INORGANIC CHEMISTRY

NEET

CRASH COURSE

p - BLOCK ELEMENTS

SMART ACHIEVERS

JEE | NEET | FOUNDATION

587, Nitikhand-1, Indirapuram, Gzb.

7292077839 / 7292047839 | smartachievers.online

A Unit of SMARTACHIEVERS LEARNING Pvt. Ltd., Delhi

SUMMARY

Groups 13 to 18 of the periodic table consist of **p-block elements** with their valence shell electronic configuration ns^2np^{1-6}. Groups 13 and 14 were dealt with in Class XI. In this Unit remaining groups of the p-block have been discussed.

Group 15 consists of five elements namely, N, P, As, Sb and Bi which have general electronic configuration ns^2np^3. Nitrogen differs from other elements of this group due to small size, formation of **$p\pi$–$p\pi$ multiple bonds** with itself and with highly electronegative atom like O or C and **non-availability of d orbitals** to expand its valence shell. Elements of group 15 show gradation in properties. They react with oxygen, hydrogen and halogens. They exhibit two important oxidation states, + 3 and + 5 but +3 oxidation is favoured by heavier elements due to 'inert pair effect'.

Dinitrogen can be prepared in laboratory as well as on industrial scale. It forms oxides in various oxidation states as N_2O, NO, N_2O_3, NO_2, N_2O_4 and N_2O_5. These oxides have **resonating structures** and have multiple bonds. Ammonia can be prepared on large scale by **Haber's process**. HNO_3 is an important industrial chemical. It is a strong monobasic acid and is a powerful oxidising agent. Metals and non-metals react with HNO_3 under different conditions to give NO or NO_2.

Phosphorus exists as P_4 in elemental form. It exists in several **allotropic forms**. It forms hydride, PH_3 which is a highly poisonous gas. It forms two types of halides as PX_3 and PX_5. PCl_3 is prepared by the reaction of white phosphorus with dry chlorine while PCl_5 is prepared by the reaction of phosphorus with SO_2Cl_2. Phosphorus forms a number of oxoacids. Depending upon the number of P–OH groups, their basicity varies. The oxoacids which have P–H bonds are good reducing agents.

The Group 16 elements have general electronic configuration ns^2np^4. They show maximum oxidation state, +6. Gradation in physical and chemical properties is observed in the group 16 elements. In laboratory, dioxygen is prepared by heating $KClO_3$ in presence of MnO_2. It forms a number of oxides with metals. Allotropic form of oxygen is O_3 which is a highly oxidising agent. Sulphur forms a number of allotropes. Of these, a– and b– forms of sulphur are the most important. Sulphur combines with oxygen to give oxides such as SO_2 and SO_3. SO_2 is prepared by the direct union of sulphur with oxygen. SO_2 is used in the manufacture of H_2SO_4. Sulphur forms a number of oxoacids. Amongst them, the most important is H_2SO_4. It is prepared by contact process. It is a dehydrating and oxidising agent. It is used in the manufacture of several compounds.

Group 17 of the periodic table consists of the following elements F, Cl, Br, I and At.These elements are extremely reactive and as such they are found in the combined state only. The common oxidation state of these elements is –1. However, highest oxidation state can be +7. They show regular gradation in physical and chemical properties. They form oxides, hydrogen halides, interhalogen compounds and oxoacids. Chlorine is conveniently obtained by the reaction of HCl with KMnO4. HCl is prepared by heating NaCl with concentrated H_2SO_4. Halogens combine with one another to form interhalogen compounds of the type XX1 n (n = 1, 3, 5, 7) where X1 is lighter than X. A number of oxoacids of halogens are known. In the structures of these oxoacids, halogen is the central atom which is bonded in each case with one OH bond as X–OH. In some cases X = 0 bonds are also found.

Group 18 of the periodic table consists of noble gases. They have ns^2 np^6 valence shell electronic configuration except He which has $1s^2$. All the gases except Rn occur in atmosphere. Rn is obtained as the decay product of ^{226}Ra.

