P - BLOCK ELEMENTS

1.Q.Why does NO_2 dimerise?

2.Q.Give chemical reactions involved in brown ring test to confirm nitrates.

3. Q.Give the structure of nitric acid.

4. Q.Give equations in each step of oswald's process
5.Q.Give flow chart for preparation of ammonia by Haber's process.
6.Q.Explain preparation of nitrogen.

7.Q. Why do chromium and aluminium not react with the most oxidizing agent?
8.Q. Name the oxides of nitrogen and give oxidation number of each oxide.

9.Q. Give conditions which favors formation of ammonia as it is a reversible reaction.

10.Q. Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?
11.Q.Whichoxoacids of phosphorus are reducing in nature?
12.Q.Why is phosphorus acid diprotic and phosphoric acid triproticinpite 3 hydrogens in both?
13.Q.Give the structure of oxy acids of phosphorus and list the anions formed.
14.Q.Why does PCl_3 fume in moisture?
15 Q.Show that PH_3 is basic in nature.
16 Q.Give reason that NCl_5 is not formed but PCl_5 is formed.
.17.Show that hydrogen peroxide behaves both as an oxidizing and reducing agent.

18.Q.What is oleum? Draw its structure.
19.Q.What happens when sulphur is passed through conc. H_2SO_4 solution and SO_2 is passed through an aqueous solution of Fe(III) salt?
20. Q.Whyare halogens coloured?

P – BLOCK

ANS.

1.NO_2 contains odd number of valence electrons. It behaves as an odd electron molecule and therefore undergoes dimerisation to form stable N_2O_4 molecule with even number of electrons.

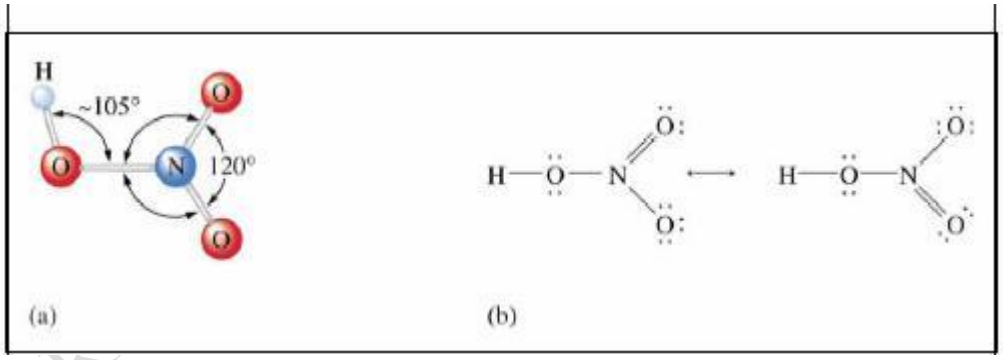
2.

The brown ring tests depend on the ability of ferrous ion to reduce nitrates to nitric oxide, which reacts with ferrous ion to form a brown colored complex.

$$NO_3^{-1} + 3Fe^{2+} + 4H^+ \rightarrow NO + 3\,Fe^{3+} + 2H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow [Fe(H_2O)_5(NO)]^{2+} + H_2O$$

3



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4.

Nitric acid is produced industrially by the Ostwald Process, which involves three steps:

Step 1: Catalytic oxidation of ammonia

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

Step 2: Oxidation of nitric oxide

$$2NO + O_2 \longrightarrow 2NO_2$$

Step 3: Reaction with water and oxygen to form nitric acid:

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

5.

nitrogen + hydrogen ⟶ ammonia (+ heat)

The process operates continuously and the recycling of the unreacted nitrogen and hydrogen, gives overall conversion of about 98%.

6.Air is liquefied, and the oxygen which is about 20.9% gets boiled off at -183°C, leaving liquid nitrogen behind, which boils at -196°C .This process is known as Fractional distillation. Nitrogen can also be made by heating NaN_3 to 300 degrees C. Annual worldwide production is around 44,000,000 tons.

7.These elements form a passive layer of oxide on the surface and prevent the metal to react with nitric acid.

