl + 3O_2$.

70. (d) Due to free electron liquid ammonia becomes paramagnetic.

72. (a) They possess highest atomic volume in their respective periods.

74. (c) $Fe(OH)_3$ is soluble in sodium hydroxide solution.

76. (d) The cell involves the following reaction,

$NaCl \rightleftharpoons Na^+ + Cl^-$

At anode : $2Cl^- \rightarrow 2Cl + 2e \rightarrow Cl_2$

At cathode : $Na^+ + e \rightarrow Na$

$Na + Hg \rightarrow$ amalgam

At anode : $Na -$ amalgam $\rightarrow Na^+ + Hg + e$

At cathode : $2H_2O + 2e \rightarrow H_2 \uparrow + 2OH^-$

78. (a) *Li* is a more reducing agent compare to other element.

79. (b)

Element –	*Li*	*Na*	*K*	*Rb*	*Cs*
M.pt in *K* –	4535	370.8	336.2	312	301.5

80. (a) $2Na + 2HOH \rightarrow 2NaOH + H_2 \uparrow$

$2K + 2HOH \rightarrow 2KOH + H_2 \uparrow$

82. (a) Alkali metal are good conductor of heat and electricity.

83. (c) Potassium react with halogens (chlorine) to gives violet colour flame.

84. (b) Mobility decreases from top to bottom because of the atomic size is increases.

85. (c) Lithium shows digonal relationships with *Mg*.

86. (c) $K > Ca > C > Cl$

Electropositive character in decreasing order.

87. (d) $\underset{\text{Molten}}{2NaCl} \xrightarrow{\text{Electrolysis}} \underset{\text{Cathode}}{2Na} + \underset{\text{Anode}}{Cl_2}$

88. (b) When sodium bicarbonate $(NaHCO_3)$ is heated, sodium carbonate, CO_2 and water are formed.

$2NaHCO_3 \xrightarrow{\Delta} \underset{\text{Sodium carbonate}}{Na_2CO_3} + CO_2 \uparrow + H_2O$

89. (c) Alum is used for softning of water.

90. (a) Only salts of (weak acid + strong base) and (strong acid + weak base) get hydrolysed (*i.e.,* show alkalinity or acidity in water). $KClO_4$ is a salt of strong acid and strong base therefore it does not get hydrolysed in water.

$KClO_4 \rightleftharpoons K^+ + ClO_4^-$; $H_2O \rightleftharpoons \underset{\text{Strong}}{\underset{\Downarrow}{OH^-}\ KOH} + \underset{\text{Strong}}{\underset{\Downarrow}{H^+}\ HClO_3}$

91. (c) Carbon dioxide does not help in burning, also it forms carbonate with alkali metals.

92. (a) When carbonate are heated they decompose to form the oxide. Sodium carbonate and potassium carbonate do not decompose. The carbonate become more difficult to decompose as we go down the group.

93. (c) Aluminium reacts with caustic soda to form sodium meta aluminate.

$2Al + 2NaOH + 2H_2O \rightarrow \underset{\text{Sodium meta aluminate}}{2NaAlO_2} + 3H_2 \uparrow$

94. (a) Alkaline earth metals (ns^2) are denser than alkali metal (ns^1) because metallic bonding in alkaline earth metal is stronger.

95. (c) Lithium is basic in nature and hence it is not amphoteric.

96. (a) $CsOH$ of the following is most basic in character due to increase electropositive character in a group of alkali.

97. (a) Group 1 element are so highly electropositive that they emit electrons even when exposed to light (Photoelectric effect) and this character increase on moving down the group from lithium towards cesium.

98. (b) Lithium form nitride on heating with nitrogen. Lithium nitride gives ammonia when heated with H_2O. Ammonia gas form tetrammine copper complex with $CuSO_4$ solution.

$6Li + N_2 \rightarrow 2Li_3N$

$Li_3N + 3H_2O \rightarrow 3LiOH + NH_3$

$CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]SO_4$

99. (d) The given compound *x* must be $CaCO_3$. It can be explained by following reactions,

$\underset{(x)}{CaCO_3} \xrightarrow{\Delta} \underset{\text{Residue}}{CaO} + CO_2 \uparrow$; $CaO + H_2O \rightarrow \underset{(y)}{Ca(OH)_2}$

$Ca(OH)_2 + CO_2 + H_2O \rightarrow \underset{z}{Ca(HCO_3)}$

$Ca(HCO_3)_2 \xrightarrow{\Delta} \underset{(x)}{CaCO_3} + CO_2 \uparrow + H_2O$

100. (c) According to Fajan's rule *RbCl* has greatest ionic character due to large ionic size of Rb^+ ion. $BeCl_2$ has least ionic (Maximum covalent) due to small size of Be^{+2} ion which has highly polarising.

105. (c) $2Na + 2NH_3 \rightarrow 2NaNH_2 + H_2$

110. (d) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

112. (c) It reacts with alcohol to form sodium alkoxide

$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$

113. (a) Causticizing process (Gossage process) it is an old process and involves heating of 10% solution of Na_2CO_3 with a little excess of milk of lime $Ca(OH)_2$

$Na_2CO_3 + Ca(OH)_2 \rightarrow CaCO_3 \downarrow + 2NaOH$

114. (c) $NaOH + CO \xrightarrow[5-10\text{ atm}]{150°-200°C} HCOONa$

115. (a) $2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + Cl_2$

119. (b) $NaOH$ is a deliquescent white crystalline solid. It absorbs moisture from the atmosphere.

120. (a) $Na_2CO_3 + H_2O + 2SO_2 \rightarrow 2NaHSO_3 + CO_2$

123. (c) $NaOH + CaO$ is called soda lime 3 : 1

124. (c) Molten sodium is used as a coolant

126. (c) $AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$

128. (b) $Na_2SO_3 + S \xrightarrow{NaOH} \underset{\text{Sod. thiosulphate}}{Na_2S_2O_3}$

129. (a,b) $2NaCl + 2H_2O \rightarrow 2NaOH + \underset{\text{Anode}}{Cl_2} + \underset{\text{Cathode}}{H_2}$

132. (b) $Sn + 2NaOH + H_2O \rightarrow Na_2SnO_3 + 2H_2$

135. (b) $2NaCl + 2H_2O \xrightarrow{\text{Electrolysis}} 2NaOH + \underset{\text{Anode}}{Cl_2} + \underset{\text{Cathode}}{H_2}$

136. (d) $2NaCl \xrightarrow{\text{Electric current}} \underset{\text{Cation}}{2Na^+} + \underset{\text{Anion}}{2Cl^-}$

138. (a) $HgCl_2 + 2NaOH \rightarrow HgO + 2NaCl + H_2O$

139. (a) Down's cell is used for the electrolysis of fused $NaCl$

142. (c) $Fe(OH)_3$ does not dissolve in $NaOH$

143. (a) Castner's process used to obtain Na, by electrolysis of sodium hydroxide.

144. (a) Excess of Na^+ ion causes high B.P.

145. (b) Ferric alum is $(NH_4)_2SO_4.Fe_2(SO_4)_3.24H_2O$

146. (d) When Na is heated in presence of air or oxygen, Na burns to form sodium oxide and sodium peroxide.

148. (d) Pyrolusite or Manganese dioxide (MnO_2) is a mineral of manganese.

149. (c) $CaCl_2$ bring down the melt temperature from 1075 K to 850 K

Alkaline earth metals

2. (d) $CaSO_4.\frac{1}{2}H_2O$ or $(CaSO_4)_2.H_2O$

3. (a) $CaCl_2$ because it is hygroscopic

7. (d) Setting of plaster of paris is exothermic process

$$CaSO_4.\frac{1}{2}H_2O \xrightarrow{H_2O} \underset{\text{Orthorhomb ic}}{CaSO_4.2H_2O} \xrightarrow{\text{Hardening}} \underset{\substack{\text{Mono orthorhomb ic}\\ \text{Gypsum}}}{CaSO_4.2H_2O}$$

The setting is due to formation of another hydrate

10. (a) $MgCO_3 \xrightarrow{\text{Heat}} MgO + CO_2$

The metal whose oxide is stable, it's carbonate is unstable

12. (d) $\underset{\text{(Molten)}}{MgCl_2} \xrightarrow{Electrolysis} \underset{\text{Cation}}{Mg^{+2}} + \underset{\text{Anion}}{2Cl}$

Anode – $2Cl^- \rightarrow 2Cl + 2e^-, Cl + Cl \rightarrow Cl_2$

Cathode – $Mg^{+2} + 2e^- \rightarrow Mg$

13. (a) Because of small atomic size and high I.E. Be forms covalent chloride.

16. (d) $BeSO_4$ is most soluble because hydration energy is more than lattice energy.

$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO$

Hydration energy decreases hence, solubility decreases.

19. (b) $2(\underset{\text{Gypsum}}{CaSO_4.2H_2O}) \xrightarrow[\text{Dehydration}]{120^oC} \underset{\text{Plaster of paris}}{2CaSO_4.H_2O} + 3H_2O$

21. (b) Lithopone $(ZnS + BaSO_4)$ is used as a white pigment.

23. (d) $\underset{\text{Slaked lime}}{Ca(OH)_2} + Cl_2 \rightarrow \underset{\substack{\text{Bleaching}\\ \text{powder}}}{CaOCl_2} + H_2O$

24. (a) Strontium $\rightarrow$ Crimson or pink colour

26. (b,c) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

$K_3P + 3H_2O \rightarrow 3KOH + PH_3$

27. (d) $CaCl_2 \rightarrow \underset{\text{Cathode}}{Ca^{+2}} + \underset{\text{Anode}}{2Cl^-}$

Cathode : $Ca^{+2} + 2e^- \rightarrow Ca$

Anode : $2Cl^- \rightarrow 2e^- + Cl_2$

28. (d)

Element –	Mg	Al	Si	P
Atomic radii (Å)–	1.60	1.43	1.32	1.28

as we move across the period nuclear charge increases, hence, size decreases.

30. (b) $MgCl_2.6H_2 + 5MgO + xH_2O \rightarrow \underset{\substack{\text{Magnesia cement or sorrel cement}}}{MgCl_2.5MgO.xH_2O}$

31. (d) $ZnS + BaSO_4$ is lithopone used as white pigment.

36. (d) Aqueous $CaCl_2$ or hydrated $CaCl_2$ can not act as dehydrating agent.

38. (d) As we go down the group electropositive character increases because I.E. decreases.

Ba is most electropositive element in the group.

39. (d) Due to the inert pair effect.

40. (a)

Element –	Be	Al
Electronegativity –	1.5	1.5

41. (c) $Be > Mg > Ca > Sr > Ba$

On moving down the group lattice energy remains almost constant as the sulphate is so big that small increase in the size of the cations from Be to Ba does not make any difference. However the hydration energy decreases from Be^{+2} to Ba^{+2}. This causes decrease in the solubility of the sulphates as the ionic size increases.

42. (a)

Element –	Be	Mg	Ca	Sr	Ba
Electrode potential –	1.70	– 2.37	– 2.87	– 2.89	–2.90

43. (a)

Element –	Mg	Ca	Sr	Ba
I.E –	737	590	549	503

44. (a) Be due to diagonal relationship

45. (a) K^+ is highly soluble because of high hydration energy.

47. (b) $\underbrace{MgO}_{\text{Basic}}\ \underbrace{Al_2O_3}_{\text{Amphoteric}}\ \underbrace{SiO_2 \quad P_2O_5}_{\text{Acidic}}$

$MgO + H_2O \rightarrow Mg(OH)_2$ Base or alkali

48. (d) Duralium $(Al = 95\%,\ Cu = 4\%,\ Mn = 0.5\%,\ Mg = 0.5\%)$ being light, tough and durable is used for the manufacture of aeroplanes and automobile parts.

49. (c)

Na	K	Ba	Ca	Sr
Yellow	Pale violet	Apple green	Brick red	Crimson

51. (a) Magnesium burns with an intense light. Therefore Mg is used in flash bulbs for photography, fireworks and signal fires.

53. (b) $CaO + CO_2 \rightarrow CaCO_3$

$CaO + H_2O \rightarrow Ca(OH)_2$

54. (a) When water is added to cement an exothermic reaction occurs. During this process, the cement reacts with water to form a gelatinous mass which slowly sets into a hard mass having three dimensional network structure involving $-Si-O-Si-$ and $-Si-O-Al-$ chains.

55. (b) CaO – (quick lime)

$Ca(OH)_2$ – (slaked lime)

$Ca(OH)_2 + H_2O$ – an aqueous suspension of $Ca(OH)_2$ in water is called lime water.

$CaCO_3$ (lime stone).

57. (d) Lime stone – $CaCO_3$

Clay – silica and alumina

Gypsum – $CaSO_4.2H_2O$

59. (b) Because hydration energy decreases down the group.

63. (d) *Be* does not react with water.

64. (a) (i) Small atomic size.

(ii) High electronegativity

(iii) Absence of *d* orbitals

65. (a) $Ba(OH)_2 > Sr(OH)_2 > Ca(OH)_2 > Mg(OH)_2$ (Solubility decreasing order.)

66. (d) Solubility increasing top to bottom.

67. (a) *Be* to *Ba* ionic character increasing.

70. (a) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

$CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$

72. (a) They are denser than alkali metals because they can be packed more tightly to their greater charge and smaller radii.

