



## CHEMISTRY

### PHYSICAL, INORGANIC, AND ORGANIC CHEMISTRY

### NITROGEN & OXYGEN FAMILY

#### Solved Example

1. Give reason, why elemental nitrogen exists as a diatomic molecule, whereas elemental phosphorus is a tetraatomic molecule.

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2. Why does nitrogen show catenation properties less than phosphorus.

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3. Write the allotropic forms of oxygen.

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4. Which allotropic form of sulphur is stable at room temperature ?

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5. Out of following forms of sulphur which one is paramagnetic in nature and why ?  $S_8$ ,  $S_6$  and  $S_2$

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6. Describe the changes which occur on heating sulphur

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7. Why does  $R_3P = O$  exist but  $R_3N = O$  does not (R is an alkyl group )?

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8. Explain the high reactivity of white phosphorus as compared to red phosphorus.

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9. Why are pentahalides more covalent than trihalides?

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10. Explain why  $NH_3$  is basic while  $BiH_3$  is only feebly basic ?

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11. Write the reaction of thermal decomposition of sodium azide

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12. What happens when: Itbr (a)  $NH_4Cl$  &  $NaNO_3$  is heated strongly  
(b)  $(NH_4)_2CO_3$  is heated. (c)  $NH_4NO_2$  is heated.

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13.  $P_4 + NaOH$  underset (warm) to Products.

Explain the reducing character of one of the products obtained by taking the example of copper sulphate.

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14. (A) Colourless salt +  $NaOH \xrightarrow{\Delta}$  (B) gas + (C) alkaline solution

(C) +  $Zn(\text{dust}) \xrightarrow{\text{warm}}$  gas (B), (A)  $\xrightarrow{\Delta}$  gas (D) +  $\underbrace{\text{liquid}(E)}_{\text{both triatomic}}$

Gas (B) given white fumes with HCl. Identify (A) to (E) and write the chemical reaction involved

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15. Anhydrous  $CaCl_2$ ,  $P_4O_{10}$  or concentrated  $H_2SO_4$  can not be used as drying agent for ammonia. Why?

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16. Why  $NH_3$  gas cannot be dried by passing over  $P_2O_5$ ,  $CaCl_2$  and  $H_2SO_4$ ?

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17. What happens ?

(a) When phosphine is heated at  $150^\circ C$ .

(b) When phosphine is dissolved in water in presence of light.

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18. Black (A) +  $H_2SO_4 \rightarrow (B)\text{gas} + (C)$

(B) +  $(CH_3COO)_2Pb \rightarrow (D)$  black ppt.

(C) +  $K_3[Fe(CN)_6] \rightarrow (E)$  blue.

(C) also decolourises acidified  $KMnO_4$ . Identify (A) to (E)

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19.  $NO_2$  can not be dried by an alkali, why ?

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20.  $O_3$  is a powerful oxidising agent. Write equation to represent oxidation of

(a)  $I^-$  to  $I_2$  in acidic solution,

(b) sulphur to sulphuric acid in the presence of moisture,

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21. Give the important applications of  $O_3$

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22. Ozone layer is being depleted. This is due to :

- A. NO emission from supersonic jets
- B. chlorofluorocarbon used as aerosols
- C. both A and B
- D. none of the above

**Answer:**

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23.  $O_3$  is a powerful oxidising agent. Write equation to represent oxidation of

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24. Give the important applications of  $O_3$