Due to complete octet of outermost shell, they have less tendency to form compounds. The best characterised compounds are those of xenon with fluorine and oxygen only under certain conditions. These gases have several uses. Argon is used to provide inert atmosphere, helium is used in filling balloons for meteorological observations, neon is used in discharge tubes and fluorescent bulbs.

p - BLOCK ELEMENTS

Q.1 Which of the following can be detected by the borax-bead test ?
(1) Ni^{2+} (2) Co^{2+} (3) Pb^{+2} (4) Both (1) & (2)

Q.2 In diborane
(1) 4 bridged hydrogens and two terminal hydrogen are present
(2) 2 bridged hydrogens and four terminal hydrogen are present
(3) 3 bridged and three terminal hydrogen are present
(4) None of the above

Q.3 A mixutre of boric acid with ethyl alcohol burns with green edged flame due to the formation of
(1) Ethyl borax (2) Ethyl borate (3) Methyl borax (4) Methyl borate

Q.4 In alums, each metal ion is surrounded by–
(1) Two water molecules (2) Four water molecules
(3) Six water molecules (4) Eight water molecules

Q.5 Which of the following property does not support anamalous behaviour of boron ?
(1) Small size (2) High electronegativity
(3) High ionization energy (4) Formation of trihalides

Q.6 Borax $Na_2B_4O_7 . 10H_2O$ is actually :-
(1) $Na_2[B_4O_5(OH)_4].8H_2O$ (2) $Na_2[B_4O_4(OH)_6].7H_2O$
(3) $Na_2[B_4O_3(OH)_8].6H_2O$ (4) $Na_2[B_4O_2(OH)_{10}].5H_2O$

Q.7 B_2O_3 is -
(1) Acidic (2) Basic (3) Amphoteric (4) None of these

Q.8 When an inorganic compound (X) having 3c–2e as well as 2c–2e bonds reacts with ammonia gas at a certain termperature, gives a compound (Y), isostructural with benzene. Compound (X) with ammonia at a high temperature produces a substance (Z) :
(1) (X) is B_2H_6 (2) (Z) is known as inorganic graphite
(3) (Y) is $B_3N_3H_6$ (4) All of these

Q.9 $AlCl_3$ exist as dimer because -
(1) Al has greater IP (2) Al has larger radius
(3) High charge in nucleus (4) Incomplete p-orbital

Q.10 Corundum is -
(1) SiO_2 (2) Al_2O_3 (3) CaF_2 (4) Cr_2O_3

Q.11 Pick up the wrong statement -
(1) Anhydrous $AlCl_3$ exists as Al_2Cl_6(dimer) (2) Anhydrous $AlCl_3$ is a trigonal planar molecule
(3) Anhydrous $AlCl_3$ fumes in air (4) Anhydrous $AlCl_3$ is ionic

Q.12 Specify the coordination geometry around and hybridization of N and B atoms in a 1 : 1 complex of BF_3 and NH_3 -
(1) N : Tetrahedral, sp^3 ; B : Tetrahedral, sp^3 (2) N : Pyramidal, sp^3 ; B : Pyramidal, sp^3
(3) N : Pyramidal, sp^3 ; B : planar, sp^3 (4) N : Pyramidal, sp^3 B : tetrahedral, sp^3

Q.13 Alums are used for -
(1) Tanning of Leather (2) Coagulation of Blood
(3) Purification of water (4) All the above

Q.14 Boric acid is polymeric due to -
(1) Its acidic nature (2) The presence of hydrogen bonds
(3) Its monobasic nature (4) Its geometry

Q.15 Lithum cannot form alums because of its -
(1) Small size (2) High electropositivity
(3) High ionisation energy (4) Small number of electron

Q.16 The hydrolysis of borax produces -
(1) An acidic medium (2) A basic medium
(3) A neutral medium (4) An acidic or an neutral medium

Q.17 In organic graphite is :
(1) $B_3N_3H_4$ (2) B_2H_6 (3) BN (4) None of these

Q.18 $Ni(CO)_4$, $Fe(CO)_5$ and $Cr(CO)_6$ are:
(1) Organometallics (2) Carbonyls (3) Both (1) & (2) (4) None

Q.19 Which element-element bond has the highest bond dissociation energy ?
(1) C–C (2) Si–Si (3) Ge–Ge (4) Sn–Sn

Q.20 Which gas is responsible for green house effect :
(1) CO_2 (2) SO_2 (3) CO (4) SO_3

Q.21 Trisilylamine $[N(SiH_3)_3]$ has a
(1) Planar geometry (2) Tetrahedral geometry
(3) Pyramidal geometry (4) None of these

Q.22 Amongst the elements of group 14, the reducing power of the divalent species decreases in the order
(1) Ge > Sn > Pb (2) Sn > Ge > Pb (3) Pb > Sn > Ge (4) Sn > Pb > Ge