76. (d) $Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

On moving down the group basic character increases.

77. (b) $Mg(OH)_2$ *Mg* is most electropositive element amongst the given elements.

78. (d) Lime stone = $CaCO_3$

Quick lime = CaO

Slaked lime = $Ca(OH)_2$

79. (c) As we go down the group I.E. decreases. Hence, *Ba* can easily give electrons. Therefore strongest reducing agent.

80. (c) $\underset{\text{Plaster of paris}}{CaSO_4.\frac{1}{2}H_2O} + \frac{1}{2}H_2O \rightarrow \underset{\text{Hard mass}}{CaSO_4.2H_2O}$

82. (a) $BeCl_2 < MgCl_2 < CaCl_2 < BaCl_2$

As we go down the group I.E. decreases. Hence ionic character increases.

83. (c) $MgCl_2.6H_2O \xrightarrow{\text{heat}} MgO + 5H_2O + 2HCl$

84. (a) The solubility of hydroxides of alkaline earth metals in water increases on moving down the group.

85. (c) Bleaching action of Cl_2 in moist condition is permanent.

$Cl_2 + H_2O \rightarrow HCl + HClO$

$HClO \rightarrow HCl + O$

$Cl_2 + H_2O \rightarrow 2HCl + O$

Coloured matter + nascent oxygen $\rightarrow$ colourless matter

86. (d) The solubility of hydroxides of alkaline earth metals in water increases on moving down the group.

87. (c) CO_2 escapes simultaneously.

88. (d) It consist of high lattice energy and lowest hydration energy.

90. (a) It is a *s*-block elements.

91. (b) Barium Ba_{56} is a alkali earth metal.

92. (c) Thermal stability increasing from top to bottom.

94. (b) On moving down the group; Lattice energy decreases with increase in size of cation.

96. (d) $BaSO_4$ is sparingly soluble in water because the solubility of second group sulphates decreases with increasing atomic size. Because of hydration energy decreases.

97. (d) Berylium because of small atomic size and high ionization energy.

99. (a) $\underset{\text{Ionic nature increases}}{Mg < Ca < Sr < Ba < Ra \longrightarrow}$

as we go down the group ionic nature increases because I.E. decreases.

100. (b) $CaSO_4.2H_2O$ – Gypsum

$CaSO_4.\frac{1}{2}H_2O$ – Plaster of paris

101. (b) $Ca + \frac{1}{2}O_2 \rightarrow CaO$.

102. (c) Calcium cyanamide is the slow acting nitrogenous fertilizer as it decompose very slowly.

$CaNCN + 2H_2O \rightarrow CaCO_3 + \underset{\text{Urea}}{NH_2CONH_2}$

$NH_2CONH_2 + H_2O \rightarrow CO_2 + 2NH_3$

$NH_3 \xrightarrow[\text{bacteria}]{\text{Nitrifying}} \text{Soluble nitrates} \rightarrow \text{Plants}$

103. (a) Plaster of paris $[(CaSO_4)_2H_2O]$ is used in surgery for setting of bones, dentistry and manufacturing of statues. It is prepared as follows,

$2CaSO_4.2H_2O \xrightarrow{125°C} \underset{\text{Plaster of paris}}{(CaSO_4)_2.H_2O} + 3H_2O$

104. (b) Due to electropositive and reactive in nature, magnesium is readily converted into positive ions on contact with iron pipes and hence, iron pipes remains as it is.

105. (c) A binary compound is one made of two different elements. These can be one of each element such as *CuCl* or *FeO*. These can also be several of each element such as Fe_2O_3 or $SnBr_4$. Metal which have variable oxidation number can form more than one type of binary compound like *Fe* shows the oxidation state +2 and +3. Hence it forms two type of binary compound *e.g.*, $FeCl_2, FeCl_3$.

106. (a) Diagonal relationship: elements of 2nd period often show resemblance to the element of the IIIrd period diagonaly placed to it. This type of behaviour is called as diagonal relationship *Li* shows the diagonal relationship with *Mg*.

107. (a) $MgCl_2 + 2NaHCO_3 \rightarrow Mg(HCO_3)_2(aq) + 2NaCl$

$Mg(HCO_3)_2(aq) \xrightarrow{\Delta} \underset{\text{(White ppt.)}}{MgCO_3 \downarrow} + H_2O + CO_2 \uparrow$

108. (c) We know that

$MgCl_2.6H_2O \xrightarrow{Heat} MgCl_2 + 6H_2O$

Thus in this reaction magnesium dichloride is produced.

109. (d) Magnesium burns in *CO* to produce

$Mg + CO \rightarrow MgO + C$

110. (d) Sorel's cement is, $MgCl_2.5MgO.xH_2O$

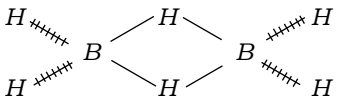
111. (b) Colemnite is a mineral of boron having composition as $Ca_2B_6O_{11}.5H_2O$.

Boron family

3. (a) $B_2O_3 + 3C + 3Cl_2 \rightarrow 2BCl_3 + 3CO$

BCl_3 is obtained by passing chlorine over the heated mixture of B_2O_3 and powdered charcoal.

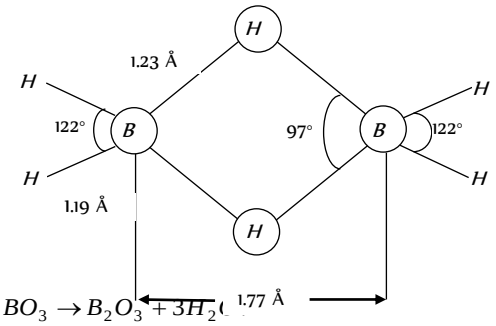
6. (d) B_2H_6 has two types of $B-H$ bonds



B 119 pm *H* (Terminal bond)

B 134 pm *H* (Bridge bond)

12. (b) Dilthey in 1921 proposed a bridge structure for diborane. Four hydrogen atoms, two on the left and two on the right, known as terminal hydrogens and two boron atoms lie in the same plane. Two hydrogen atoms forming bridges, one above and other below, lie in a plane perpendicular to the rest of molecule.



15. (c) $2H_3BO_3 \rightarrow B_2O_3 + 3H_2O$

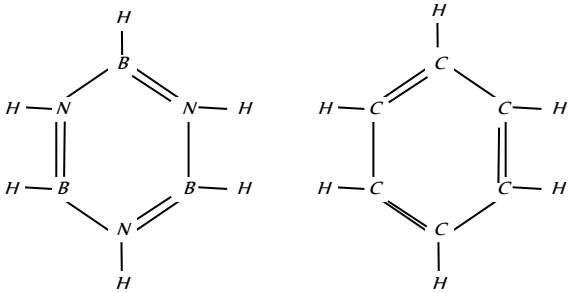
16. (a,c,d) Al_2Cl_6, In_2Cl_6, Ga_2Cl_6

17. (a) Liquified *Ga* expand on solidification *Ga* is less electropositive in nature, It has the weak metallic bond so it expand on solidification.

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

19. (e) B_4C is the hardest substance along with diamond.

20. (a) Borazine $B_3N_3H_6$, is isoelectronic to benzene and hence, is called inorganic benzene some physical properties of benzene and borazine are also similar.



21. (c) Except $B(OH)_3$ all other hydroxide are of metallic hydroxide having the basic nature $B(OH)_3$ are the hydroxide of nonmetal showing the acidic nature.

22. (c) Moissan boron is amorphous boron, obtained by reduction of B_2O_3 with *Na* or *Mg*. It has 95-98% boron and is black in colour.

23. (d) Boron form different hydride of general formula B_nH_{n+4} and B_nH_{n+6} but BH_3 is unknown.

24. (c) Alumina is amphoteric oxide, which reacts acid as well as base.

25. (a) *Al* is the most abundant metal in the earth crust.

29. (a) $AlCl_3.6H_2O \xrightarrow{\Delta} Al(OH)_3 + 3HCl + 3H_2O$

Thus $AlCl_3$ can not be obtained by this method

30. (d) Amphoteric substance can react with both acid and base.

33. (c) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

34. (c) $Al \rightarrow$ III group $\rightarrow$ Forms Al_2O_3

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

37. (c) $Na_2CO_3 + H_2O \rightarrow 2NaOH + CO_2$

$2NaOH + 2Al + 6H_2O \rightarrow 2Na[Al(OH)_4] + 3H_2$

41. (c) $B(OH)_3 \Rightarrow H_3BO_3$ Boric acid

$Al(OH)_3 \Rightarrow$ Amphoteric

45. (b) $FeSO_4.(NH_4)_2SO_4.6H_2O$

46. (b) Al_2O_3 is an amphoteric oxide.

47. (c) Aluminium oxide is highly stable therefore, it is not Reduced by chemical reactions.

48. (d) Aluminium is used as reducing agent in metallurgy.

49. (a) *Al* is used as reducing agent in thermite process.

50. (c) In Goldschmidt aluminothermic process, thermite contains 3 parts of Fe_2O_3 and 1 part of Al.

51. (c) For the purification of red bauxite which contains iron oxide as impurity $\rightarrow$ Baeyer's process. For the purification of white bauxite which contains silica as the main impurity Serpeck's process.

52. (b) In Hall's process

$Al_2O_3.2H_2O + Na_2CO_3 \rightarrow 2NaAlO_2 + CO_2 + 2H_2O$

$2NaAlO_2 + 3H_2O + CO_2 \xrightarrow{333\ K}$

$2Al(OH)_3 \downarrow + Na_2CO_3$

$2Al(OH)_3 \xrightarrow{1473\ K} Al_2O_3 + 3H_2O$

54. (d) Cryolite Na_3AlF_6

(1) Decreases the melting point of alumina

(2) Increases conductivity of the solution

55. (b) Cryolite Na_3AlF_6 is added

(1) To decrease the melting temp from $2323\,K$ to $1140\,K$

(2) To increase the electrical conductivity of solution

61. (d) Iron oxide impurity – Baeyer's process

Silica impurity – Serpeck's process

64. (b) Cryolite is added to lower the melting point of alumina and to increase the electrical conductivity.

65. (c) The purification of alumina can be done by Baeyer's process.

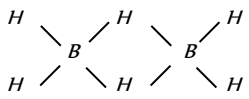
67. (c) In electrolytic method of obtaining aluminium from purified bauxite, cryolite is added to charge because it reduces the melting point of Bauxite (from 1200^oC to $800^o - 900^oC$) and also it increases electrical conductivity of mixture.

68. (a) Hoop's process $\Rightarrow$ Purification of *Al*

Hall and Heroult process $\Rightarrow$ Reduction of Al_2O_3

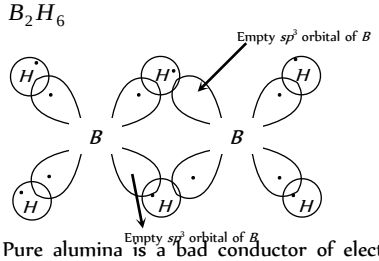
Baeyer's and Serpeck's process $\Rightarrow$ Concentration of Bauxite ore

74. (a)



$3c-2e : B-H-B$; $2c-2e : H-B-H$

75. (a) B_2H_6



76. (b) Pure alumina is a bad conductor of electricity and the fusion temperature of pure alumina is about 2000°C and at this temperature when the electrolysis is carried of fused mass the metal formed vapoureses as the boiling point of *Al* is 1800°*C*. To overcome this difficulty, Na_3AlF_6 and CaF_2 are mixed with alumina.

77. (a) Concentration of Lewis acid of boron tri halides is increased in following order. $BF_3 < BCl_3 < BBr_3 < BI_3$.

Carbon family

3. (d) It react with alkali as well as acid.

6. (a) Among alkali metal carbonates only Li_2CO_3 decomposes.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2 \uparrow$$

7. (b) Propyne can be prepared by the hydrolysis of magnesium carbide.

$$Mg_2C_3 + 4H_2O \rightarrow CH_3C \equiv CH + 2Mg(OH)_2$$

10. (d) Generally red lead decompose into *PbO* and O_2.

11. (c) CO_2 is acidic oxide and thus more effectively absorbed by an alkali.

12. (b) CaC_2 have one sigma and two π bond.

13. (d) *C* and *Si* are non-metal and *Pb* is a metal.

16. (a) $SiO_2 + 2Mg \rightarrow Si + 2MgO$.

17. (b) Generally IV group element shows catenation tendency and carbon has more catenation power.

18. (b) Metal oxides or some salts are fused with glass to imported colour of glass.

19. (d) $Al_2(CO_3)_3$ is less soluble in water than Na_2CO_3, $ZnCO_3$.

20. (d) The inert pair effect is most prominent in *Pb* because from top to bottom due to increase in number of shells.

25. (c) $Co + NaOH \xrightarrow{200\,^\circ C} \underset{\text{Sod. formate}}{HCOONa}$

27. (c) Sodium oxalate react with conc. H_2SO_4 to form *CO* and CO_2 gas.

33. (d) It is hydrolysed with water to form a $Si(OH)_4$.

35. (b) When hydrogen peroxide react with *PbS* then they form $PbSO_4$.

36. (b) Grey tin is very brittle and easily crumbles down to a powder in very cold climates.

$$\underset{\text{(Cubic)}}{\text{Grey tin}} \rightleftharpoons \underset{\text{(Tetragonal)}}{\text{Whitetin}}$$

The change of white tin to grey tin is accompanied by increase in volume. This is called tin disease or tin plague.