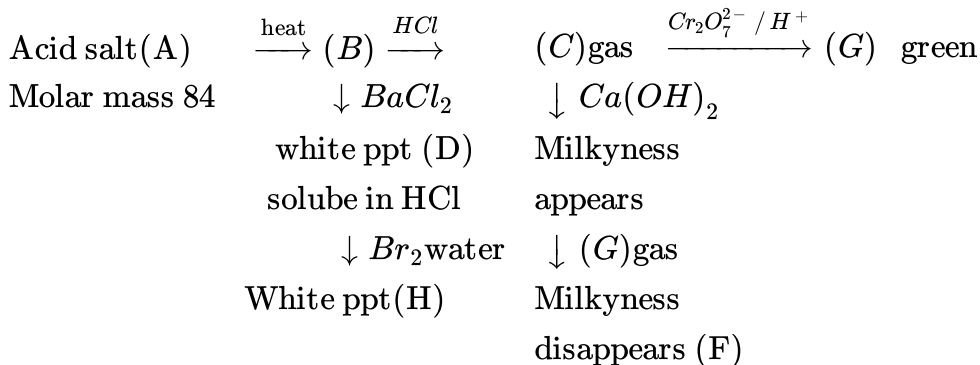
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25.  $SO_2$  and  $Cl_2$  both are used as bleaching agent. What factors cause bleaching ?

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26.



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27. Illustrate, how copper gives different products on reaction with  $\text{HNO}_3$ .

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28. (i) Sodium salt of an acid (A) is formed on boiling white phosphorus with NaOH solution.

(ii) On passing chlorine through phosphorus kept fused under water, another acid (B) is formed.

(iii) Phosphorus on treatment with concentrated  $HNO_3$  gives an acid (C) which is also formed by the action of dilute  $H_2SO_4$  on powdered phosphorite rock.

(iv) (A) on treatment with a solution of  $HgCl_2$  first gives a white precipitate of compound (D) and then a grey precipitate of (E). Identify (A) to (E) and write balanced chemical equation for the reactions at steps (i) to (iv)

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29. Why concentrated  $H_2SO_4$  can not be used for drying  $H_2S$ ?

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30. Can  $PCl_5$  act as oxidising as well as reducing agent ? Justify.

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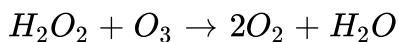
31. क्या होता है जब  $PCl_5$  को गर्म करते हैं?

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32. Colourless salt ( $A$ ) decolourise  $I_2$  solution and gives white precipitate (change to black) with  $AgNO_3$  solution. ( $A$ ) also produces pink colour with  $FeCl_3$  solution. Identify ( $A$ ) and explain reactions.

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33. In the following reaction explain which one is oxidising agent and which one is reducing agent ?



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1. Nitrogen forms a simple diatomic molecule but other elements of same group do not form. Explain.

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2. White phosphorus is very reactive, but not the red one. Why ?

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3. Which allotropic form of sulphur is thermodynamically stable at room temperature and pressure ?

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4. The important source of phosphorus is phosphorite rocks which is mainly phosphates. The same chemical compound is also present in bones. What is the formula of the compound(s)

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5. Why is Bi(V) a stronger oxidant than Sb(V) ?

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6. Nitrogen shows different oxidation states in the range \_\_\_ to \_\_\_. Its most stable oxidation state is \_\_\_

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7. The tendency to exhibit  $-3$  oxidation state by a group VA element decreases down the group. Why ?

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8. Why sulphur in vapour state exhibits paramagnetic behaviour at above  $800^{\circ}C$



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9. Write the following for a white phosphorus molecule

(a) oxidation state of P (b) covalency of P (c) total number of bonds (d) bond order (e) bond angle (f) geometry



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10. Tellurium forms oxides of the formula  $TeO$ ,  $TeO_2$  and  $TeO_3$ . What is the nature of these tellurium oxides ?



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11. Write the structure and oxidation number of sulphur in tetrathionate ion.



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12. Bond angle in  $\text{PH}_4^+$  is higher than that in  $\text{PH}_3$ . Why?

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13. Write the oxyacids of the following

Oxide	Oxyacids
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$\text{N}_2\text{O}_3$

$\text{NO}_2 / \text{N}_2\text{O}_4$

$\text{N}_2\text{O}_5$

$\text{P}_4\text{O}_6$

$\text{P}_4\text{O}_{10}$

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14.  $\text{N}_2$ ,  $\text{CO}$ ,  $\text{CN}^-$  and  $\text{NO}^+$  are isoelectronic but the former is chemically inert and latter three are very reactive, why?

