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www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Class: 12
Subject: Chemistry
Topic: P block elements
No. of Questions: 27

1. How red phosphorous can be obtained?

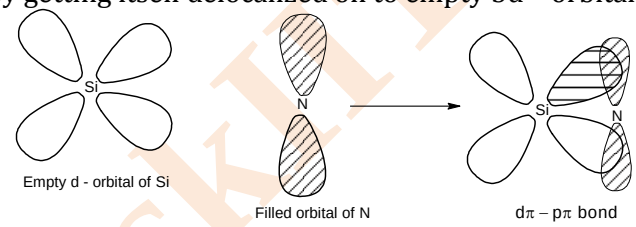
Sol. Red phosphorus is formed by exposing white phosphorous to sunlight or heating it under pressure above 275°C.

2. How arsenic is used in preventing wooden article?

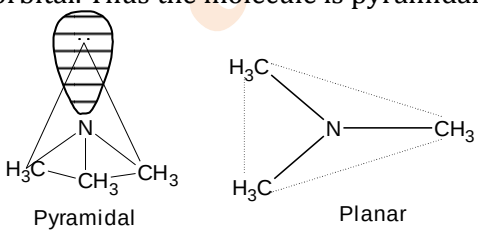
Sol. It is used in the form of a compound called chromated copper arsenate (CCA) and is added to wood which prevents organism growing in the wood and causing it to root.

3. Trisilyl amine, $N(SiH_3)_3$ is planar whereas trimethyl amines $N(CH_3)_3$ is pyramidal. Explain.

Sol. In $N(SiH_3)_3$, N attains sp^2 hybridization and the lone pair of N is involved in $d\pi$ - $p\pi$ bonding by getting itself delocalized on to empty 3d – orbitals of silicon.



But in $N(CH_3)_3$, N is sp^3 hybridized in which three of the hybrid orbitals are used in forming σ - bonds with NH_3 groups, while the lone pair is present in the fourth hybrid orbital. Thus the molecule is pyramidal.



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4. Give the reasoning for decrease in bond angle in the hydrides of group 15 down the group.
Hydride : $NH_3 > PH_3 > AsH_3 > SbH_3$
H – M – H angle : $107° > 92° > 90°$

Sol. This is due to the decrease in electronegativity of the central atom of hydride. As the electronegativity decrease the electron which were more close to central atom at lower hydrides tends to more far from it and bp – bp repulsion decreases.

5. Why b.p of hydrides of group 15 increases top to bottom (PH_3 to BiH_3)?

Sol. It is due to increase in the magnitude of van der waal forces due to increase in the size of the molecules.

6. Phosphorus can form PCl_5 but nitrogen can not form NCl_5 why?

Sol. Phosphorus forms PCl_5 due to availability of vacant d – orbital though white P can extend its oxidation state but this is not applicable in case of N due to unavailability of d – orbitals.

7. Why NCl_3 can not be hydrolysed?

Sol. Due to unavailability of vacant d – orbitals.

8. Why the hexahalides with Cl, Br and I are not formed by group 16 elements?

Sol. Due to the bigger size of these halogen atoms a co-ordination number of six is not achieved.

9. Write the following oxides in their decreasing bond angle.
OF_2, Cl_2O, Br_2O

Sol. $Br_2O > Cl_2O > OF_2$

10. Why fluorine form only hypohalous acid (HOF) but chlorine and higher halogens forms a series of oxyacids?

Sol. Due to unavailability of d – orbitals.

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11. Name one non – metal which is liquid at room temperature.

Sol. Bromine

12. Why fluorine can be obtained by electrolysis method?

Sol. Fluorine being the strongest chemical oxidizing agent therefore, the only practicable method of preparing elemental fluorine is by an electrolytic method.

13. How is dinitrogen prepared in the laboratory?

Sol. Dinitrogen is prepared in the laboratory by reacting an aqueous solution of NH_4Cl with sodium nitrite.

$$NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2(g) + 2H_2O(\ell) + NaCl(aq)$$

14. Complete the following equations:

(i) $(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}}$

(ii) $2NH_3 + A \longrightarrow B + 3Cu + 3H_2O$

Sol. (i) $(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_2 + 4H_2O + Cr_2O_3$

(ii) $A \longrightarrow 3CuO$ and $B \longrightarrow N_2$

15. How is dioxygen prepared in the laboratory?

Sol. Dioxygen is prepared by the thermal decomposition of $KClO_3$ using MnO_2 as a catalyst.

$$2KClO_3(s) \xrightarrow[\text{Heat}]{MnO_2} 2KCl(s) + 3O_2(g)$$

16. What happens when (give chemical equation)?

(i) Mixture of ammonia and oxygen is passed platinum gauge at 1100K.

(ii) A mixture of dinitrogen and dioxygen is subjected to an electric discharge.