37. (c) Solid CO_2 is knows as dry ice because it evaporates at $-78^\circ C$ without changing in the liquid state.

38. (b) Zeolite have SiO_4 and AlO_4 tetrahedrons linked together in a three dimensional open structure in which four or six membered ring predominate. Due to open chain structure they have cavities and can take up water and other small molecules.

39. (b) Crook's glass is a special type of glass containing cerium oxide. It does not allow the passage of ultra violet ray and is used for making lenses.

40. (b) Inert pair effect become significant for the 6th and 7th period of *p*-block element.

41. (a) Carbon suboxide has linear structure with $C-C$ bond length equal to $130\ \text{Å}$ and $C-O$ bond length equal to $120\ \text{Å}$.

$$O=C=C=C=O \leftrightarrow O^- - C \equiv C - C \equiv O^+$$

42. (c) Pb_3O_4 is a mixed oxide. It can be represented as $2PbO - PbO_2$.

43. (b) Noble gases are found in very minute amount in atmosphere. These are separated from each other by using coconut charcoal. Which adsorb different gas at different temperature.

44. (c) Lapis Lazuli is a rock composed mainly of the following mineral, lazurite, hauynite sodalite, nosean, calcite, pyrite, lapis lazuli is actually sulphur containing, sodium aluminium silicate having chemical composition $3Na_2O.3Al_2.6SiO_2.2Na_2S$.

45. (d) In carbon family stability +2 oxidation state increases on moving down the group in the periodic table with an increase in atomic number due to screening effect.

46. (c) Tin is oxidised to meta stannic acid when it is treated with nitric acid.

$$Sn + 4HNO_3 \rightarrow H_2SnO_3 + 4NO_2 + H_2O$$

47. (c) $Pb + Sn$

49. (d) Three dimensional sheet structures are formed when three oxygen atoms of each $[SiO]^{-}$ tetrahedral are shared.

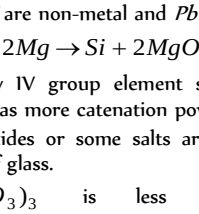
50. (a) $Pb_3O_4 \Rightarrow$ Red lead (Sindhur)

51. (c) White lead $\Rightarrow 2PbCO_3.Pb(OH)_2$

52. (c) Organic acids dissolve lead in presence of oxygen

$$Pb + 2CH_3COOH + \frac{1}{2}O_2 \rightarrow Pb(CH_3COO)_2 + H_2O$$

53. (a)



55. (a) S^2P^2 Total 4 valence electrons $\Rightarrow$ IV group

56. (c) $PbCl_2$ is most ionic because on going down the group the metallic character increases and also the inert pair effect predominates.

58. (b) Type metal *Pb* = 82%, *Sb* = 15%, *Sn* = 3%

60. (b) Sugar of lead $(CH_3COO)_2Pb \Rightarrow$ lead acetate

63. (d) *Pb* $\Rightarrow$ 11.34 *g/ml* Heaviest

64. (c) Pb_3O_4 is a mixed oxide of $2PbO + PbO_2$

67. (c) Boron (*B*), *Si*, *Ge*, *As*, *Sb*, and *At* are the metalloid elements. Bismuth (*Bi*) and tin (*Sn*) are metals while carbon (*C*) is non-metal.

68. (a) $Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$

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

$$Na_2SiO_3 + 3H_2F_2 \rightarrow Na_2SiF_4 + 3H_2O$$

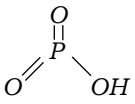
$$CaSiO_3 + 3H_2F_2 \rightarrow CaSiF_4 + 3H_2O$$

The etching of glass is based on these reactions.

Nitrogen family

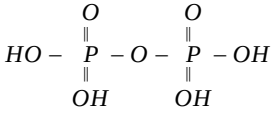
3. (b) $FeSO_4 + NO \rightarrow \underset{\text{(Brown)}}{FeSO_4.NO}$

4. (b) HPO_3 , metaphosphoric acid



6. (a) White phosphorus is soluble in CS_2 whereas red phosphorus is insoluble in it.

7. (d) $H_4P_2O_7$ pyrophosphoric acid

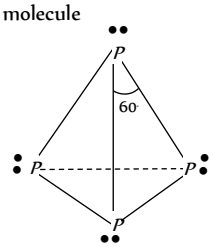


Tetrabasic ($4-OH$ groups)

8. (b) $\underset{\text{(White)}}{P_4} + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{Sod. hypophosph ite}}{3NaH_2PO_2}$

9. (a) NCl_5 is not known because of absence of *d*-orbitals in nitrogen.

11. (a,d) P_4 molecule



Bond angle $= 60^o$

Six *P*–*P* = Single bonds

Lone pairs = 4

12. (b) $\underset{(S)}{NH_4NO_3} \xrightarrow{\Delta} 2H_2O\uparrow + \underset{\substack{\text{Nitrous oxide}\\ \text{(Laughing gas)}}}{N_2O}\uparrow$

13. (a) Birkeland – Eyde process

Dinitrogen is prepared commercially from air by liquification and fractional distillation. When liquid air is allowed to distil, dinitrogen having lower b.pt (77*K*) distils over first leaving behind liquid oxygen (bpt 90*K*). World wide production of dinitrogen from liquid air is more than 50 million tonns per year.

14. (b) $\underset{(s)}{NH_4NO_3} \xrightarrow{\Delta} 2H_2O\uparrow + N_2O\uparrow$

$\underset{(s)}{NaNO_3} \xrightarrow{\Delta} \underset{(s)}{NaNO_2} + O_2\uparrow$

$2AgNO_3(s) \rightarrow 2Ag(s) + 2NO_2(g) + O_2(g)$

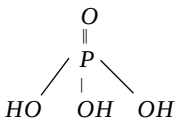
Lunar caustic

$2Pb(NO_3)_2 \rightarrow \underset{(s)}{2PbO} + 4NO_2\uparrow + O_2\uparrow$

16. (b) $\underset{\text{White}}{P_4} + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + 3NaH_2PO_2$

17. (d) $\underbrace{N \quad P}_{\text{Non-metals}} \quad \underbrace{As \quad Sb}_{\text{Metalloids}} \quad \underbrace{Bi}_{\text{Metal}}$

18. (b)



3 - *OH* groups are present hence it is tribasic.

19. (c) Nitrous acid behaves as reducing as well as an oxidising agent. It reduces potassium permanganate, potassium dichromate, H_2O_2 and other strong oxidising agents. It oxidises strong reducing agents such as hydroiodic acid, sulphurous acid etc.

It oxidises Fe^{+2} into Fe^{+3} in acidic medium;

$Fe^{+2} + HNO_2 + H^+ \rightarrow Fe^{+3} + NO + H_2O$

It reduces acidified $KMnO_4$.

$2KMnO_4 + 3H_2SO_4 + 5HNO_2 \rightarrow$

$K_2SO_4 + 2MnSO_4 + 3H_2O + 5HNO_3$

20. (a) $\underset{(S)}{2KNO_3} \xrightarrow{\Delta} \underset{(S)}{2KNO_2} + O_2$

23. (b) $NH_4Cl + KNO_2 \rightarrow \underset{\downarrow}{NH_4NO_2} + KCl$

$N_2 + 2H_2O$

24. (d) $\underset{\text{Nitric acid}}{2HNO_3} \rightarrow N_2O_5 + H_2O$

25. (c) $2Ca_3(PO_4)_2 + 6SiO_2 \xrightarrow{1770K} 6CaSiO_3 + P_4O_{10}$

$P_4O_{10} + 10C \xrightarrow{1770K} \underset{\text{White}}{P_4} + 10CO$

26. (c) $P_4 + 5O_2 \rightarrow 2P_2O_5$

$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$

27. (c) $H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$

$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$

$HPO_4^{2-} \rightleftharpoons H^+ + PO_4^{3-}$

28. (c) (i) $\underset{\substack{\text{Nitric oxide}\\ \text{Colourless gas}}}{NO}$ (ii) $\underset{\substack{\text{Nitrous oxide}\\ \text{Colourless gas}}}{N_2O}$ (iii) $\underset{\substack{\text{Dinitrogen}\\ \text{trioxide Blue}\\ \text{liquid}}}{N_2O_3}$

(iv) $\underset{\substack{\text{Dinitrogen}\\ \text{tetraoxide}\\ \text{colourless liquid}}}{N_2O_4}$ (v) $\underset{\substack{\text{Dinitrogen}\\ \text{pentaoxide}\\ \text{colourless gas}}}{N_2O_5}$

30. (c) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} Cr_2O_3 + N_2 + 4H_2O$

31. (d) $4HNO_3 \rightarrow 4NO_2 + O_2 + 2H_2O$

32. (c) Because of its very low ignition temperature (303*K*) it is always kept under water.

33. (d) NH_3 when dissolved in water forms

$NH_3 + H_2O \rightarrow NH_4^+ + OH^- \rightleftharpoons NH_4OH$

34. (a,b) Stability of + 3 oxidation states increases on account of inert pair effect.

Reducing character of hydrides increases down the group because bond dissociation energy decreases down the group.

35. (a) Haber's process →Industrial process

$N_2 + 3H_2 \underset{\substack{650-800\,K\\ 200-350\,atm}}{\overset{Fe-Mo}{\rightleftharpoons}} 2NH_3$

36. (a) $P_4 + 5O_2 \rightarrow P_4O_{10}$; white phosphorus gets easily oxidized because it is highly reactive.

38. (d) N_2O is itself non-combustible but supports combustion.

$S + 2N_2O \rightarrow SO_2 + 2N_2$

39. (b) When N_2O is inhaled in moderate quantities, it produces hysterical laughter, hence the name laughing gas.

40. (c) $2NO_2 + H_2O \rightleftharpoons HNO_2 + HNO_3$

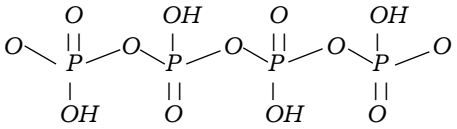
When dissolved in water, gives a mixture of nitrous acid and nitric acid.

$N_2O_4 + H_2O \rightarrow HNO_2 + HNO_3$

$HNO_3 + HNO_2 + 2NaOH \rightarrow NaNO_2 + NaNO_3 + 2H_2O$

41. (b) $\underset{\text{hot \& dil.}}{4Zn + 10HNO_3} \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$

42. (a) $(HPO_3)_n$ Polymetaphosphoric acid



43. (b) Superphosphate of lime – It is a mixture of calcium dihydrogen phosphate and gypsum and is obtained by treating phosphatic rock will conc. H_2SO_4

$$Ca_3(PO_4)_2 + 2H_2SO_4 + 5H_2O \rightarrow$$
$$\underset{\text{Superphosp hate of lime}}{Ca(H_2PO_4)_2.2H_2O} + 2CaSO_4.2H_2O$$

44. (d) $3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$

46. (d) $4NH_3 + 5O_2 \xrightarrow[1100\ K]{Pt} 4NO + 6H_2O$

NO is used in the preparation of HNO_3

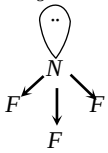
$2NO + O_2 \rightarrow 2NO_2$; $4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$

47. (d) $P_4 + 20HNO_3 \rightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$

49. (b) $\underbrace{P_2O_3 \quad A_2O_3 \quad B_2O_3}_{\text{Acidic oxides}} \quad \underbrace{Bi_2O_3}_{\text{Alkaline}}$

50. (b) $P_2O_3 + 3H_2O \rightarrow 2H_3PO_3$

51. (a) NF_3



It is least basic because of the high electronegativity of $3F$ atoms. The lone pair present on nitrogen atom is not easily available for donation.

52. (d) $3H_2O + PCl_3 \rightarrow H_3PO_3 + 3HCl$

53. (c) Due to less reactivity of red phosphorus

54. (d) NO_2 brown coloured gas.

55. (d) N_2O_5 is an anhydride of HNO_3

$2HNO_3 \rightarrow N_2O_5 + H_2O$

Therefore, it can act only as oxidising agent.

56. (c) $\underset{\text{(Oxidation number)}}{NH_4NO_2} \rightleftharpoons \overset{*}{NH_4^+} + \overset{*}{NO_2^-}$

$x + 4 = +1 \quad x - 4 = -1$

$x = 1 - 4 = -3 \quad x = +3$

57. (b) $\overset{*}{P_4}\ O_8$

$4x + (-2 \times 8) = 0$

$4x - 16 = 0$

$x = \dfrac{16}{4} = +4$

58. (c) $\overset{*}{N}H_2OH$

$x + 2 + (-2) + 1 = 0$

$x + 2 - 2 + 1 = 0$

$x = -1$

60. (c) $NH_3 > PH_3 > AsH_3 > SbH_3$

On moving down the group atomic size increases and availability of lone pair decreases. Hence, basic character decreases.

61. (a) $PH_3 > AsH_3 > SbH_3 > BiH_3$

On moving down the group bond energy decreases. Hence, stability decreases.

62. (d) Due to absence of d-orbitals in N atom, it cannot accept electrons from H_2O for hydrolysis of NF_3.

63. (b) NH_3 is most thermally stable hydride. Hence, electrolysis temperature is maximum.