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15. On moving down the group from  $O$  to  $Te$  acidic strength increases, why?

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16. What happens when barium azide is heated?

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17. Which stable elements of  $15^{th}$  and  $16^{th}$  group do not react with water under normal conditions?

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18. Chemiluminescence is a phenomenon in which an element glows in dark when exposed to moisture. Which element of  $15^{th}$  group shows this phenomenon?



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19. Among the hydrides of group 16, water shows unusual boiling point.

Why?

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20. Ammonium salts generally resemble those of potassium and rubidium in solubility & structure. Give reason

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21. Write balanced equation when  $NH_3$  is dissolved in

(a) water (b) HCl (c) aq.  $CO_2$

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22. What happens when phosphine is absorbed in mercuric chloride solution ?

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23. On being slowly passed through water,  $PH_3$  forms bubbles but  $NH_3$  dissolves. Why is it so ?

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24. How is hydrazine prepared ?

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25. Both  $PH_3$  and  $NH_3$  are Lewis bases, but basic strength of  $PH_3$  is less than that of  $NH_3$ . Explain

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26. In the preparation of  $P_4O_6$ , a mixture of  $N_2$  and  $O_2$  is used rather than pure  $O_2$ , why ?

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27. A compound of 15<sup>th</sup> group element is used as a fast drying agent in the laboratory. If is

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28. Write the structures of the oxides:  $N_2O_3$ ,  $N_2O_5$

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29. Why does  $NO_2$  dimerise ?

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30. In the manufacture of sulphuric acid by the contact process, sulphur trioxide is not directly dissolved in water. Why ?

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31. How are  $SO_2Cl_2$ ,  $SO_3$  and  $SO_2$  obtained from sulphuric acid ?

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32. Sulphur on oxidation with hot sulphuric acid gives :

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33. Pentahalides of phosphorus are known, but not pentahydride. Why ?

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34. A compound 'X' which is a yellowish white powder is prepared by the reaction of white phosphorus with excess of dry  $Cl_2$ . Identify 'X'

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35. Which hydride of the oxygen family shows the lowest boiling point ?

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36. What happens when

(A)  $PCl_5$  is heated

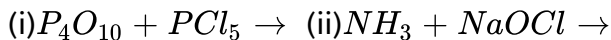
(b)  $PCl_5$  is reacted with heavy water

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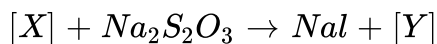
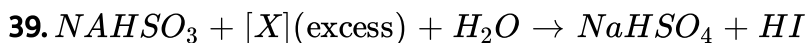
37. Why does  $PCl_3$  fume in moist air ?

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**38.** Complete and balance the following :



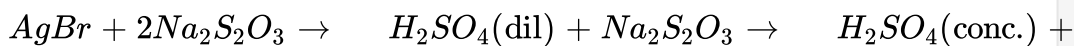
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Identify X and Y ?

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**40.** Identify the product of the given reaction:



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41. A and B are elements with atomic numbers 16 and 17. Write different combinations of binary compounds known from them

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### Exercise 1 Part II Only One Option Correct Type

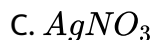
1. Which of the following is least reactive?