8.The common oxides of nitrogen include examples of nitrogen with every oxidation number from +1 to +5

N as +1: N_2O

N as +2: NO

N as +3: N_2O_3

N as +4: NO_2

N as +5: N_2O_5

9.The reaction is reversible. Only about 15-20 % of the reactants are converted into products.The forward reaction) is exothermic.

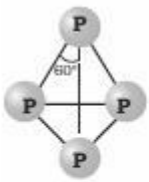
Amount of product or yield from a reversible reaction depends on temperature, pressure and catalyst

Decreasing the temperature favors exothermic reactions.

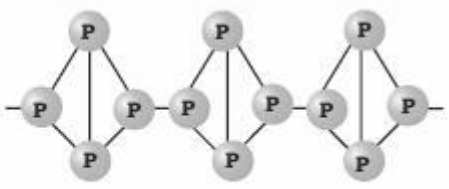
Increasing the pressure favors smaller volume.

Using a catalyst gives the equilibrium conditions more quickly.

10.



Red phosphorus



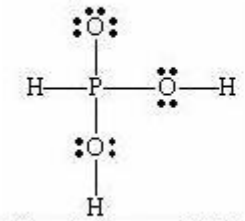
Red phosphorus

White phosphorus is less stable and therefore, more reactive than the red phosphorus under normal conditions because of angular strain in the P_4 molecule where the angles are 60° only.

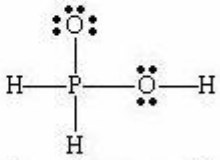
11.

All acid which have P-H bond are reducing in nature.

Example



Phosphorous acid, H_3PO_3



Hyphosphorous acid, H_3PO_3

(1x20)

1. Which of NH_3 and H_3O^+ has higher bond angle and why?
2. Which of PH_4I and PH_4Cl is more stable and why?
3. What is the basicity of H_3PO_3 and H_3PO_4?
4. NH_3 is easily liquefiable than PH_3?
5. Which of NH_3 and PH_3 is stronger Lewis base and why?
6. Why does NO_2 dimerise?
7. N_2O_4 is colourless but NO_2 is brown in colour?
8. Write the products of hydrolysis of ClF_3.
9. Why is S_2 paramagnetic?
10. Why does not SO_3 disproportionate?
11. Why Cl_2 bleaches permanently but SO_2 temporarily?
12. Why is He used in observation balloons?
13. Why is SF_6 resistant to hydrolysis?
14. What is the geometry and shape of ClF_5?
15. Why is ICl more reactive than I_2?
16. Arrange following in increasing order of their reactivity.

    IF, F_2 and I_2
17. Xe is more reactive than He. Why?
18. Does the hydrolysis of XeF_6 lead to a redox reaction? Why?
19. H_2S is less soluble in water than H_2Se .Why?
20. Trimethylamine is more basic than tri silylamine. Why?

Answer:(20x1)

1. H_3O^+because central atom has higher electronegativity thus it pulls bond pairs of electrons towards itself and bp-bp repulsion increases.

2. PH_4I is more stable PH_4^+ is bigger cation and I- is bigger anion so offers effective crystal packing and has larger lattice enthalpy.
3. 2 and 3
4. Due to intermolecular H- bonding in NH_3.
5. NH_3 because of its smaller size it has greater charge density on nitrogen.
6. In NO_2, there is an odd electron.
7. In N_2O_4 there is no unpaired electron.
8. $ClF_3 + 2H_2O$ -----→ $3HF + HClO_2$
9. Due to presence of unpaired electrons on anti-bonding orbitals.
10. Sulphur is in highest oxidation state.
11. Cl_2 bleaches by oxidation but SO_2 bleaches by reduction.
12. He is very light.
13. SF_6 if sterically protected.
14. Geometry-Octahedral and shape: square pyramidal
15. ICl has low bond dissociation enthalpy.
16. $I_2 > F_2 > IF$
17. Less I.E.
18. No, because the oxidation state of Xe does not change.
19. H2Se has stronger Vander wall's forces with water.
20. Due to presence of vacant of d- orbitals in Si, the pair of electron lying on N disperses via dπ-pπ back bonding.