64. (a) Phosphorus is kept in water due to it burt at 30^oC.

66. (c) $BiCl_3 + H_2O \rightarrow BiOCl + 2HCl$

67. (c) When the black ppt. of Bi_2S_3 is dissolved in 50% HNO_3 and a solution of NH_4OH is added. A white ppt. of $Bi(OH)_3$ is obtained.

69. (a) Atmospheric nitrogen is inert and unreactive because of very high bond energy $(945\ kJ/mole)$.

70. (b) Bismuth does not show allotropy other elements show allotropy.

Nitrogen $\rightarrow$ α-nitrogen and β-nitrogen (solid crystalline forms)

Phosphorus $\rightarrow$ White, Red and Black forms

Arsenic $\rightarrow$ Yellow and Grey forms

Antimony $\rightarrow$ Yellow and Grey forms

71. (a) Nitrogen does not form complexes because of the absence of d-orbitals.

72. (a) NH_3 is a strongest base because Lone pair is easily available for donation.

74. (b)

Hydride	NH_3	PH_3	AsH_3	SbH_3	BiH_3
Boling point	238.5	185.5	210.6	254.6	290

75. (a) NCl_3 is highly reactive and unstable. Hence it is explosive.

76. (b) $\underbrace{N_2O_3 \quad P_2O_3 \quad As_2O_3}_{\text{Acidic Oxides}} \quad \underbrace{Sb_2O_3}_{\text{Amphoteric}} \quad \underbrace{Bi_2O_3}_{\text{Basic}}$

Acidic character decreases down the group

77. (c) $SbCl_2$ is not exists because

Vth group elements normally show +3 and +5 oxidation state.

78. (b) $\underset{(aq)}{NH_4Cl} + \underset{(aq)}{NaNO_2} \rightarrow NH_4NO_2 + NaCl$

$NH_4NO_2 \xrightarrow{\text{heat}} \underset{(g)}{N_2} + \underset{(l)}{2H_2O}$

79. (c) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

80. (d) $6Li + N_2 \rightarrow 2Li_3N$ Lithium nitride

$3Mg + N_2 \rightarrow Mg_3N_2$ Magnesium nitride

81. (d) $N \equiv N$ bond energy is very high $945\ kJ\ mol^{-1}$.

83. (d) $N_7 \rightarrow 1s^2, 2s^2, 2p^3$

d-orbitals are absent in nitrogen.

85. (d) $NH_4NO_3 \xrightarrow{\text{heat}} \underset{\text{(Laughing gas)}}{N_2O} + 2H_2O$

86. (d) $NH_2OH + HNO_2 \rightarrow H_2\overset{+1}{N}_2O_2 + H_2O$

87. (c) N_2O is a linear molecule

88. (b) $2HNO_2 \rightarrow H_2O + N_2O_3$

89. (d) $2HNO_3 \rightarrow H_2O + N_2O_5$

90. (c) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

91. (a) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

92. (b) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$

93. (d) In upper atmosphere NO is formed by lightning flash.

$N_2 + O_2 \rightleftharpoons 2NO$

96. (c) $2NO + O_2 \rightarrow 2NO_2$

98. (b) $2AgNO_3 \rightarrow \underset{\downarrow}{2AgNO_2} + O_2$
$2Ag + 2NO_2$

100. (d) $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

101. (d) $C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } HNO_3} \underset{\text{Oxalic acid}}{\overset{COOH}{\underset{COOH}{|}}} + H_2O$

102. (b) $4NH_3 + 5O_2 \xrightarrow[800^oC]{Pt} 4NO + 6H_2O$

103. (d) HNO_2 can be either reduced to nitric oxide (NO) or oxidised to nitric acid and hence it acts both as an oxidising as well as a reducing agent.
$2HNO_2 \rightarrow 2NO + H_2O + [O]$
$HNO_2 + [O] \rightarrow HNO_3$

106. (d) NH_3 is highly volatile compound. When vapourized, liquid ammonia causes intense cooling. Hence used as a coolant in ice factories and cold storages.

107. (d) $\underset{\text{Hydrazoic acid}}{N_3H} \rightleftharpoons N_3^- + H^+$

108. (a) *d*-orbitals are absent in nitrogen.

109. (d)

	Phosphide ion (P^{3-})	Chloride ion (Cl^-)
Total electrons	18	18

P^{3-} and Cl^- are isoelectronic.

110. (a) Due to the less reactivity.

116. (a) $P_4 + 3H_2O + 3NaOH \rightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{Sod. hypophosph ite}}{3NaH_2PO_2}$

117. (c) Both oxidation and reduction (Disproportionation)

Reduction (0 → −3); Oxidation (0 → +1)

$P_4 + 3H_2O + 3NaOH \rightarrow \overset{-3}{PH_3} + 3NaH_2\overset{+1}{P}O_2$

118. (b) $\underset{\text{Red}}{P_4} + NaOH \rightarrow$ No reaction

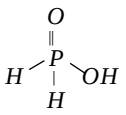
120. (c) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

122. (b) PH_3 is less basic because lone pair is not easily available for donation.

123. (d) $P_2O_3 + 3H_2O \rightarrow 2H_3PO_3$

124. (d) $P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$ orthophosphoric acid.

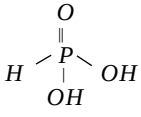
125. (c) H_3PO_2 Monobasic acid



Only one $-OH$ group

126. (b) $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

127. (b) H_3PO_3



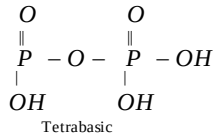
128. (c) $H_3\overset{*}{P}O_2$
$3 + x + (-2 \times 2) = 0$
$x = +1$

129. (d) $Na_4P_2O_7$ Salt of strong acid and strong base.

130. (b) $P_4 + 6H_2SO_4 \rightarrow 4H_3PO_4 + 6SO_2$

131. (c) $CaCN_2 + 3H_2O \rightarrow CaCO_3 + 2NH_3$

132. (b) $H_4P_2O_7$



Tetrabasic

$4 - OH$ group are present.

134. (b) $BiCl_3 + H_2O \rightarrow BiOCl + 2HCl$

135. (b) $CaC_2 + N_2 \xrightarrow[6-8\text{ atm}]{500-600^oC} CaCN_2 + C$

136. (a) $CaCN_2 + 3H_2O \rightarrow CaCO_3 + 2NH_3$

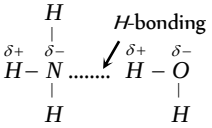
137. (a) NH_2CONH_2

$$\%\text{ of } N = \frac{\text{Mass of } N}{\text{Mass of compound}} \times 100 = \frac{28}{60} \times 100 = 46\%.$$

141. (a) Anhydride of nitrous acid is N_2O_3.

144. (b) $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + NaH_2PO_4$

145. (a) NH_3 is highly soluble due to *H*-bonding.



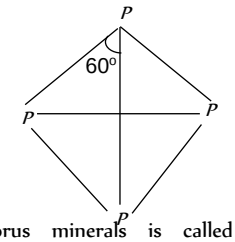
146. (d)

	NH_3	PH_3	AsH_3	SbH_3
B.pt in (K)	238.5	185.5	210.6	254.6

149. (a) $\overset{*}{H_3}PO_2$
$3 + x - 4 = 0$
$x = +1$

151. (d) Solid PCl_5 exists as PCl_4^+ and PCl_6^-.

153. (a)



154. (e) Phosphorus minerals is called as hydroxy apatite and fluorapatite.

156. (a) Nitrogen does not have *d*-orbitals.

157. (c) $3CuO + 2NH_3 \rightarrow 3Cu + N_2 + 3H_2O$.

159. (b) Liquid ammonia is used in refrigeration because it has high heat of vaporisation.

160. (a) $Sn + \text{conc. } 4NHO_3 \rightarrow \underset{\text{Meta stannic acid}}{H_2SnO_3} + 4NO_2 + H_2O$

161. (c) $3Cu + 8NHO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + \underset{\text{Nitric oxide}}{2NO}$

163. (c) Pentavalency in phosphorus is more stable that of nitrogen due to large size of phosphorus atom.

164. (b) Ammomium nitrate is neutral fertilizer.

165. (d) PH_3 insoluble in water because does not consist of hydrogen bond.

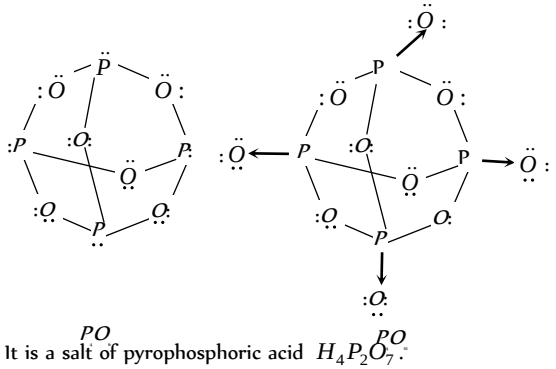
166. (a) $NH_4Cl + NaNO_2 \xrightarrow{\Delta} NH_4NO_2$

$NH_4NO_2 \longrightarrow N_2 + 2H_2O$

167. (a) Nitrogen react with metal to form a nitride.

$6Li + N_2 \xrightarrow{450^oC} 2Li_3N$ (Lithium nitride)

168. (a)



169. (b) It is a salt of pyrophosphoric acid $H_4P_2O_7$.

172. (d) Copper react with conc. nitric acid to form a nitric oxide.

173. (a) N_2O on account of stimulating effect on nervous system.

174. (d) Sodium metal in liq. NH_3 solution shows strong reducing power due to solvated electron.

$$Na + (x+y)NH_3 \rightleftharpoons \underset{\text{solvated electron}}{[Na(NH_3)_x]^+ + [e(NH_3)_y]^-}$$

175. (c) $PH_3 + 4Cl_2 \rightarrow PCl_5 + 3HCl$

178. (c) Generally P_2O_5 are used as a dehydrating agent.

180. (a) Phosphorus show + 5 valency.

181. (b) In the Haber process for the manufacture of NH_3, *Fe* is used catalyst and *Mo* as a promotre.

182. (a) On adding excess of ammonium hydroxide to a copper chloride solution a deep blue solution of $[Cu(NH_3)_4]^{2+}$ ion is formed.

183. (d) $(NH_4)_2SO_4 + KCNO \rightarrow$

$$NH_4CNO + K_2SO_4 \rightarrow \underset{\text{Urea}}{NH_2 - CO - NH_2}$$

185. (a) Nitric acid turns the skin yellow because it reacts with protein giving a yellow compound called xanthoprotein.

186. (d) Ammonium sulphate is a nitrogenous fertilizers.

187. (d) Ammonia generally prepared by the Haber's process.

192. (a) H_3PO_2 is hypophosphorus acid

193. (c) $(NH_4)_2SO_4$ is a salt of weak base & strong acid

$$(NH_4)_2SO_4 + 2H_2O \rightarrow \underset{\text{Weak base}}{2NH_4OH} + \underset{\text{Strong acid}}{H_2SO_4}$$

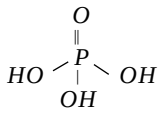
194. (a) One part of concentrated HNO_3 and 3 parts concentrated HCl form aquaregia.

196. (c) –3 to +5 $PH_3(-3)$ and $H_3PO_4(+5)$

199. (b) $BiCl_5$ does not exist because +3 oxidation state of Bi s more stable than +5 due to inert pair effect.

200. (c) $H_3PO_3 \rightarrow$ Tribasic acid$\rightarrow$ $3-OH$ groups are present

$H_3PO_4 \rightarrow 3H^+ + PO_4^{3-}$



201. (d) $Na_2HPO_4 \rightarrow Na_2PO_4^- + H^+$

It can give H^+ ion in solution.

202. (c) $\overset{\bullet\bullet}{NH_3}$ and $\overset{\cdot\cdot}{PH_3}$ both are basic because of the presence of lone pair of electrons.

203. (b) $\xrightarrow{NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3}$

Stability decreases down the group because bond energy decreases down the group.

204. (a) Nitrogen forms NH_3 which is most basic.

205. (b) H_3PO_3 is a diabasic acid. It forms two types of salts NaH_2PO_3 and Na_2HPO_3.

206. (a) $NH_2 - CO - NH_2 + 2HNO_2 \rightarrow CO_2 + 3H_2O + 2N_2$

207. (c)

	I	II	III	IV	V
Element –	*N*	*P*	*As*	*Sb*	*Bi*
Atomic no.	7	15	33	51	83

210. (c) $HO-\underset{\underset{OH}{|}}{\overset{\overset{O}{\|}}{P}}-OH$ it is ionizes in three steps because three – *OH* group are present.

212. (c) $Ca_3P_2 + 3H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

213. (d) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$

214. (b) $B > P > As > Bi$

As we go down the group bond angle decreases because repulsion between bonded pairs of electron decreases.

215. (b,c) $3NH_3 + OCl^- \rightarrow NH_2 - NH_2 + NH_4Cl + OH^-$

217. (a) Acidic character of oxides decreases down the group.

218. (d) $N_7 - 1s^2, 2s^2, 2p^3$

d-orbitals absent in second sub-shell.

220. (c) N_2 can form NCl_3, N_2O_5 and Ca_3N_2 but does not form NCl_5.

221. (a) Highest oxidation state is +5 which remains unchanged.