Q.23 Glass or silica soluble in :
(1) $HClO_4$ (2) HF (3) Aqua-regia (4) H_2SO_4

Q.24 The reducing character of hydrides of group 14 elements is :
(1) Maximum for CH_4 and minimum for PbH_4
(2) Maximum for CH_4 and minimum for SnH_4
(3) Maximum for PbH_4 and minimum for SiH_4
(4) Maximum for PbH_4 and minimum for CH_4

Q.25 CO forms a volatile compound with
(1) Nickel (2) Copper (3) Sodium (4) Aluminium

Q.26 Which is/are true statements :
(1) Diamond is unaffected by conc. acids but graphite reacts with hot conc. HNO_3 forming meltitic acid, $C_6(COOH)_6$
(2) CO is toxic because it forms a complex with haemoglobin in the blood
(3) C_3O_2, carbon suboxide, is a foul-smelling gas
(4) All are true statements

Q.27 Phosgene is the common name given to
(1) Carbonyl chloride (2) Phosphine
(3) Phosphorus oxychloride (4) Phosphorus trichloride

Q.28 The number and type of bonds between two carbon atoms in CaC_2 are :
(1) One sigma and one pi bonds (2) One sigma and two pi bonds
(3) One sigma and half pi bond (4) One sigma bond

Q.29 Carborundum is :
(1) Al_2O_3 (2) SiC (3) BF_3 (4) B_4C

Q.30 If a person is injured by the shot of a gun and all the pellets could not be removed, it may cause poisoning by :
(1) Hg (2) Pb (3) Fe (4) As

Q.31 Red phosphorus is chemically unreactive because :
(1) It does not contain P – P bonds
(2) It does not contain tetrahedral P_4 molecules
(3) It does not catch fire in air even up to 400°C
(4) It has a polymeric structure.

Q.32 What is false about N_2O_5 ?
(1) It is anhydride of HNO_3 (2) It is a powerful oxidizing agent
(3) Solid N_2O_5 is called nitronium nitrate (4) Structure of N_2O_5 contains no [N→O] bond

Q.33 Phosphine is produced by adding water to :
(1) $CaCl_2$ (2) HPO_3 (3) Ca_3P_2 (4) P_4O_7

Q.34 Sequence of acidic character is :
(1) $SO_2 > CO_2 > CO > N_2O_5$ (2) $SO_2 > N_2O_5 > CO > CO_2$
(3) $N_2O_5 > SO_2 > CO > CO_2$ (4) $N_2O_5 > SO_2 > CO_2 > CO$

Q.35 Nitric acid (conc.) oxidizes phosphorus to :
(1) H_3PO_4 (2) P_2O_3 (3) H_3PO_3 (4) $H_4P_2O_7$

Q.36 The correct order of decreasing acid strength of oxy acids of group 15 elements is :
(1) $HNO_3 > H_3SbO_4 > H_3AsO_4 > H_3PO_4$ (2) $H_3PO_4 > H_3AsO_4 > H_3SbO_4 > HNO_3$
(3) $HNO_3 > H_3PO_4 > H_3AsO_4 > H_3SbO_4$ (4) $HNO_3 > H_3AsO_4 > H_3PO_4 > H_3SbO_4$

Q.37 Phosphine is not evolved when :
(1) white phosphorus is boiled with a strong solution of $Ba(OH)_2$
(2) phosphorus acid is heated
(3) Calcium hypophosphite is heated
(4) metaphosphoric acid is heated

Q.38 Phosphorus pentachoride is kept in a well stoppered bottle because :
(1) It is highly volatile
(2) It reacts with air of atmosphere to give $POCl_3$
(3) It reacts with moisture of air
(4) It is decomposed by light

Q.39 Which one of the following does not undergo hydrolysis -
(1) $AsCl_3$ (2) $SbCl_3$ (3) PCl_3 (4) NF_3

Q.40 Dimerisation of NO_2 as the temperature is lowered, is accompanied by :
(1) An increase in pressure (2) A darkening in colour
(3) A decrease in paramagnetism (4) The formation of a colloid

Q.41 Which one of the following properties of white phosphorous are shared by red phosphorous -
(1) It dissolves in CS_2 (2) It burns when heated in air
(3) It reacts with NaOH to give PH_3 (4) It phosphorescences in air

Q.42 When white phosphorous is heated with caustic soda, the compounds formed are -
(1) $PH_3 + NaH_2PO_3$ (2) $PH_3 + NaH_2PO_2$
(3) $PH_3 + Na_2HPO_3$ (4) $PH_3 + NaH_2PO_4$