- A. White phosphorous
- B. Yellow phosphorus
- C. Red phosphorus
- D. Black phosphorus

**Answer: D**

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2. Nitrogen is obtained by the thermal decomposition of :



**Answer: D**



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3. In modern proces, white phosphorus is manufactured by :

A. heating a mixture of phosphorite mineral with sand and coke in an electric furnace

B. heating calcium phosphate with lime

C. heating bone ash with coke

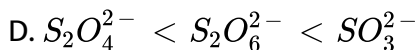
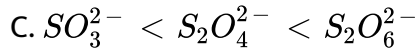
D. heating phosphate mineral with sand



**Answer: A**

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4. The oxidation states of sulphur in the anions  $SO_3^{2-}$ ,  $S_2O_4^{2-}$ , and  $S_2O_6^{2-}$  follow the order



**Answer: B**

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5. Correct statement about allotropy of sulphur is:

- A. Monoclinic sulphur is more stable than Rhombic sulphur at room temperature
- B. Both Monoclinic and Rhombic sulphur have same ring structures and crystalline structure
- C. Rhombic sulphur exists at room temperature
- D. None of these

**Answer: C**

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6. The nitrogen atom may complete its octet in several ways. Which one is incorrect ?

- A. Electron gain to form the nitride ion,  $N^{3-}$  e.g.,  $Li_3N$
- B. Formation of electron pair bonds e.g.  $NH_3$  or  $NF_3$  Azo compounds (  $-N=N-$  )

C. Formation of electron - pair bonds with electron gain e.g., Amide

ion  $NH_2^-$  and imide ion  $NH^{2-}$

D. Formation of electron pair bonds with electron gain :

$NH_4^+$ ,  $N_2H_5^+$ ,  $(C_2H_5)_4N^+$

**Answer: D**

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7.  $NH_4^+$ ,  $NH_3$ ,  $NH_2^-$ ,  $NH^{2-}$ , and  $N^{3-}$  are:  
Ammonium    Ammonia    Amide    Imide    Nitride

A. Isoelectronic

B. Isostructural

C. Homologous members

D. Nitrogen has different oxidation state

**Answer: A**

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8. How many  $P = O$  bonds are present in  $(HPO_3)_3$  ?

A. 0

B. 6

C. 3

D. 9

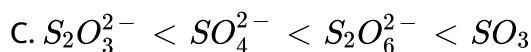
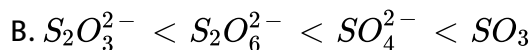
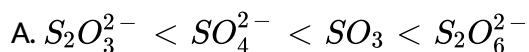
Answer: C

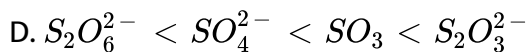


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9. The correct order of sulphur - oxygen bond energy in

$S_2O_3^{2-}$ ,  $SO_4^{2-}$ ,  $SO_3$  and  $S_2O_6^{2-}$  is





**Answer: C**



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**10.** Which of the following bonds has the highest energy?

A. Se - Se

B. Te - Te

C. S - S

D. O - O

**Answer: C**



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**11.** The wrong statement about  $N_2O$  is :

- A. It is nitrous oxide
- B. It is a neutral oxide
- C. It is not a linear molecule
- D. It is known as laughing gas

**Answer: C**

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**12. The hydrides of group 15 elements act as :**

- A. lewis acid
- B. lewis base
- C. both
- D. none

**Answer: B**

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13. The basic strength of the hydrides of group 15 elements :

- A. decreases on moving down the group
- B. increases on moving down the group
- C. first decrease upto  $AsH_3$  and then increases
- D. first increases upto  $AsH_3$  and then decreases

**Answer: A**



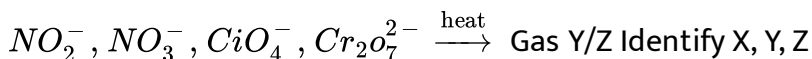
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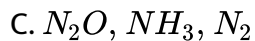
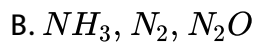
14. Ammonium salts decompose quite readily on heating :

(i) Ammonium salt of weak oxidizing anion (e.g.  $Cl^-$ ,  $CO_3^{2-}$ ,  $SO_4^{2-}$ )



(ii) Ammonium salt of strong oxidizing anion (e.g.