222. (a) Hypophosphorus acid (H_3PO_2) is a monobasic acid which act as reducing agent. In this molecule two $P-H$ bonds are responsible for its reducing character and one $O-H$ bond is responsible for its monobasic acid character.

223. (a) Bone black is the polymorphic form of phosphorus.

224. (b) Nitrous oxide is known as Laughing gas.

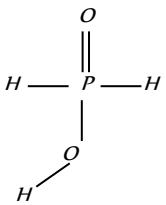
225. (a) We know that,

$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

So nitric oxide (NO_2) is produced.

226. (d) Phosphorus exist as solid at $27^\circ C$ and 1 atmospheric pressure (m.p. of white phosphorus = $44^\circ C$)

227. (b) We know that, $4HNO_3 + P_4O_{10} \rightarrow 4HPO_3 + 2N_2O_5$ The product is dinitrogen pentaoxide (N_2O_5).



228. (b) Hypophosphorous acid is H_3PO_2.

229. (b) $NO(g) + NO_2(g) \xrightarrow{-30^\circ C} \underset{\text{(Blue)}}{N_2O_3(l)}$

230. (c) The ignition temperature of black phosphorus is highest among all allottropes.

231. (a) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 \uparrow + Cr_2O_3 + 4H_2O$

$NH_4NO_2 \xrightarrow{\Delta} N_2 \uparrow + 2H_2O$

232. (a) Nitrogen shows $+I$ to $+V$, all oxidation states.

233. (c) Boiling points of $SbH_3(254\ K)$, $NH_3(238\ K)$, $AsH_3(211\ K)$ and $PH_3\ (185\ K)$ therefore boiling points are of the order $SbH_3 > NH_3 > AsH_3 > PH_3$.

234. (a) Because phosphorous is most electronegative element out of *P, Bi, Sb* and *C.*

235. (d) $Ca_3(PO_4)_2 + 3SiO_2 \rightarrow 3CaSiO_3 + P_2O_5$

236. (a) When a solid compound on heating change into gaseous state without changing into liquid state, the phenomenon is known as sublimation. *e.g.,* I_2, NH_4Cl and camphor.

237. (b) 16 bond by its structure.

238. (d) Phosphorus is a non-metallic element. It form's acidic oxide.

239. (b) $\underset{\text{Mixed acid anhydride}}{2\overset{+4}{N}O_2 + H_2O} \rightarrow HNO_2 + \overset{+5}{H}NO_3$

240. (c) Oxidation number of As in $H_2AsO_4^-$

$2 + x - 8 = -1$

$x - 6 = -1$

$x = 5$

241. (a) The inorganic nitrogen exists in the form of ammonia, which may be lost as gas to the atmosphere, may be acted upon by nitrifying bacteria, or may be taken up directly by plants.

Oxygen family

2. (c) Sulphur –

(1) Monoclinic (2) Rhombic (3) Plastic

4. (c) $S + O_2 \rightarrow SO_2$

5. (a) $\frac{1}{8}S_8 + 2e^- \rightarrow S^{2-}$

6. (c) $2H_2O + 2F_2 \rightarrow 4HF + O_2$

9. (b) O_8 – $1s^2$ $2s^2$ $2p^4$

2 unpaired electrons

11. (a) Element – *O S Sc Te Po*

Electronegativity – 3.5 2.5 2.4 2.1 2.0

13. (b,c) $\underset{(S)}{Na_2SO_3} + \underset{(aq)}{H_2SO_4} \rightarrow \underset{(aq)}{Na_2SO_4} + \underset{(l)}{H_2O} + \underset{(g)}{SO_2}$

15. (d) H_2O H_2S H_2Se H_2Te

104.5^o 92.1^o 91^o 90^o

As we go down the group electronegativity decreases due to which repulsion between bonded pairs of electron also decreases. Hence, bond angle decreases.

20. (a) Paramagnetism because of two unpaired electrons in the antibonding molecular orbitals.

21. (a) $2Na_2SO_3 + O_2 \rightarrow 2Na_2SO_4$

24. (c) $3O_2 \underset{\text{electric discharge}}{\overset{\text{silent}}{\rightleftharpoons}} 2O_3$

28. (b) $O_3 \rightarrow O_2 + [O]$

$2KI + H_2O + [O] \rightarrow 2KOH + I_2$

$2KI + H_2O + O_3 \rightarrow 2KOH + I_2 + O_2$

32. (d) $2KMnO_4 + 3H_2SO_4 + 5H_2S \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$

33. (a) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$

35. (a) The minimum and maximum oxidation number of *S* are –2 and +6 respectively. Since the oxidation number of *S* in SO_2 is +4, therefore it can be either increased or decreased. Therefore SO_2 behaves both as an oxidising as well as reducing agent.

36. (a) $\underset{\text{reducing agent}}{2H_2S} + \underset{\text{oxidising agent}}{SO_2} \rightarrow 2H_2O + 3S$

37. (d) $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow K_2SO_4 + \underset{\text{Green}}{Cr_2(SO_4)_3} + 3H_2O$

39. (a) $SO_2 + 2Mg \rightarrow 2MgO + S$

40. (a) $2H_2O + SO_2 \rightarrow H_2SO_4 + 2[H]$ (nascent hydrogen)

Coloured flower $+ 2[H] \rightarrow$ Colourless flower

41. (c) $H_2SO_3 + 2NaOH \rightarrow \underset{\text{Sodium sulphite}}{Na_2SO_3} + 2H_2O$

42. (a) $H_2O + SO_3 \rightarrow H_2SO_4$

43. (d) $H_2SO_4 + SO_3 \rightarrow \underset{\text{(oleum)}}{H_2S_2O_7}$

45. (b) $\underset{\text{Reducing agent}}{2Ag} + \underset{\text{Oxidising agent}}{2H_2SO_4} \rightarrow Ag_2SO_4 + 2H_2O + SO_2$

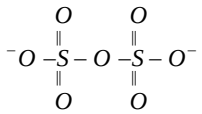
46. (a) Only dehydrating agent

$HCOOH \xrightarrow{H_2SO_4} CO + H_2O$

48. (b) $\begin{matrix} COOH \\ | \\ COOH \end{matrix} \xrightarrow{\text{conc. } H_2SO_4} H_2O + CO + CO_2$

51. (d) $H_2SO_4 + SO_3 \rightarrow \underset{\text{(Oleum or Fuming } H_2SO_4)}{H_2S_2O_7}$

53. (d) $S_2O_7^{2-}$



55. (d) $Na_2SO_3 + S \rightarrow Na_2S_2O_3$

56. (b) $Na_2S_2O_3 + Cl_2 + H_2O \rightarrow Na_2SO_4 + 2HCl + S$

58. (c) $AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$

60. (a) $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$

63. (a) $2H_2S + O_2 \rightarrow 2H_2O + 2S$

64. (a) Mixture of $K_2Cr_2O_7$ and conc. H_2SO_4 is known as chromic acid.

65. (c) H_2O contain hydrogen bond while no hydrogen bonding is present in H_2S.

67. (a) H_2O containing hydrogen bond.

69. (c) $HO-SO_2-OH+PCl_5 \rightarrow Cl-SO_2-OH+POCl_3 + HCl$

$HO-SO_2-OH+2PCl_5 \rightarrow \underset{\text{Sulphuryl chloride}}{Cl-SO_2-Cl}+2POCl_3+2HCl$

70. (d) Mixture of O_2 and CO_2.

71. (c) The bond between (H_2Te) is weakest hence it gives H^+ ion easily.

73. (c) KO_2 because in O_2^- (superoxide ion)

One unpaired electron is present in the antibonding orbital.

75. (b) Oxidation states are 2, 4, 6

77. (b) $H_2O \quad H_2S \quad H_2Se \quad H_2Te$

$373K \quad 213K \quad 269K \quad 232K$

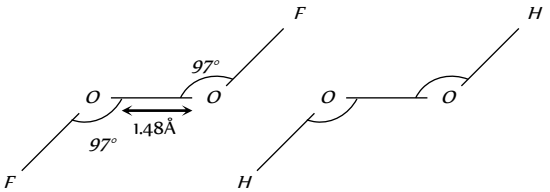
H_2S has lowest boiling point and H_2O has highest boiling point because if any compound has hydrogen bond. Its boiling point is high.

78. (c) V_2O_5 catalyst are used for the manufacture of H_2SO_4 by Contact process.

81. (d) *O, S, Se* shows polymorphism.

84. (e) $H_2S+2HNO_3 \rightarrow 2NO_2+S+2H_2O$.

85. (b) O_2F_2 is similar to that of H_2O_2



87. (d) 16· group called chalcogens (oxygen family) while *Na* is a 1· group element which is called alkali metal.

90. (b) Caro's acid (H_2SO_5)

91. (c) $2KO_2+CO_2 \rightarrow K_2CO_3+\frac{3}{2}O_2$

93. (a) H_2O consist of highest boiling point than other hydride (Due to presence of the hydrogen bonding).

94. (b) Lose of electron.

95. (c) SO_2 is soluble in water

$H_2O+SO_2 \rightarrow \underset{\text{Sulphurus acid}}{H_2SO_3}$

96. (c) $2Na_2O_2+2H_2O \rightarrow 4NaOH+O_2$.

In this reaction oxygen (O_2) is formed.

97. (b) $3S+4NaOH \xrightarrow{\text{boiling}} Na_2S_2O_3+Na_2S$

98. (c) Quartz is a crystalline variety of silica.

99. (b) 98% H_2SO_4 is used for absorbing dense fog of acid which is formed by dissolving SO_3 in water. Hence 98% H_2SO_4 is the most efficient agent for the absorption of SO_3.

100. (b) Concentrated H_2SO_4 is diluted by adding the conc. H_2SO_4 in the water drop by drop with constant stirring because it is an exothermic reaction and by doing so heat is generated slowly and dissipated in the atmosphere.

101. (a) Photochemical smog is caused by oxides of sulphur and nitrogen.

102. (d) SO_2 act as bleaching agent due to its reducing property.

$SO_2+2H_2O \rightarrow H_2SO_4+2H$

Coloured matter $+H \rightarrow$ Colourless matter

103. (b) Ozone on treatment with SO_2 produce SO_3.

$3SO_2+O_3 \rightarrow 3SO_3$

104. (b) PbO_2 is a powerful oxidizing agent and liberate O_2 when treated with acids SO, O_2 gas will be evolved.

105. (c) Dithionous acid $(H_2S_2O_4)$ has sulphur in +3 oxidation state.

$HO-\overset{\overset{O}{\|}}{S}-\overset{\overset{O}{\|}}{S}-OH \;;\; 2(+1)+2x+4(-2)=0$

$2x=8-2=6 \;;\; x=+3$

106. (a) SO_2 acts as an oxidising agent particularly when treated with stronger reducing agents. SO_2 oxidises H_2S into S.

107. (a) R_3SiCl on hydrolysis forms only a dimer.

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

108. (d) Formation of chlorine nitrate is the main cause of ozone depliction.

Halogen family

1. (b) *HF* > *HCl* > *HBr* > *HI* (Thermal stability).

2. (a) $CHCl_3+\frac{1}{2}O_2 \rightarrow \underset{\text{Phosgene or carbonyl chloride}}{COCl_2}+HCl$

3. (d) Iodine has the least affinity for water and is only slightly soluble in it. However, it dissolves in 10% *aq.* solution of *KI* due to the formation of a complex ion *i.e.* I_3^-.

$I_2+KI \rightleftharpoons KI_3$ or $I_2+I^- \rightleftharpoons I_3^-$ (complex ion)

4. (c) $2Na_2S_2O_3+I_2 \rightarrow 2NaI+Na_2S_4O_6$

5. (a) $Cl_2+2KBr \rightarrow 2KCl+Br_2$

A more electronegative halogen can displaces less electronegative halogen.

6. (a) HI is the strongest reducing agent among halogen acids because of lowest bond dissociation energy.

8. (a) Due to H-Bonding free ions are not present in aq. solution. Hence, bad conductor.

9. (c) Electronegativity of I_2 is less than Br_2. Therefore unable to displace bromine.

10. (b) Carnellite is $KCl.MgCl_2.6H_2O$. The mother liquor life after crystallisation of *KCl* from carnellite contain about 0.25% of bromine as *MgBr*, and *KBr.*

11. (a) *HF* is liquid because of intermolecular H-Bonding.

12. (a) $\underset{\text{Weak acid}}{HClO} \rightleftharpoons H^+ + \underset{\text{Strong conjugate base}}{ClO^-}$

13. (d) $\underset{\text{(dil.)}}{2NaOH}+Cl_2 \xrightarrow{\text{Cold}} NaCl+\underset{\text{Sod. hypochlorite}}{NaClO}+H_2O$

$$6\underset{\text{(conc.)}}{NaOH} + 3Cl_2 \xrightarrow{\text{heat}} 5NaCl + \underset{\text{Sodium chlorate}}{NaClO_3} + 3H_2O$$

15. (b) $6KOH + 3Cl_2 \rightarrow 5KCl + KClO_3 + 3H_2O$.

17. (a) *HF* is the weakest acid. Since it is unable to give H^+ ions which are trapped in H-Bonding.

18. (b) Hydride – *HF* *HCl* *HBr* *HI*
B.pt (in *K*) – 293 189 206 238
Becouse of having low b.p. *HCl* is more volatile.