(10x2)

1.Give reason for the following-

(A) Phosphorus is reactive but Nitrogen is much stable.

(B) Nitrogen is linear but Phosphorus is tetrahedral.

2. Explain why?

(A)Nitrogen has stronger tendency of multiple bonding than that of Phosphorus.

(B)NCl_5 does not exist but PCl_5 exists.

3. Explain the chemistry of ring test of nitrate ion.

4. Draw the structures of following using VSEPR Model

XeO_2F_2 and XeO_3

5. Complete the following reactions:

(A) $Ca_3P_2 + H_2O$-------→

(B) Cu + Conc. HNO_3 -------→

6. Give reason for the following:

(a)NO_2 has net dipole moment but N2O4 does not have?

(b)Phosphorus has greater catenation tendency than Nitrogen?

7. Explain following:

(1)Interhalogens are covalent, diamagnetic.

(2)I_2 is soluble in aqueous KI.

8. Arrange following according to the property shown against each:

(a) $HClO$, $HClO_3$, $HClO_4$, $HClO_2$ ------ Increasing order of acidity

(b)PH_3, NH_3, SbH_3, AsH_3, BiH_3 ------- Decreasing order of basicity

9. Arrange following according to the property shown against each:

(a) I_2, F_2, Cl_2, Br_2 ---------- Increasing order ease of liquefaction

(b)ClO, Cl_2O_3, Cl_2O_5, Cl_2O_7 ---------- Increasing acidity strength

10. Complete the following reactions:

(1)$P_4 + NaOH + H_2O$ ---------→

(2)$NaCl + MnO_2 + H_2SO_4$ ----------→

Answer (10x2)

1.

(A)N_2 has much higher bond enthalpy..

(B)In N_2, N is sp-hybridized but in P_4, P is sp^3- hybridized.

2. (A)N- has three unpaired electrons in p-orbital, has high effective nuclear charge and small atomic size to undergo greater overlapping of the orbitals.

(B)N does not have d- orbitals.

3. $3Fe^{2+} + NO_3^{-1} + 4H^+$ ----------→ $3Fe^{3+} + NO + 2H_2O$

$[Fe(H_2O)_6]^{2+} + NO$ ---------→$[Fe(H_2O)_5(NO)]^{2+} + H_2O$

(brown ring)

4. Each correct structure one mark

5. (A) $Ca_3P_2 + 6H_2O$-------→$3Ca(OH)_2 + 2PH_3$

(B) $Cu + 4HNO_3$ -------→$Cu(NO_3)_2 + 2NO_2 + 2H_2O$

6. (a)In NO_2 there is an odd electron on nitrogen.

(b)P-P bond is stronger than N-N bond.

7.

(1)Because they have high electronegativity and paired electrons.

(2)It forms KI_3

8.

(a) $HClO$, $HClO_2$, $HClO_3$, $HClO_4$

(b)NH_3, PH_3, AsH_3, SbH_3, BiH_3

9. Arrange following according to the property shown against each:

(a) F_2, Cl_2, Br_2, I_2

(b)ClO, Cl_2O_3, Cl_2O_5, Cl_2O_7

10. Complete the following reactions:

(1)$P_4 + 3NaOH + 3H_2O$ ---------→ $PH_3 + 3NaH_2PO_2$

(2)$4NaCl + MnO_2 + 4H_2SO_4$ ----------→ $MnCl_2 + 4NaHSO4 + Cl_2 + 2H_2O$

(10x3)

1. Give reason for the following-

i) NO_2 is acidic oxide but NO is neutral?

ii) NH_3 has greater tendency of complex formation than PH_3?

iii) PH_3 dissolves in HI. Why?

2. Explain for the following-

a) H_3PO_3 shows disproportionation reactions?

b) PCl_5 in solid state exists as an ionic compound?

c) $BiCl_5$ is a strong oxidizing agent?