Q.43 Phosphine produces smoky rings when it comes in contact with air because -
(1) It reacts with water vapour (2) It reacts with nitrogen
(3) It burns in air (4) It contains impurities of P_2H_4

Q.44 The solid PCl_5 exists as -
(1) PCl_5 molecules (2) P_2Cl_{10} (3) $[PCl_4]^+ [PCl_6]^-$ (4) None of these

Q.45 Which of the following is used as anaesthetic -
(1) NH_3 (2) NO (3) N_2O (4) NO_2

Q.46 H_2S gas changes a filter paper dipped in lead acetate solution into :
(1) Black (2) Red (3) Green (4) Yellow

Q.47 Aqua regia is mixture of –
(1) 3HCl + HNO_3 (2) 3HNO_3 + HCl (3) H_3PO_4 + HCl (4) PH_3 + HClO

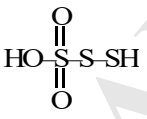
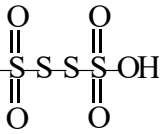
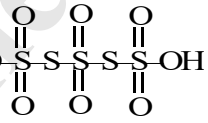
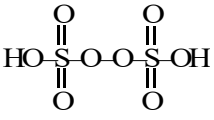
Q.48 Oil of vitriol is :
(1) H_2SO_4 (2) H_2SO_3 (3) $H_2S_2O_9$ (4) $H_2S_2O_8$

Q.49 The number of molecules of water needed to convert one molecule of P_2O_5 into orthophosphoric acid is –
(1) 2 (2) 3 (3) 4 (4) 5

Q.50 A gas that cannot be collected over water is :
(1) N_2 (2) O_2 (3) SO_2 (4) PH_3

Q.51 Sulphuric acid can not be used as :
(1) Hygroscopic agent (2) oxidising agent
(3) sulphonating agent (4) efflorescent

Q.52 The structure of peroxodisulphuric acid is :

(1)  (2)  (3)  (4) 

Q.53 The most stable allotropic form of sulphur is :
(1) Rhombic sulphur (2) monoclinic sulphure
(3) plastic sulphur (4) flowers of sulphur

Q.54 Cyclic trimer structure of SO_3 contains :-
(1) 6 S=O bonds and three S–O–S bonds (2) 3 S=O bonds and six S–O–S bonds
(3) 6 S=O bonds and six S–O–S bonds (4) None of these

Q.55 When H_2S is passed through nitric acid solution, the product formed is :
(1) milk of sulphur (2) colloidal sulphur (3) γ – sulphur (4) β – sulphur

Q.56 The halogen that is most easily reduced is ?
(1) F_2 (2) Cl_2 (3) Br_2 (4) I_2

Q.57 Ozone is -
(1) An isobar of oxygen (2) An isotope of oxygen
(3) A polymer of oxygen (4) An allotrope of oxygen

Q.58 Which halogen does not react with water :
(1) F_2 (2) Cl_2 (3) Br (4) I_2

Q.59 One gas bleaches the colour of the flowers by reduction while the other by oxidation. The gases are-
(1) CO and CO_2 (2) H_2S and Br_2 (3) SO_2 and Cl_2 (4) NH_3 and SO_3

Q.60 The commercial name for peroxodisulphuric acid is -
(1) Sulphuric acid (2) Marshall's acid
(3) Sulphuric acid crystals (4) Sulphurous acid

Q.61 Volatile nature of halogen is because :
(1) Halogen molecules are bonded by strong forces
(2) Halogen molecules are bonded by electrostatic forces
(3) The forces existing between the discrete molecule are only weak vander Waals force.
(4) Halogen molecules are more reactive

Q.62 Oxygen is more electronegative than sulphur, yet H_2S is acidic while H_2O is neutral. This is because-
(1) Water is a highly associated compound
(2) H – S bond is weaker than H – O bond
(3) H_2S is a gas while H_2O is a liquid
(4) The molecular weight of H_2S is more than that of H_2O

Q.63 The acidic character of dioxides of members of oxygen family decreases in the order -
(1) $SeO_2 > SO_2 > TeO_2 > PoO_2$ (2) $SO_2 > SeO_2 > Te O_2 > PoO_2$
(3) $PoO_2 > TeO_2 > SeO_2 > SO_2$ (4) $TeO_2 > PoO_2 > SeO_2 > SO_2$

Q.64 The reaction - $3ClO^-(aq) \rightarrow ClO_3^-(aq.) + 2Cl^-(aq.)$ is an example of :-
(1) Oxidation reaction (2) Reduction reaction
(3) Disproportionation reaction (4) Decomposition reaction