19. (a) $2KClO_3 + I_2 \rightarrow 2KIO_3 + Cl_2$

20. (c) $2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6$

21. (d) $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 8H_2O$

22. (a) $\overset{+7}{HClO_4} > \overset{+5}{HClO_3} > \overset{+3}{HClO_2} > \overset{+1}{HClO}$

As the oxidation no. of halogen increases acidic character increases.

25. (c) $2KBr + 3H_2SO_4 + MnO_2 \xrightarrow{\Delta}$
$2KHSO_4 + MnSO_4 + 2H_2O + Br_2$

29. (b,d) Electron affinity of *Cl* is maximum

Element –	*F*	*Cl*	*Br*	*I*
E.A. *kJ/mole* –	332.6	348.5	324.7	295.5
Boiling pt (°*C*)	–188.1	–34.6	59.5	185.2

32. (a) $Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$

33. (d) $CCl_4 + H_2O \rightarrow$ No reaction

d-orbitals are absent in carbon atom.

34. (a) $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

35. (d) $KI + I_2 \rightarrow KI_3$

36. (a) $2KBr + H_2SO_4 \rightarrow K_2SO_4 + 2HBr$

37. (b) $H_2 + F_2 \rightarrow 2HF$

42. (b) $CuSO_4 + 2KI \rightarrow CuI_2 + K_2SO_4$

$2CuI_2 \rightarrow \underset{\text{Cuprous iodide}}{2CuI} + I_2$

43. (d) As the atomic number increases electronegativity decreases. Hence, tendency to gain electron decreases.

51. (a) $F_2 + 2Cl^- \rightarrow Cl_2 + 2F^-$

$F_2 + 2Br^- \rightarrow Br_2 + 2F^-$

$F_2 + 2I^- \rightarrow I_2 + 2F^-$

53. (d) $Br_2 + 2KI \rightarrow I_2 + 2KBr$

56. (d) $2F_2 + 2H_2O \rightarrow 4HF + O_2$

$3F_2 + 3H_2O \rightarrow 6HF + O_3$

58. (c) $2NaCl + 2H_2O \rightarrow 2NaOH + \underset{\text{(anode)}}{Cl_2} + \underset{\text{(cathode)}}{H_2}$
Reduction: $+4 \rightarrow +2$

59. (a) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

61. (b) $2NaCl + 2H_2O \xrightarrow{\text{Electrolysis}} \underset{\text{(aq)}}{2NaOH} + \underset{(g)}{Cl_2} + \underset{(g)}{H_2}$

62. (c) $\underset{\text{Exposed to air}}{H_2O + Cl_2} \rightarrow HCl + HClO$

$HClO \rightarrow HCl + [O]$ or $2HClO \rightarrow 2HCl + O_2$

63. (a) $2NaOH + Cl_2 \rightarrow NaClO + NaCl + H_2O$

66. (b) $Cl_2 + H_2O \rightarrow 2HCl + [O]$ Nascent oxygen

$\underset{\text{flower}}{\text{Coloured}} + [O] \xrightarrow[\text{agent}]{\text{Bleaching}} \underset{\text{(Oxidized)}}{\text{Colourless flower}}$

68. (b) $CaO + Cl_2 \rightarrow CaOCl_2$

$NaHCO_3 + Cl_2 \rightarrow$ No reaction

69. (c) $\underset{\text{Slaked lime}}{Ca(OH)_2} + Cl_2 \rightarrow CaOCl_2 + H_2O$

71. (b) $MgBr_2 + Cl_2 \rightarrow MgCl_2 + Br_2$

72. (a) $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$

73. (a) $KI + \underset{\text{Conc.}}{H_2SO_4} \xrightarrow{\Delta} KHSO_4 + HI$

Conc. $H_2SO_4 + 2HI \rightarrow 2H_2O + \underset{\text{Violet vapour}}{I_2} + SO_2 \uparrow$

74. (b) $2NaI + Cl_2 \rightarrow 2KCl + I_2$

$CCl_4 + I_2 \rightarrow$ Violet colour

76. (b) $KI + H_2SO_4 \xrightarrow{\Delta} KHSO_4 + HI$

$H_2SO_4 + 2HI \rightarrow 2H_2O + I_2 + \underset{\text{Violet vapour}}{SO_2} \uparrow$

79. (c) $KI + H_2SO_4 \rightarrow KHSO_4 + HI$

HI is formed but it is further oxidised by conc. H_2SO_4 into I_2

$2HI + H_2SO_4 \rightarrow 2H_2O + I_2 + \underset{\text{Violet vapour}}{SO_2} \uparrow$

80. (b) $HCl \xrightarrow{H_2O} \underset{\text{(aq)}}{H^+} + \underset{(aq)}{Cl^-}$

81. (b) $4NaCl + K_2Cr_2O_7 + 3H_2SO_4 \rightarrow$
$K_2SO_4 + 2Na_2SO_4 + \underset{\text{Chromyl chloride}}{2CrO_2Cl_2} + 3H_2O$

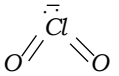
82. (c) Hydrogen bonding is absent in *HI* while it is present in NH_3, H_2O and C_2H_5OH.

84. (d) In case of *HI* due to large size of iodine strong Vander Waal forces are present. Hence, it has highest molar heat of vaporisation.

85. (d) *HI* is strongest acid because $H-I$ bond is weakest among halogen acids.

86. (a) In *HF* the molecules aggregate because of intermolecular hydrogen bonding. Hence, it has highest boiling point.

88. (a) ClO_2^- has sp^3 -hybridization and two lone pairs on halogen which produces V-shape Bent structure



89. (d) $2HClO_4 \rightarrow H_2O + Cl_2O_7$.

90. (b) F_2, Cl_2 } gases
Br_2 } liquid
I_2 } solid

As we go down the group Vander Waal forces increases. Hence, physical state changes.

92. (c) *F* can not act as reducing agent because it has highest reduction potential

$F_2 + 2e^- \rightarrow 2F^-; E^o = +2.87\ V$

93. (c) $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

94. (a) $IF_5 + F_2 \rightarrow IF_7$.

95. (a) Pseudohalide ions and Pseudohalogens

There are certain monovalent negative ions made up of two or more electronegative atoms which exhibit properties similar to these of halide ions. Such ions are known as pseudo halide ions just as halide ions, pseudo halide ions have also corresponding dimoric molecules. These are called pseudo halogens and show properties similar to those of halogens.

Pseudohalide	Pseudohalogens
CN^- cyanide	$(CN)_2$ Cyanogen
SCN^- Thiocyanate	$(SCN)_2$ Thiocyanogen

96. (c) NaF is highest melting halide because it is most ionic in nature.

98. (b) $2F_2 + 2H_2O \rightarrow 4HF + O_2$

99. (c) $CaOCl_2 \rightarrow CaCl_2 + [O]$ Nascent oxygen

100. (a) Generally alkali metals and alkali earth metals elements extracted by the fused electrolysis method.

102. (c) $2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6$.

104. (b) Beilstein test – In this test organic compound is heated on a copper wire in a flame. The appearance of a green or bluish green flame due to the formation of volatile cupric halides indicate the presence of halogens in the organic compound. (It does not tell which halogen is actually present).

105. (d) $\overset{0}{Cl_2} + 2\overset{-1}{KBr} \xrightarrow[\text{Reduction}]{} \overset{0}{Br_2} + 2\overset{-1}{KCl}$

107. (b) $3HCl + HNO_3 \xrightarrow[\text{Oxidation}]{} NOCl + 2H_2O + Cl_2$.

108. (a) $Cl - Cl \xrightarrow{U.V} \underset{\text{Free radical}}{Cl + Cl}$

109. (a) *HF* is a weak acid due to intermolecular hydrogen bonding.

110. (a) Acidic nature of oxide $\propto$ Non metallic nature of element

Non metallic nature decrease in the order $Cl > S > P$.

111. (c) Aqua regia is 1 part of HNO_3 and 3 part of *HCl*.

113. (a) *AgI* is a covalent compound.

114. (a) Bromine is a liquid at room temperature.

115. (a) $Cl_2 + H_2O \rightarrow 2HCl + \underset{\text{Nascent oxygen}}{[O]}$

117. (b) The enamel of our teeth is the hardest substance in the body made up of CaF_2 and dentine below it made of $Ca_3(PO_4)_2$.

118. (b) As the electronegativity decreases reactivity also decreases.

119. (b) $KI + I_2 \rightarrow \underset{\text{(soluble complex)}}{KI_3}$

121. (d) $\underset{-1}{HI} < \underset{0}{I_2} < \underset{+1}{ICl} < \underset{+7}{HIO_4}$

122. (a) $HF < HCl < HBr < HCl$

As we go down the group bond energy decreases hence, acidic nature increases.

123. (b) Caliche is crude chile salt petre $(NaNO_3)$ which contains about 0.02% iodine as sodium iodate $(NaIO_3)$.

124. (a) $LiF > LiCl > LiBr > LiI$

Lattice energy depends on the size and charge of the ion.

125. (a) *F-F* more strong bond compare to *F-Cl*, *F-Br* and *Cl-Br* bond.

126. (c) $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$.

127. (d) $CaCl(OCl) \Rightarrow Ca\begin{matrix}\nearrow Cl \\ \searrow O-Cl\end{matrix}$

128. (a) $2NaOH + Cl_2 \rightarrow \underset{\downarrow}{NaCl} + \underset{\downarrow}{NaOCl} + H_2O$

$Na^+ + Cl^- \quad Na^+ + OCl^-$

131. (d) $I_2 + NaF \longrightarrow$, $I_2 + NaBr \longrightarrow$, $I_2 + NaCl \longrightarrow$ } No reaction

Because I_2 is least electronegative among halogens.

132. (a) $HClO_4 > HCl > H_2SO_4 > HNO_3$

Decreasing order of acidic character.

134. (a) $\underset{\text{Mercuric chloride}}{HgCl_2} + \underset{\text{Mercuric cyanide}}{Hg(CN)_2} \rightarrow HgCl_2.Hg(CN)_2$

135. (a) $HI > \underrightarrow{HBr > HCl > HF}$

Acidic character decreasing order.

136. (c) $\underset{\text{Slaked lime}}{Ca(OH)_2} + Cl_2 \rightarrow \underset{\text{Bleaching poeder}}{CaOCl_2} + HOCl$

137. (d) $K_2Cr_2O_7 + 14HCl \rightarrow 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$

139. (d) Fluorine does not gives positive oxidation state it is always show –1 oxidation state.

140. (a) $\overset{+7}{HClO_4} > \overset{+5}{HClO_3} > \overset{+3}{HClO_2} > \overset{+1}{HCl}$

141. (d) $Ca(OH)_2 + Cl_2 \rightarrow \underset{\substack{\text{bleaching}\\ \text{powder}}}{CaOCl_2} + H_2O$

146. (a) $F_2 + (dil.)\,2NaOH \rightarrow 2NaF + OF_2 + H_2O$

147. (a) Fluorine can not be oxidised by even strongest oxidising agent.

148. (b) $Br_2 + 2H_2O + SO_2 \rightarrow H_2SO_4 + 2HBr$

149. (c) $2KBr + I_2 \rightarrow 2KI + Br_2$

Iodine is a less electronegative compare to Bromine hence iodine does not change Br^- to Br_2.

150. (a) CaI_2 are show covalent properties than other CaF_2, $CaCl_2$, $CaBr_2$ compound.

151. (d) $2KMnO_4 + 3H_2SO_4 + 10HCl \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5Cl_2$

153. (d) PbI_4 is least stable because of two reasons

(1) Size of iodine is biggest.

(2) +2 oxidation state of Pb is more stable than +4 state because of inert pair effect.

154. (a) $Cl_2 + NaF \rightarrow$ No reaction

Since Cl_2 is less electronegative then F_2. Therefore unable to displace fluorine from its salt.

156. (b) $CS_2 + 3Cl_2 \xrightarrow{I_2} CCl_4 + S_2Cl_2$

157. (b) According to the Fajan's rule largest cation and smallest anion.

158. (a) $2F_2 + 4NaOH \rightarrow 4HF + 2H_2O + O_2$

159. (c) $\underbrace{Cl_2}_{\text{1 mole}} \rightarrow \underbrace{2Cl}_{\text{2 moles}}\ \Delta H = +ve$

High temperature and low pressure is favourable.

160. (d) BF_3 accept lone pair of electrons.

161. (d) CrO_2Cl_2 is a orange red gas.

164. (a) Florine always show -1 oxidation state.

165. (a) Solid *NaF* is used to purify fluorine *i.e.* by removing of *HF* fumes.

166. (c) $KHF_2 \rightarrow KF + HF$

$KF \rightarrow K^+ + F^-$

At cathode : $K^+ + e^- \rightarrow K$

$2K + 2HF \rightarrow 2KF + H_2$

At anode : $F^- \rightarrow F + e^-$

$F + F \rightarrow F_2$

168. (c) Small atomic size of *Li* and *F* lattice energy is highest.

169. (b) SO_2 bleaches flower by reduction

$2H_2O + SO_2 \rightarrow H_2SO_4 + 2[H]$

$2[H] + \underset{\text{flower}}{\text{Coloured}} \xrightarrow{\text{Reduction}} \underset{\text{reduced flower}}{\text{Colourless}}$

This bleaching is temporary because reduced flower again oxidised by air to form coloured flower

$Cl_2 + H_2O \rightarrow 2HCl + [O]$

$[O] + \underset{\text{flower}}{\text{Coloured}} \xrightarrow{\text{Oxidation}} \underset{\text{Oxidised flower}}{\text{Colourless}}$

This bleaching is permanent because oxidised flower remains colourless.