3. Explain the structure of the following compounds using VSEPR theory

a) PCl_6^{-1} b) SF_4 c) ICl_2^{-1}

4.Give the comparative account of the chemistry of carbon and silicon with regard to their:

[i] property of catenation

[ii] stability of hydrides and oxides

5.Account for the following:

[i] Ammonia has higher boiling point than phosphine

[ii] Trimethyl ammine is pyramidal and trisilyl ammine is planar.

[iii] Ammonia is stronger base than phosphine.

6.Describe the following about halogen family:

[i] Oxidising power

[ii] Relative acidic strength of their hydrides

[iii] Relative reducing strength of their hydrides.

7.Give reason for the following observations.

[i] Noble gases are mostly chemicallly inert

[ii] Nitrogen does not form pentahalide

[iii] Bismuth is a strong oxidising agent in pentavalent state

8. Arrange following according to the property shown against each:

a)NO_2, P_2O_3, N_2O_5, P_2O_5, As_2O_3, Bi_2O_3 --- Increasing acidity strength

b)PH_3, NH_3, SbH_3, AsH_3, BiH_3 ----- Decreasing order of thermal stability

c)Xe, He, Ne, Kr, Ar, ---------- Increasing order ease of liquefaction

9. Complete following reactions:

1)NH_3 + AgCl ---------→

2)$XeF_2 + H_2O$ ----------→

3)$NaNO_2 + NH_4Cl$ -------→

10. How does ozone reacts with following

i) NO ii) PbS iii) Aq. KI

Answer(10x3)

1.

i) More oxygen contents in NO_2 than NO.

ii) NH_3 is stronger Lewis base

iii) PH_3 is a base and HI is acid so gives PH_4I

2.

a) The O.S. of P is +3 so it can undergo oxidation as well as reduction.

b) It exists as $[PCl_4]^+[PCl_6]^-$

c) Bi is in +5 oxidation state but its stable O.S. is +3

3. correct structure

4.

[i] P- has greater catenation tendency than N

[ii] The oxides and hydrides of N are more stable than that of P

5.

[i] Due to inter molecular H- bonding

[ii] presence of d- orbitals in Si can allow dπ-pπ back bonding thereby dispersing lone pair.

[iii] The lone pair lying on N in NH_3 can be easily donated due to greater charge density on nitrogen..

6.

[i] $F_2 > Cl_2 > Br_2 > I_2$

[ii] HI>HBr>HCl>HF

[iii] HI>HBr>HCl>HF

7.Give reason for the following observations.

[i] They have very high I.E. and completed octet

[ii] Absence of d- orbitals

[iii] Inert pair effect

8.

a) N_2O_5,NO_2, P_2O_5,P_2O_3, As_2O_3, Bi_2O_3

b)NH_3,PH_3,AsH_3, SbH_3, BiH_3

c), He, Ne, Ar, Kr,Xe

9.

1) $2NH_3 + AgCl \longrightarrow [Ag(NH_3)_2]Cl$

2)$2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

3)$NaNO_2 + NH_4Cl \longrightarrow NaCl + N_2 + 2H_2O$

10. How does ozone reacts with following

i) $NO + O_3 \longrightarrow NO_2 + O_2$

ii) $PbS + 4O_3 \text{-------} \rightarrow PbSO_4 + 4O_2$

iii) $Aq.\ 2KI + O_3 + H_2O \text{-----} \rightarrow 2KOH + I_2 + O_2$

(5x5)

1. A white coloured salt (A) on treatment with conc. H_2SO_4 gives a pungent smelling gas (B) which turns moist blue litmus to red. The gas (B) oxidizes in presence of MnO_2 to yield a greenish yellow gas (C). The gas (C) is used in disinfecting drinking water and decolourising the wood pulp in paper industries. Identify A , B and C and write necessary equations.

2 .Give reason for the following observations.

a) HF is weakest acid and HI is strongest.

b)Fluorides of Xe undergo hydrolysis readily

c)Oxygen is diatomic but S is octatomic?

d)Reaction of NaBr and H_2SO_4 does not form HBr but it forms Br_2 gas.

e)HF is liquid but HCl is a gas.