Q.65 H_2SO_4 reacts with sugar and acts as -
(1) A dehydrating agent (2) An oxidizing agent
(3) A sulphonating agent (4) None of these

Q.66 If Cl_2 gas is passed into aqueous solution of KI containing some CCl_4 and the mixture is shaken, then :
(1) Upper layer becomes violet (2) Lower layer becomes violet
(3) Homogeneous violet layer is formed (4) None of these

Q.67 Which of the following statements about the halogen is correct ?
(1) They are all diatomic and forms univalent ions
(2) They are all diatomic and forms divalent ions
(3) All shows variable oxidation state
(4) All

Q.68 A greenish yellow gas reacts with an alkali metal hydroxide to form a halate which can be used in fire works and safety matches. The gas and halate respectively are :
(1) Br_2, $KBrO_3$ (2) Cl_2, $KClO_3$ (3) l_2, $NalO_3$ (4) Cl_2, NaClO

Q.69 The property of halogen acids, that indicated incorrect is -
(1) HF > HCl > HBr > HI.....acidic strength
(2) HI > HBr > HCl > HF.....reducing strength
(3) Hl > HBr > HCl > HF.....bond length
(4) HF > HCl > HBr > HI .....thermal stability

Q.70 The inert gases can be isolated and separated by:-
(1) Electrolysis of their compounds (2) Fractional distillation of liquid air
(3) Adsorption on charcoal (4) Both (2) and (3)

Q.71 Which of the noble gases is most reactive :-
(1) He (2) Ne (3) Kr (4) Xe

Q.72 In the clatherates of Xenon with water, the nature of bonding between Xenon and water molecule is
(1) Covalent (2) Hydrogen bonding
(3) Coordinate (4) Dipole induced dipole interaction

Q.73 The forces acting between noble gas atoms are
(1) Vander Waals forces (2) Ion-dipole forces
(3) London/dispersion forces (4) Magnetic forces

Q.74 The lightest gas which is non inflammable is :-
(1) O_2 (2) N_2 (3) H_2 (4) He

Q.75 XeF_4 on partial hydrolysis produces -
(1) XeF_2 (2) $XeOF_2$ (3) $XeOF_4$ (4) XeO_3

Q.76 Helium is added to oxygen used by deep sea divers because :
(1) It is less soluble in blood than nitrogen under high pressure
(2) It is lighter than nitrogen
(3) It is readily miscible with oxygen
(4) It is less poisonous than nitrogen

Q.77 The structure of XeF_6 is :
(1) Distorted octahedral (2) Pyramidal (3) Tetrahedral (4) None of these

Q.78 The xenon compound(s) that are iso-structural with IBr_2^- and BrO_3^- respectively are :
(1) Linear XeF_2 and pyramidal XeO_3 (2) Bent XeF_2 and pyramidal XeO_3
(3) Bent XeF_2 and planar XeO_3 (4) Linear XeF_2 and tetrahedral XeO_3

ANSWER KEY

Q.1	4	Q.2	2	Q.3	2	Q.4	3	Q.5	4	Q.6	1	Q.7	1
Q.8	4	Q.9	4	Q.10	2	Q.11	4	Q.12	1	Q.13	4	Q.14	2
Q.15	1	Q.16	2	Q.17	3	Q.18	3	Q.19	1	Q.20	1	Q.21	1
Q.22	1	Q.23	2	Q.24	4	Q.25	1	Q.26	4	Q.27	1	Q.28	2
Q.29	2	Q.30	2	Q.31	4	Q.32	4	Q.33	3	Q.34	4	Q.35	1
Q.36	3	Q.37	4	Q.38	3	Q.39	4	Q.40	3	Q.41	2	Q.42	2
Q.43	4	Q.44	3	Q.45	3	Q.46	1	Q.47	1	Q.48	1	Q.49	2
Q.50	3	Q.51	4	Q.52	4	Q.53	3	Q.54	1	Q.55	1	Q.56	1
Q.57	4	Q.58	4	Q.59	3	Q.60	2	Q.61	3	Q.62	2	Q.63	2
Q.64	3	Q.65	1	Q.66	2	Q.67	1	Q.68	2	Q.69	1	Q.70	4
Q.71	4	Q.72	4	Q.73	3	Q.74	4	Q.75	2	Q.76	1	Q.77	1
Q.78	1	Q.79	4	Q.80	3	Q.81	4	Q.82	1	Q.83	2	Q.84	1
Q.85	3	Q.86	2	Q.87	3	Q.88	3	Q.89	1				