170. (a) Fluorine does not form oxyacids because it is more electronegative than oxygen.

173. (c) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

$2KMnO_4 + 3H_2SO_4 + 10HCl \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5Cl_2$

175. (b) $3KClO_3 + 3H_2SO_4 \xrightarrow{\text{Heat}} 3KHSO_4 + HClO_4 + 2ClO_2 + H_2O$

176. (b) $F > Cl > Br > I$. As the size increases electronegativity decreases.

177. (c) Ionic radius increases on going down the group because no. of shells increases.

178. (b) Reducing properties increase from *F* to *I* so it oxidise by nitric acid.

$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

179. (a) Fluorine and chlorine are more electronegative than sulphur.

180. (d) Upper halogen can replace lower halogen from their compounds solution.

181. (a) Iodine (I_2) is slightly soluble in water but it dissolves in 10% aqueous solution of *KI* due to the formation of potassium triodide (KI_3).

182. (a) Due to highest electronegativity of fluorine the anion $[F---H-F]^-$ exists as a result of strong hydrogen bond by which K^+ associate to form KHF_2.

183. (a) Fluorine is the most electronegative element. It does not form oxyfluoxides like other halogens. If reacts with *NaOH* to form sodium fluoride and oxygen fluoride.

$2NaOH + 2F_2 \rightarrow 2NaF + OF_2 + H_2O$

184. (c) Due to unpaired e^- ClO_2 is paramagnetic.

185. (a) Oxidation number of $HBrO_4$ is more than that of $HOCl$, HNO_2 and H_3PO_3 so it is the strongest acid among these.

186. (a) Chlorine heptachloride (Cl_2O_7) is the anhydride of perchloric acid.

$2HClO_4 \xrightarrow{\Delta} Cl_2O_7 + H_2O$

187. (c) I_2 forms complex ion I_3^- in KI solution due to which it dissolves in it.

Noble gases

3. (a) Gas – H_2 O_2 He N_2

Mol. mass – 2 32 4 28

5. (c) Helium (In Greek Helios = Sun)

6. (d) All the noble gases are monoatomic, colourless and odourless gases. Their monoatomic nature is due to the stable outer configuration ns^2np^6 of their atoms. As a result, they do not enter into chemical combination even amongst themselves.

7. (c) Except *He*, all other noble gases are adsorbed by coconut charcoal at low temperatures. The extent of adsorption increases as the atomic size of the noble gas increases.

10. (b) An oxygen-helium mixture is used artificial respiration in deep sea diving instead of air because nitrogen present in air dissolves in blood under high pressure when sea diver goes into deep sea. When he comes to the surface, nitrogen bubbles out of the blood due to decrease in pressure, causing pains. This disease is called "bends".

11. (c) XeF_2, $XeOF_2$. XeF_4, $XeOF_4$. XeF_6, XeO_3.

12. (c)

Gas	(Abundance in air by volume (ppm))
Helium	5.2
Neon	18.2
Argon	93.4
Krypton	1.1
Xenon	0.09

13. (c) Neon $\rightarrow$ *Ne* is monoatomic and others are diatomic N_2, F_2 and O_2.

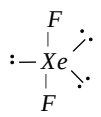
14. (c) ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4$

15. (b) HeF_4 does not exist.

16. (d) $Ar_{18} \rightarrow$ 2, 8, 8

17. (b) $Ne_{10} \rightarrow 1s^2\ 2s^2\ 2p^6$

23. (d) XeF_2 has sp^3d –hybridization with linear shape



24. (b) Partial hydrolysis; $XeF_4 + H_2O \rightarrow XeOF_2 + 2HF$

Complete hydrolysis;

$2XeF_4 + 3H_2O \rightarrow Xe + XeO_3 + F_2 + 6HF$

26. (d) *He* is least polarizable because of small atomic size.

27. (a) *Rn* because it is radioactive element obtained by the disintegration of radium

$_{88}Ra^{206} \rightarrow {}_{86}Rn^{202} + {}_{2}He^{4}$

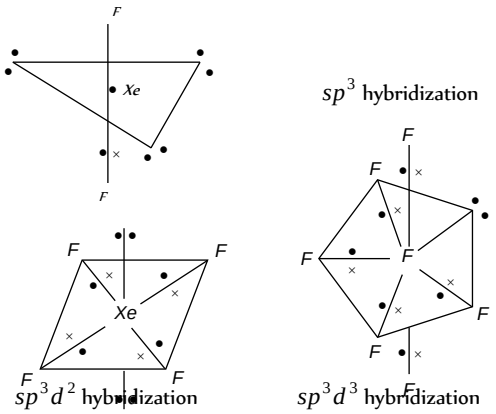
30. (c) $1s^2\ 2s^2\ 2p^6 \rightarrow$ Neon

35. (a) $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

36. (c) $Xe > Kr > Ar > Ne > He$

Solubility in decreasing order.

37. (d)



sp^3 hybridization

sp^3d^2 hybridization

sp^3d^3 hybridization

38. (b) Zero group element are show less chemically activity because this group element have 8 electron.

39. (d) *Xe* is formed following compounds.

$XeF_2,\ XeF_4,\ XeF_6$.

40. (a) As the number of shells increases, size increases and the effective nuclear charge on the outermost electron decreases. Thus, I.E. decreases.

44. (c) XeF_2, XeF_4 & XeF_6 can be directly prepared

$$Xe + F_2 \xrightarrow[673\ K]{Ni\ \text{tube}} XeF_2 \ ; \quad Xe + 2F_2 \xrightarrow[6\ \text{atm}]{673\ K} XeF_4$$

$$Xe + 3F_2 \xrightarrow[50-60\,\text{atm}]{523-573\ K} XeF_6$$

XeO_3 is obtained by the hydrolysis of XeF_6

$$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$$

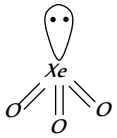
46. (a) XeO_3 shows sp^3 hybridization.

47. (a) It is because
(1) Small atomic size
(2) High Ionization energy
(3) Absence of *d*-orbitals

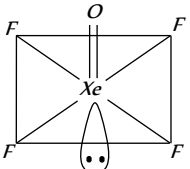
48. (a) Zero group element are attached with weak intermolecular force.

49. (b) $XeF_2,\ XeF_4,\ XeF_6$.

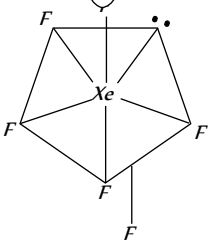
50. (d) *XeO*$_2$:



XeOF$_4$:



XeF$_6$:



51. (d) Neil Bartlett prepared first noble gas compound. Xenon hexafluoroplatinate (IV).

53. (d) *He*, *Ne*, and *Kr* all are found in very little amount in atmosphere, so all are called rare gas.

54. (c) Helium is twice as heavy as hydrogen, its lifting power is 92% of that of hydrogen. Helium has the lowest melting and boiling point of any element which makes liquid helium an ideal coolant for many extremely low temperature application such as super conducting magnet and cryogenic research where temperature close to absolute zero are needed.

55. (a) The maximum temperature at which gas can be liquified is called its critical temperature. The gas which have high boiling point will change into liquid first and so critical temperature of the gas will be more.

$T_C \propto$ B.P. and B.P. $\propto$ Molecular weight

So *Kr* liquifies first.

56. (c) Suppose the oxidation state of Xe is x. $XeOF_2$

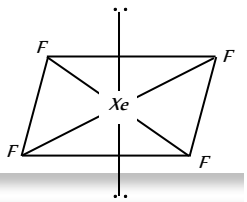
$x + (-2) + 2(-1) = 0 \Rightarrow x - 2 - 2 = 0 \Rightarrow x = 4$.

57. (a)

	He	*Ne*	*Ar*	*Kr*	*Xe*	*Rn*
Boiling point of	– 269	–246	– 186	–153.6	–108.1	–62
Inert gases						

59. (d) Xe is highly polar since the ionisation potential of xenon is quite close to the ionisation potential of oxygen.

60. (d) In the formation of XeF_4, sp^3d^2 hybridisation occurs which gives the molecule an octahedral structure. The xenon and four fluorine atoms are coplanar while the two equatorial positions are occupied by the two lone pairs of electrons.



Critical Thinking Questions

1. (c) Correct sequence is

$NH_2CONH_2 > NH_4N_3 > NH_3NO_3 > NH_4Cl$.

2. (d) Second group elements are show strong reducing properties but less I^{-} group element show less.

3. (a) The size of alkaline earth metals is smaller as compared to its corresponding alkali metals and its effective nuclear charge is also more than that of its corresponding alkali metals.

4. (d) Lead is maximum in flint glass.

5. (b) $BaSO_4 + 4C \xrightarrow{\text{Heat}} BaS + 4CO$

Thus, on heating they produce $BaS + 4CO$.

6. (d) Smaller the atomic size tendency of hydration is more as the size increases tendency for hydration also decreases.

7. (a) Fusion mixture is $Na_2CO_3 + K_2CO_3$.

8. (b) *HCl* is a gas.

9. (a) (A) Peroxide is $H_2O_2(4)$; (B) Super oxide is $KO_2(3)$

(C) Dioxide is $PbO_2(2)$; (D) Suboxide is $C_3O_2(1)$

10. (a) $\underset{98\%}{H_2SO_4} + SO_3 \rightarrow \underset{\substack{\text{Oleum} \\ (\text{Fuming } H_2SO_4)}}{H_2S_2O_7}$

11. (c) $SnO_2 + 2NaOH \rightarrow Na_2SnO_3 + H_2O$

$SnO_2 + 4HCl \rightarrow SnCl_4 + 2H_2O$

12. (b) $NaOH + Al^{+3} \rightarrow \underset{\substack{\text{Sod. metaaluminate} \\ (\text{Soluble in } NaOH)}}{NaAlO_2}$

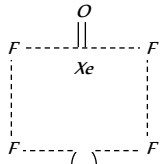
$NaOH + Fe^{+3} \rightarrow$ No reaction (Insoluble in *NaOH*)

13. (d) The composition of the common glass is $Na_2O.CaO.6SiO_2$.

14. (c) Lead form nitric oxide with dil. HNO_3

$$3Pb + 8HNO_3 \rightarrow 3Pb(NO_3)_2 + 2NO + 4H_2O$$

15. (b)



Therefore, total number of lone pair of electron on central atom *Xenon* =1

16. (d) Order of acidic strength is $H_2Te > H_2Se > H_2S > H_2O$

Na_2O is a salt of $NaOH + H_2O$ and H_2O is least acidic among given acids hence *pH* in this case will be maximum.

17. (a) HNO_3 is the strong oxidising acid so it react with alkali while rest can be react with both and alkali.

18. (d) Zero group is called a buffer group because it lies between highly electronegative halogens and highly electropositive alkali metal element.

19. (c) $PbSO_4$ is insoluble in water.

20. (a) N_2O_5 is most acidic.

21. (b)

Element –	Fluorine	Chlorine	Bromine	Iodine
B.E. in *kJ mole* –	158.8	242.6	192.8	151.1

22. (d) $CaCN_2 + 3H_2O \xrightarrow[\text{pressure}]{\text{under}} CaCO_3 + 2NH_3$.

23. (a) $6O_2 \xrightarrow{\text{Ozonolysis}} 4O_3$

Complete ozonalysis gives 4 volume of ozone.

24. (b) Marble statue $\rightarrow CaCO_3$; Calcinated Gypsum $\rightarrow CaSO_4.2H_2O$; Sea shell $\rightarrow CaCO_3$; Dalomite $\rightarrow CaCO_3.MgCO_3$.

25. (b) Sodium is basic in nature.

26. (c) $I_2 + I^- \rightarrow I_3^-$

27. (a) The hydration energy decreases from Be^{+2} to Ba^{+2}. This causes the decrease in the solubilities of the sulphates in this order. In other words, the solubilities decreases with increase in the ionic size.

28. (d) $2Mg + O_2 \rightarrow 2MgO$

$3Mg + N_2 \rightarrow Mg_3N_2$

29. (a) $ZnO + BaO \xrightarrow{1100^oC} BaZnO_2$

30. (b) There are no free electron in N_2O_4, so it is dimagnetic in nature.

31. (b) $\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow{120^oC} \underset{\text{Ploster of paris}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}H_2O$

32. (d) Third alkaline earth metal is calcium $_{20}Ca^{40}$.

No. of electron are 20 & No. of proton are 20; e/20, p/20.

33. (a) In the compounds of alkaline earth metals all the electrons are paired. Hence, they are diamagnetic in nature.

34. (a) Mixture of helium and oxygen is used in artificial respiration.

35. (a) Alkaline solution of pyrogallol quickly absorbs oxygen.

36. (d) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

$2NaN_3 \rightarrow 2Na + 3N_2$

$(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$

37. (b) Because yellow phosphorus is most reactive form of phosphorus and is highly polymerised.

38. (c) Carbon has 2 electrons in their penultimate shell configuration so due to *d*-orbital in penultimate shell is false statement.