3 .Arrange following according to the property shown against each:

a) $HClO, HClO_3, HClO_4, HClO_2$ ------ Increasing order of acidity

b) HClO, HBrO, HIO, HFO -------- Increasing order of acidity

c) F_2, O_2, Cl_2, Br_2 ------- ---------- Increasing order of oxidizing tendency

d) $PH_3, NH_3, SbH_3, AsH_3, BiH_3$ -------- Decreasing order of bond angle

e) I_2, F_2, Cl_2, Br_2 ---------- Increasing order of b.p.

4. A element (X) on heating with Conc. NaOH yields a poisonous gas(Y) and spontaneously catches fire. The gas (Y) reacts with $Aq.HgCl_2$ to form precipitate (Z). Identify X , Y and Z and write necessary equations.

5 . Draw the structure of the following compounds using VSEPR theory.

XeF_6,$XeOF_4$, XeO_3,PCl_3,White Phosphorus (P4)

<u>Answer: 5 Marks</u>

1. (A)=NaCl

(B)=HCl

(C)= Cl_2

$4NaCl\ (A) + 4H_2SO_4 \text{----------} \rightarrow NaHSO_4 + HCl(B)$

$4HCl + MnO_2 \text{-----} \rightarrow MnCl_2 + 2H_20 + Cl_2(C)$

2 . a) Bond dissociation enthalpy of HF is more than HI

b)Presence of vacant d- orbitals in Xe

c)O=O is stronger than S=S

d)Because H_2SO_4 oxidisesHBr to Br_2

e)Presence of intermolecular H- bonding in HF.

3 .

a) $HClO$, $HClO_2$, $HClO_3$, $HClO_4$

b) HFO,HClO,HBrO, HIO

c) Cl_2, Br_2 ,O_2,F_2

d) NH_3,PH_3, AsH_3, SbH_3,BiH_3

e) F_2, Cl_2, Br_2,I_2

4

X= P_4

Y= PH_3

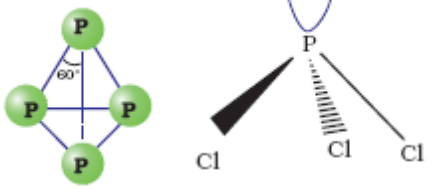
Z= Hg_3P_2

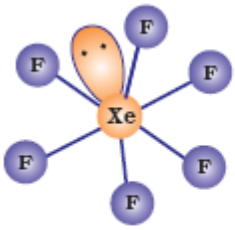
$P_4 + 3NaOH + 3H_2O$ ---------→ $PH_3 + 3NaH_2PO_2$

$2\ PH_3 + 3\ HgCl_2$ ----------→Hg_3P_2 + 6 HCl

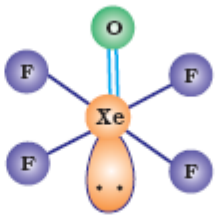
5 .

Structures

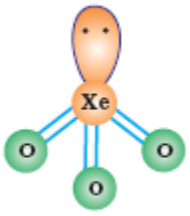




(c) Distorted octahedral



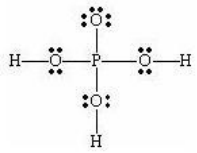
(d) Square pyramidal



(e) Pyramidal

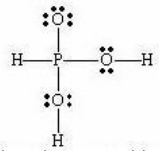
12.

Structure of phosphoric acid is



Phosphoric acid, H_3PO_4

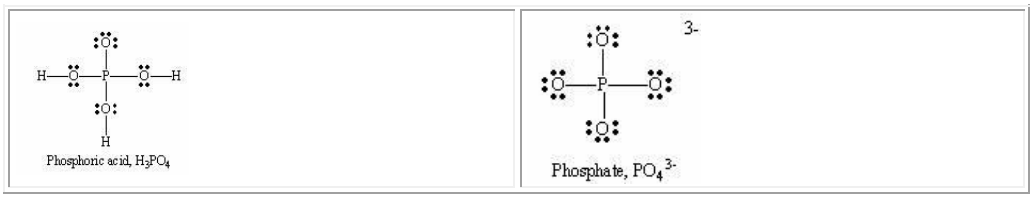
and has 3 ionisable hydrogens.
In phosphorus acid there are 2 ionisable hydrogens the third one is bonded to phosphorus.