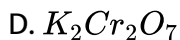
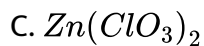
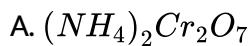




**Answer: B**

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**15.** Which of the following does not give oxygen on heating?



**Answer: A**

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16. Red and white phosphorus will differ but not in:

- A. smell
- B. solubility in  $CHCl_3$
- C. exhibiting phosphorescence
- D. reaction with concentrated  $HNO_3$

Answer: D



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17. Which of the following is incorrect ?

- A. Ammonia is prepared in the laboratory by the action of NaOH on Ammonium salt

B. All the hydrides of 15<sup>th</sup> group are colourless, highly volatile and poisonous gases

C. Metal phosphides upon hydrolysis given phosphine.

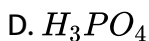
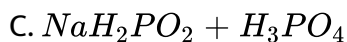
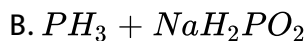
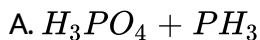
D. Metal phosphides upon hydrolysis give phosphoric acid

**Answer: D**

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18.  $P_4 + NaOH \xrightarrow{\text{warm}}$  Products

Products will be :



**Answer: B**

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19. Hydrolysis of Nitride of s-Block elements (for e.g.

$Ba_3N_2$ ,  $Ca_3N_2$ ,  $Li_3N$ ) will yield

A.  $NH_3$  + Metal hydroxide

B. only  $NH_3$

C.  $NH_3$  +  $HNO_3$

D.  $NH_4OH$

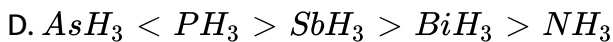
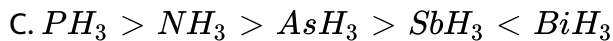
**Answer: A**

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20. The correct order of thermal stability of hydrides of group 15 is

A.  $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

B.  $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$



**Answer: B**

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21. One mole of calcium phosphide on reaction with excess of water give:

A. one mole of phosphine

B. two moles of phosphoric acid

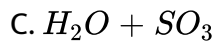
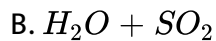
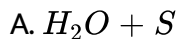
C. two moles of phosphine

D. one mole of phosphorus pentoxide

**Answer: C**

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22.  $H_2S$  burns in  $O_2$  to form

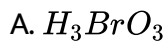


**Answer: B**



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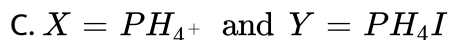
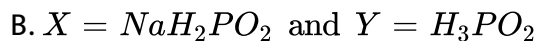
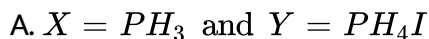
23.  $PH_3$ (anhydrous) +  $HBr$ (anhydrous)  $\rightarrow$  X. Identify X ?



**Answer: B**

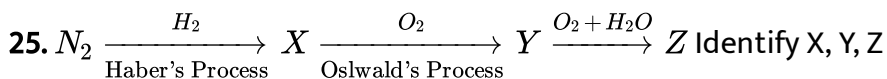
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24. Calcium phosphide reacts with water or dil. HCl and give a compound 'X', which fails to react with HCl but produces dense white fumes with  $HI(g)$  due to formation of 'Y'. Compound X and Y respectively



**Answer: A**

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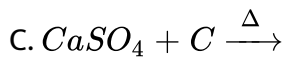
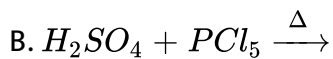
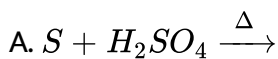




**Answer: B**

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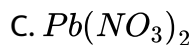
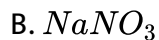
**26.** Sulphur trioxide can be obtained by which of the following reactions :



**Answer: D**

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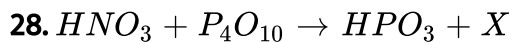
27.  $NO_2$  can be prepared by heating :



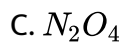
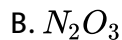
**Answer: C**



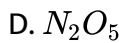
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in the above reaction the product  $X$  is :



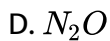
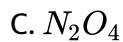
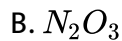
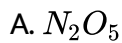




**Answer: D**

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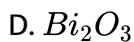
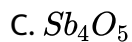
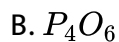
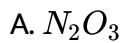
**29.** Which of the following oxides of Nitrogen is Neutral



**Answer: D**

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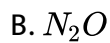
**30.** Which of the following oxides is amphoteric in nature ?