39. (d) All other oxides of nitrogen except N_2O and *NO* are acidic in nature.

40. (a) $PbCl_4 < PbCl_2 < CaCl_2 < NaCl$ is the increasing order of ionic character.

41. (a) $Si + 3HCl \rightarrow \underset{\text{siliconchloroform}}{SiHCl_3} + H_2$

42. (a) KO_2 is used in oxygen cylinder because it absorbs CO_2 and increases O_2 content. Super oxides reacts with water to give H_2O_2 & O_2.

43. (d) $NaHCO_3$ and Na_2CO_3 decomposes to give CO_2 which extinguish fire.

44. (d) CaF_2 is insoluble in water.

45. (a) PCl_3 is most acidic.

46. (b) $CsCl > KCl > NaCl > LiCl$

47. (d) $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_8 + 2NaI$.

48. (b) In general, higher the oxidation state, more is the covalent character of the oxide. I_2O_7 & I_2O_5 do not exist. I_2O_4 is ionic in nature. It is infact iodyl iodate $[IO]^+[IO_3]^-$. The only covalent oxide is I_2O_5.

49. (b) $LiAlH_4$ act as reducing agent

$$CH_3CHO + 2H \xrightarrow{LiAlH_4} CH_3CH_2OH$$

50. (c) When conc. *HCl* react with potassium chlorate to gives $Cl_2 + ClO_2$.

51. (c) $2H_2S + SO_2 \rightarrow 2H_2O + 3S$

52. (b) Lithium nitrate on heating gives

$$\underset{(S)}{4LiNO_3} \xrightarrow{\Delta} \underset{(S)}{2Li_2O} + 4NO_2 \uparrow + O_2 \uparrow$$

53. (d) $CaCO_3 > NaHCO_3 > KHCO_3$ is the Increasing order of solubility.

54. (c) Nitrolim is $CaCN_2 + C$.

55. (a) The oxidation state of halogens is same +1. Therefore the acidic character depends only upon the electronegativity. Higher the electronegativity of the halogen more easily if will pull the electrons of $O-H$ bond toward itself and hence, stronger is the acid.

56. (c) Iridium $[I, Z = 77]$ is not belong to noble gas.

57. (c) Name and basicity of H_3PO_2 is hypophosphorus acid & one.

58. (c) In NO_2 there are free electron so it is paramagnetic in nature.

59. (a) Nessler's reagent is K_2HgI_4.

60. (b) Helium was firstly discovered by willium Ramsay.

61. (c) 1.66 Since inert gases are monoatomic.

62. (c) In this reaction, phosphorus is simultaneously oxidised to NaH_2PO_2 and reduced to PH_3. Hence this reaction is an example of disproportionation.

$$\overset{o}{P}_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2\overset{+1}{P}O_2 + \overset{-3}{P}H_3$$

63. (c) Reduction is accompanied by an increase in oxidation number of the reducing agent. *C* belong to IVA so the max-O.N. is +4. In CO_2 the oxidation number of *C* is +4, which cannot be further increased. Hence, CO_2 can not act as reducing agent.

64. (b) When silicon tetra fluoride reacts with water H_2SiF_6 and H_4SiO_6 are formed

$$\underset{\text{Silicon tetrafluoride}}{3SiF_4} + \underset{\text{Water}}{4H_2O} \rightarrow 2H_2SiF_6 + \underset{\text{White silicic acid}}{H_4SiO_4}$$

65. (a) $4O_3 + 6I_2(dry) \rightarrow 3I_4O_4$

66. (c) $Na(NH_4)HPO_4.4H_2O$ (Microcosmic salt)

67. (b) Thermite mixture $Fe_2O_3 + Al$

68. (d) The colour of liquid O_2 is pale blue.

69. (a) Helium is not soluble in blood even under high pressure, a mixture of 80% helium and 20% oxygen is used instead of ordinary air by sea divers for respiration.

70. (a) $Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$

71. (a) Calcium cyanamide on treatment with steam produce $CaCO_3 + NH_3$.

Assertion & Reason

1. (b) Sulphate is estimated as $BaSO_4$ because of high lattice energy in a group.

2. (b) Fluorine is a strong oxidising agent than other halogens due to highest electronegativety..

3. (a) In HNO_3 due to presence of two *N-O* bonds it is a stronger acid than HNO_2.

6. (c) Bleaching action of chlorine carried by oxidation while bleaching action of SO_2 carried by reduction.

7. (b) On heating its outermost electron transite to next energy level by which it become more reactive.

10. (a) *K* and *Cs* emit electrons on exposure of light due to low ionisation potential.

11. (e) The lower value of bond dissociation energy of *F-F* bond due to longer inter electronic (electron - electron) repulsion between the non-bonding electrons in the 2*p* orbitals of fluorine atom.

12. (a) It is fact that halogens are highly reactive as they have seven electrons in their outermost orbit and they want to stabilize by acquiring an electron. Therefor, they do not occur in free state. Here both assertion and reason are true and the reason is the correct explanation of assertion.

13. (a) Lithium forms lithium oxide. This is due to the fact that Li^+ ion has smallest size and it has a strong positive field around it. Therefore, it stabilize O^{2-} ion with strong negative field around it. Thus, both assertion as well as reason are true.

14. (a) Liquid NH_3 is used for refrigeration is true and it is due to the fact that is vaporises quickly and for vaporisation it takes up heat and cool the refrigerator. Hence assertion and reason both are true.

15. (a) It is true that $Al(OH)_3$. The reason is that *NaOH* is a strong alkali, it dissolves $Al(OH)_3$. Which is amphoteric in nature and forms $NaAlO_2$.

$$Al(OH)_3 + NaOH \rightarrow \underset{\text{Sodium meta aluminate}}{NaAlO_2} + 2H_2O$$

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

17. (b) It is correct that inert gases are monoatomic because for inert gases $C_p / C_v = 1.66$.

18. (c) When *Mg* is burnt in nitric oxide it continue to burn because during burning the heat evolved decompose *NO* to N_2 and O_2. Oxygen thus, produced helps *Mg* to burn.

Here assertion is true but reason is false.

19. (d) Anhydrous BaO_2 is not used for preparing H_2O_2 because it reacts with H_2SO_4 and the reaction ceases after some time due to formation of $BaSO_4$ on BaO_2. Therefore, assertion and reason both are false.

20. (d) Inorganic benzene, borazine is highly reactive while benzene is much less reactive.

Here, assertion is false, but reason is true.

21. (a) The halogens absorb visible light due to which all halogens are coloured. Hence, both assertion and reason are true and reason is correct explanation.

22. (b) It is true that barium is not required for normal biological function in human beings and it is also true that it does not show variable oxidation state. It only shows +2 oxidation state.

23. (d) The $O-O$ bond length is shorter in O_2F_2 than in H_2O_2 due to higher electronegativity. H_2O_2 is a non ionic compound. Here both assertion and reason are false.

24. (d) Here both assertion and reason are false because PbI_4 is not a stable compound and iodine can not stabilize higher oxidation states. *Pb* shows (II) oxidation state more frequently than *Pb* (IV) due to inert pair effect.

25. (b) Both assertion and reason are true but reason is not correct explanation of the assertion. Enamel the hardest substance of the body is composed of fluorine not magnesium. Magnesium is an essential element as it acts as a factor of many enzymes of glycolysis and a number of other metabolic reactions dependent upon ATP.

26. (d) Both assertion and reason are false.

Radium is the rarest of all *s*-block elements comprising only 10^{-10} percent of igneous rocks. Francium (*s*-block member) is radioactive; its long lived isotope ^{223}Fr has a half life of only 21 minutes.

27. (c) Assertion is true but reason is false.

Due to high polarizing power of $Li^+, LiCl$ is a covalent compound.

28. (c) Assertion is true but reason is false.

Be has fully filled $2s^2$ – orbital which gives a relatively more stable electronic configuration.

29. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

30. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

31. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

32. (c) Assertion is true but reason is false.

Helium is a noble gas (Chemically inactive) but beryllium is a member of alkaline earth metals (Chemically active).

33. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

Lattice energy of Na_2SO_4 is less than its hydration energy but the lattice energy of $BaSO_4$ exceeds its hydration energy.

34. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

35. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

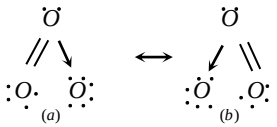
Presence of unpaired electrons in super oxides of alkali metals make them paramagnetic.

36. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

Nitrogen can not expand its octet due to the non availability of *d*-orbital.

37. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

Ozone is considered to be a resonance hybrid of the following two forms.



38. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

Molecules of sulphuric acid are associated due to large number of intermolecular hydrogen bonding.

39. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

PCl_5 is trigonal bipyramidal containing sp^3d hybridized *P* atom in liquid and gaseous state. Whereas in solid state it consists of tetrahedral PCl_4^+ cation and octahedral PCl_6^- anion.

40. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

In case of NI_3, the lone pair moment adds on the resultant of the $N-I$ moments but in case of NF_3, the lone pair moment on partly cancels the resultant $N-F$ moments.

41. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

The ignition temperature of white phosphorus is low (About $30^\circ C$). In air it readily catches fire giving dense fumes of phosphorus pentoxide. It is therefore, kept in water.

42. (c) Assertion is true but reason is false.

B does not have vacant *d*-orbitals as second shell is the outermost shell.

43. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

44. (d) Both assertion and reason are false.

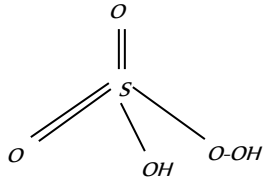
$Si-Si$ bonds are weaker than $Si-O$ bonds *Si* has no tendency to form double bonds with itself.

45. (c) Assertion is true but reason is false.

S atoms in S_8 molecule undergo sp^3 hybridization and contain two lone pairs of electrons on each and exists as staggered 8 atom rings.

46. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

This can be explained through structure of Caro's acid (Peroxomonosulphuric acid).



Oxidation no. of $S = x$, oxidation no. of $H = +1$,
Oxidation no. of oxygen in peroxo linkage = –1,

Oxidation no. of other oxygen atoms $= -2$ (each)
$2 + x - 6 - 2 = 0$ or $x = +6$.

47. (d) Both assertion and reason are false.

The melting point / boiling point of noble gases are quite low. The inter particle forces among noble gases are weak Vander Waal's forces.

48. (b) If both assertion and reason are true and reason is the correct explanation of assertion.

S atom in both SO_2 and SO_3 is sp^2 hybridized but it contains a lone pair of electrons in SO_2.

49. (d) Both assertion and reason are false.

Calcium carbide on hydrolysis gives acetylene. Calcium carbide contains C_2^{2-} anion.

50. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

51. (e) Assertion is false but reason is true.

In lab, hydrogen is generally prepared by the reaction of zinc with dilute hydrochloric acid.

52. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

The relatively inert behaviour of diprotium at room temperature is due to the high enthalpy of $H-H$ bond, being the highest for a single bond between any two elements.

53. (d) Both assertion and reason are false.

Water can be easily transformed from liquid solid and to gaseous states. The distribution of water over the earth's surface is not uniform. The desert region have no permanent surface water while the oceans cover vast areas.

54. (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

The structure of ice is open due to hydrogen bonding which makes ice less dence than liquid water at the same temperature.

55. (c) Assertion is true but reason is false.

The water molecules are joined together in an extensive three dimensional network in which each oxygen atom is bonded to four hydrogen atoms two by hydrogen bonds and two by normal covalent bonds in a near tetrahedral configuration. This situation does not exist for molecules like NH_3 and HF.

56. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

Hard water contain soluble calcium and magnesium salt like bicarbonates, chlorides and sulphates.

57. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

To stop decomposition H_2O_2 is stored in wax-lined glass or plastic vessels in the presence of stabilizers like urea.

58. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

At any given instant in liquid water at room temperature, each water molecule forms hydrogen bonds with an average 3.4 other water molecules. The H_2O molecules are in continuous motion so hydrogen bonds are constantly and rapidly broken and formed. In ice H_2O molecules are, however fixed in the space lattice.

59. (d) Both assertion and reason are false.

Calgon is used for making Ca^{2+} and Mg^{2+} ions present in hard water ineffective. It forms soluble complex with Ca^{2+} and Mg^{2+} ions.

60. (b) SO_2 shows both oxidising as well as reducing nature.

The reaction given in assertion is due to oxidising nature of SO_2.

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S$$

61. (a) (i) Due to smaller size of F; steric repulsions will be less in SiF_4.

(ii) Interaction of F lone pair electrons with Si is stronger than that of chlorine lone pairs.

62. (b) Borax bead test is not suitable for Al(III) because its oxidising as well as reducing flame is colourless in both hot as well as cold.

Alumina is insoluble in water as they exist in hydrated form like $Al_2O_3.2H_2O$, $Al_2O_3.H_2O$ etc.

63. (c) $SeCl_4$ possess see saw geometry, which can be regarded as a distorted trigonal bipyramidal structure laving one lone pair (lp) of electrons in the basal position of the trigonal bipyramidal. See-saw geometry of $SeCl_4$ molecules arises due to the sp^3d hybridisation of the central atom. The distortion in shape is due to the presence of one lone pair of electrons.

64. (b) Due to the ease with which it can liberate nascent oxygen, O_3 acts as a powerful oxidising agent.

$$O_3 \rightarrow O_2 + O$$