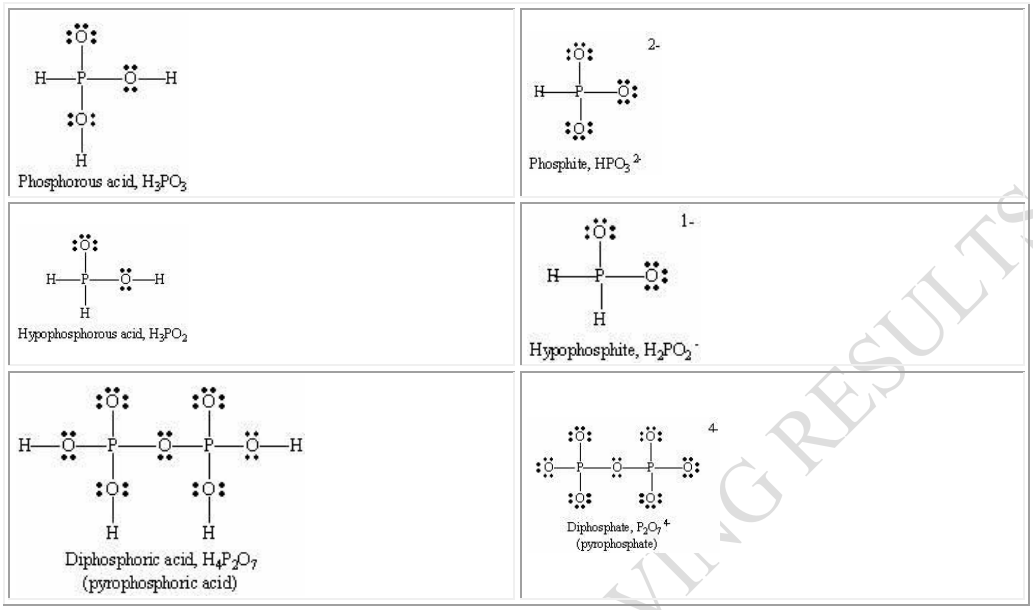


Phosphorous acid, H_3PO_3

13.

OXYACID	OXYANION





14.

It hydrolyses in moisture giving fumes of HCl.

$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

15.PH_3 has a lone pair of electron and readily reacts with acids like HI and forms.

16.Nitrogen does not have usable d orbitals and cannot expand its octet. Phosphorus can expand its valence shell to hold more than eight electrons, but nitrogen cannot.

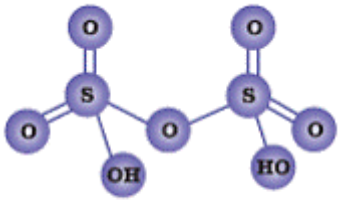
$PH_3 + HI \rightarrow PH_4I$.

17.It produces oxygen and acts as a oxidizing agent in both acid and basic medium:

$Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

As a reducing agent $HOCl + H_2O_2 \rightarrow H_2O + Cl^- + O_2$

18.Oleum is a oxoacid of sulphur and is a pyrosulphuric acid.- $H_2S_2O_7$



Pyrosulphuric acid (Oleum)
($H_2S_2O_7$)

19.

When sulphur is passed through conc H_2SO_4 solution it forms SO_2

$3S + 2H_2SO_4$ (conc.) $\longrightarrow 3SO_2 + 2H_2O$

When SO_2 is passed through an aqueous solution of Fe(III) salt, it converts Fe(III) ions to Fe(II)

$2Fe^{3+} + SO_2 + 2H_2O \longrightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$

20.Absorption of radiations in visible region by halogen atoms, results in the excitation of outer electrons to higher energy level. By absorbing radiation of different wavelength, they display different colours. For example, F_2 has yellow, Cl_2 has greenish yellow colour, Br_2 has red colour and I_2 has violet colour.