**Answer: C**

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**31. Following are neutral oxides except :**



**Answer: D**

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32. Aqueous solution of  $SO_2$  is a

- A. weak acid
- B. reducing agent
- C. bleaching agent
- D. All of these

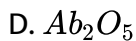
**Answer: D**



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33. Which of the following oxides is the most acidic?

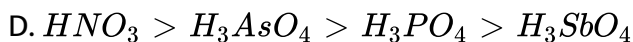
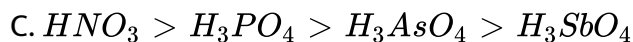
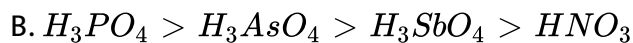
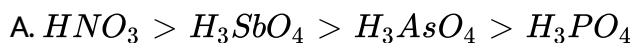
- A.  $N_2O_5$
- B.  $P_2O_5$
- C.  $As_2O_5$



Answer: A

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34. The correct order of decreasing acidic strength of oxyacids of group 15 elements is



Answer: C

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35. Industrial preparation of nitric acid by Ostwald's process involves.

- A. oxidation of  $NH_3$
- B. Reduction of  $NH_3$
- C. Hydrogenation of  $NH_3$
- D. Hydrolysis of  $NH_3$

**Answer: A**



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36. Which of the following is the most powerful oxidising agent:

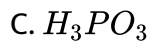
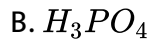
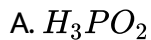
- A.  $H_2SO_4$
- B.  $HPO_3$
- C.  $H_3BO_3$
- D.  $H_3PO_4$

**Answer: A**



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37. When  $P_4O_{10}$  is dissolved in water, the acid formed finally is :

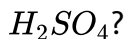


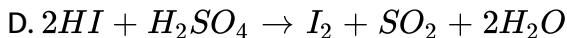
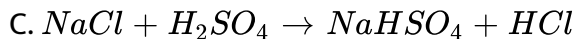
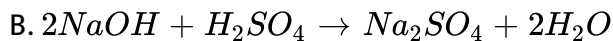
**Answer: B**



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38. Which of the following reactions depict the oxidising behaviour of

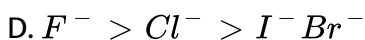
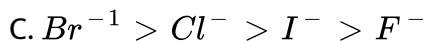
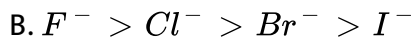
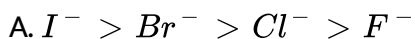




Answer: D

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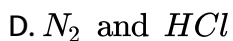
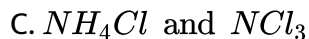
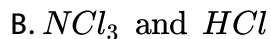
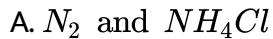
39. The order of stability of halides of sulphur with different halogens is



Answer: B

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40. Ammonia reacts with excess of chlorine to form

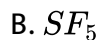
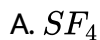


Answer: B

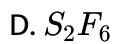


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41. A yellow coloured crystalline substance gave a colourless gas  $X$  on reaction with fluorine, which is thermally stable and has octahedral geometry.  $X$  can be



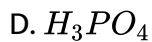
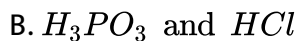




**Answer: B**

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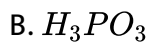
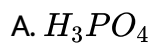
42.  $PCl_3$  reacts with water to form :



**Answer: B**

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43. The final product obtained on hydrolysis of  $PCl_5$  is

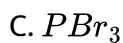
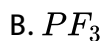


**Answer: A**



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44. Which of the following phosphorus halide is the best reducing agent?