Sol. (i) $4NH_3 + 5O_2 \xrightarrow[\substack{5-10\ \text{atm}\\ 1100\ \text{K}}]{\text{Pt}} 4NO + 4H_2O$

(ii) $N_2 + O_2 \xrightarrow[\text{electric arc}]{3000\text{K}} 2NO$

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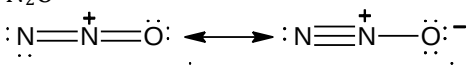
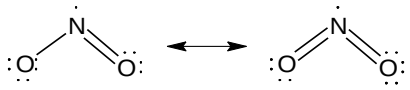
17. Write the Lewis structures of N_2O, NO_2 and N_2O_5.

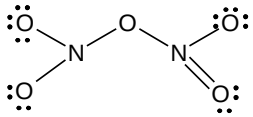
Sol. N_2O



NO_2

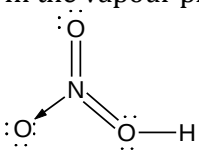


N_2O_5

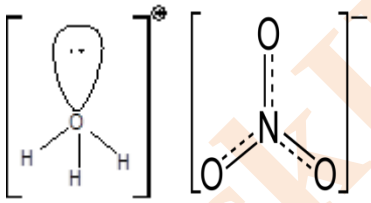


18. Give the structure of nitric acid in
(i) the vapour phase
(ii) aqueous solution

Sol. (i) In the vapour phase, HNO_3 exist as trigonal planar with N atom sp^2 hybridized.



(ii) In the aqueous solution, HNO_3 exists as hydronium ion and nitrate ion.



19. Complete and balance the following equations:
(i) $CS_2(\ell) + O_2(g) \longrightarrow$
(ii) $P_4(s) + O_2(g) \longrightarrow$

Sol. (i) $CS_2(\ell) + 3O_2(g) \longrightarrow CO_2(g) + 2SO_2(g)$
(ii) $P_4(s) + 5O_2(g) \longrightarrow P_4O_{10}(s)$

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20. Explain the oxidizing properties of ozone.

Sol. Ozone is a very powerful oxidizing agent because on decomposition it forms atomic oxygen.

$$O_3(g) \longrightarrow O_2(g) + (O)$$

Examples of reaction in which ozone acts as an oxidizing agent.

(i) $5O_3 + I_2 + H_2O \longrightarrow 5O_2 + \underset{\text{Iodic acid}}{2HIO_3}$

(ii) $\underset{\text{Lead Sulphide}}{PbS} + 4O_3 \longrightarrow \underset{\text{Lead sulphate}}{PbSO_4} + 4O_2$

21. How is ozone estimated quantitatively?

Sol: When ozone reacts with an excess of potassium iodide solution buffered with a borate buffer (ph9.2) lodide is liberated which can be titrated against a standard solution of sodium thiosulphate. This is a quantitative method for estimating O_3gas.

22. NO_2 is coloured and readily dimerises. Why?

Sol: NO_2 contains odd number of valence electrons. It behaves as a typical odd molecules. On dimerization; it is converted to stable N_20_4 molecule with even number of electrons.

23. Write the balanced chemical equation for the reaction of Cl_2 with hot and concentrated NaOH. Is this reaction a dispropotionation reaction? Justify:

Sol: $3Cl_2 + 6NaOH \rightarrow 5Na\,Cl + NaClO_3 + 3H_2O$

Yes, chlorine from zero oxidation state is change to-1 and +5 oxidation states.

24. With what neutral molecule is ClO^- lsoelectronic ? is that molecule a lewis base?

Sol: ClF. Yes, it is Lewis base due to presence of lone pair of electron.

25. (i) How is $XeOF_4$ prepared ?
(ii) When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Why?

Sol:

$XeF_6 + H_2O \rightarrow Xe\,OF_4 + 2HF$

Its structure is square pyramidal .

(ii) its reaction with iron produces H_2

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$Fe+2HCl \rightarrow FeCl_2+H_2$

Liberation of hydrogen prevents the formation of ferric chloride.

26. Account for the following.
(i) Noble gas form compounds with F_2&O_2 only.
(ii) Sulphur shows paramagnetic behavior.

Sol: (i) F_2&O_2 are best oxidizing agents.
(ii) In vapor state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding pi * orbitals O_2 and, and, hence, exhibit paramagnetism.

27. Arrange the following in the increasing order of the property mentioned.
(i) HOCl, $HClO_2$, $HClO_3$,$HClO_4$ (Acidic strength)
(ii) As_2O_3, ClO_2, GeO_3, Ga_2O_3 (Acidity)
(iii) NH_3, PH_3, AsH_3, SbH_3 (HEH bond angle)

Sol: (i) Acidic strength:$HOCl<HClO_2<HClO_3<HClO_4$
(ii) Acidity: $Ga_2O_3<GeO_2<AsO_3<ClO_2$
(iii) Bond angle: $SbH_3<AsH_3<PH_3<NH_3$