**Answer: D**



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**45.** When sulphur is boiled with  $Na_2SO_3$  solution, the compound formed is

- A. sodium sulphide
- B. sodium sulphate
- C. sodium persulphate
- D. sodium thiosulphate

**Answer: D**



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**46.**  $Na_2S_2O_3$  is prepared by :

- A. reacting  $H_2S_2O_3$  with NaOH
- B. reacting  $Na_2SO_4$  with S in alkaline medium
- C. heating NaOH and S
- D. reducing  $Na_2SO_4$  with S in acidic medium

**Answer: C**

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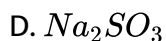
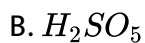
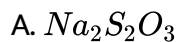
**47.** The product of the chemical reaction between  $Na_2S_2O_3$ ,  $Cl_2$  and  $H_2O$  are

- A.  $HCl + Na_2S$
- B.  $HCl + NaHSO_4$
- C.  $HCl + Na_2SO_3$
- D.  $NaHClO_3 + H_2O$

**Answer: B**

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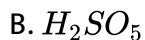
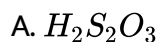
48. The term 'thio' is used in the names of all of the following compounds except :

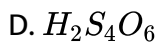
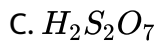


**Answer: D**

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49. Which of the following gives  $H_2O_2$  on hydrolysis ?

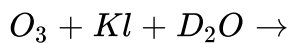




**Answer: B**

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50. Which of the following is not formed in the below reaction



A. KOH

B.  $O_2$

C.  $I_2$

D. KOD

**Answer: A**

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## Exercise 1 Part Iii Match The Column

1. Match the reaction listed in column -I with characteristic (s)/type of reactions listed in column II

Column-I	Column-II
(A) $\text{PCl}_5 \xrightarrow[\text{Air}]{\text{Moist}} \rightarrow$	(p) Hydrolysis
(B) $\text{P}_4 + \text{NaOH (conc.)} + \text{H}_2\text{O} \xrightarrow{\text{Warm}} \rightarrow$	(q) At least one of the products has tetrahedral hybridisation
(C) $\text{H}_3\text{PO}_3 \xrightarrow{200^\circ\text{C}} \rightarrow$	(r) Disproportionation
(D) $\text{P}_4\text{O}_6 + \text{H}_2\text{O} \xrightarrow{200^\circ\text{C}} \rightarrow$	(s) At least one of the products has $\text{p}\pi\text{-d}\pi$ bonding.

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2. Match the oxy-acids of phosphorus listed in column-I with type of bond (s) listed in column -II

Column-I	Column-II
(Oxy acids of phosphorus)	(Characteristic bonds)
(A) $\text{H}_4\text{P}_2\text{O}_7$	(p) P—P bond (s)
(B) $\text{H}_4\text{P}_2\text{O}_5$	(q) P—O—P bond (s)
(C) $\text{H}_3\text{P}_3\text{O}_9$	(r) P—H bond (s)
(D) $(\text{HPO}_3)_n$ (cyclic)	(s) Three or four P—OH bonds

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1. In case of nitrogen,  $NCl_3$  is possible but not  $NCl_5$  while in case of phosphorous,  $PCl_3$  as well as  $PCl_5$  are possible. It is due to

- A. Availability of vacant d-orbital in P but not in N
- B. Lower electronegativity of P than N
- C. Lower tendency of H bond formation in P than N
- D. Occurrence of P in solid while N in gaseous state at room temperature

**Answer: A**

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## Exercise 2

1. The  $P - P - P$  bond angle in white phosphorus is close to :

- A.  $120^\circ$



B.  $109^{\circ} 28'$

C.  $90^{\circ}$

D.  $60^{\circ}$

**Answer: D**

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2. Red phosphorus may be prepared from white phosphorus by :

A. adding red colour to white phosphorus

B. heating white phosphorus to red heat

C. heating white phosphorus in inert atmosphere to  $250^{\circ} C$  or at low temperature in the presence of sun light.

D. heating white phosphorus at high pressure and 473 k temperature

**Answer: C**

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3. As Rhombic sulphur is heated in a test tube :

Process	Temperature
(a) Viscosity increases	$T_1$
(b) Viscosity decrease	$T_2$
(c) Paramagnetic molecules	$T_3$
(d) Breakage of $S_8$ rings (Diradical formation in molten phase)	$T_4$

Correct order of temperature is

A.  $T_1 < T_3 < T_4 < T_2$

B.  $T_2 < T_4 < T_3 < T_1$

C.  $T_4 < T_1 < T_2 < T_3$

D.  $T_3 < T_4 < T_1 < T_2$

Answer: C

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4. Dinitrogen gas is evolved when sodium nitrite is heated below  $500^\circ C$

- A. alone
- B. with ammonium chloride
- C. with HCl
- D. with potassium nitrate

**Answer: B**

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5. Which statement is not correct for nitrogen?

- A. It is obtained by heating  $(NH_4)_2Cr_2O_7$
- B. It does not readily react with  $O_2$
- C. It is a typical non-metal
- D. d-orbitals are available for bonding

**Answer: D**

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6. Nitrolim is obtained by passing nitrogen over:

- A. heated mixture of  $Al_2O_3$  and carbon
- B. oleum
- C. calcium carbide
- D. heated calcium carbide

**Answer: D**



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7. Which of the following have  $\Delta H_f^\circ < 0$

- A. Ozone
- B. O(g)
- C. P(red)

D.  $S_8$  (monoclinic)

**Answer: C**

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8.  $CS_2$  can separate a mixture of

A.  $P_4$  and  $S_8$  (rhombic)

B.  $P_4$  and  $S_8$  (monoclinic)

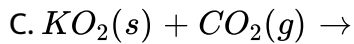
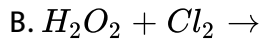
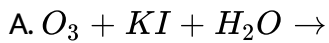
C.  $S_8$  (rhombic) and  $S_8$  (monoclinic)

D.  $S_8$  (rhombic) and S (plastic)

**Answer: D**

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9. Which of the following reaction liberate oxygen ?



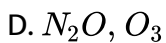
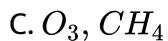
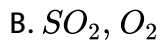
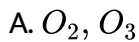
D. All of the above

**Answer: D**



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**10.** The gases respectively absorbed by alkaline pyrogallon and oil of cinnamon is.



**Answer: A**

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11. Alkaline  $KI$  is oxidised by ozone to :

- A. potassium iodate
- B. potassium periodate
- C. both (A) and (B)
- D. None of these

**Answer: C**

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12.  $NH_3$  can't be obtained by :

- A. heating of  $NH_4NO_3$  or  $NH_4NO_2$
- B. heating of  $NH_4Cl$  or  $(NH_4)_2CO_3$
- C. heating of  $NH_4NO_3$  with  $NaOH$

D. reaction of  $AlN$  or  $Mg_3N_2$  or  $CaCN_2$  with  $H_2O$

**Answer: A**

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13. When  $H_2S$  is passed through nitric acid and acidified  $KMnO_4$  solution the product formed is

A.  $H_2SO_4$

B. colloidal sulphur

C.  $SO_2$

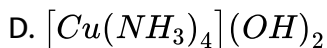
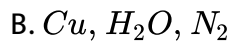
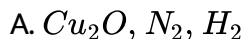
D. plastic sulphur

**Answer:**

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14. Ammonia reacts with red-hot cupric oxide to produce



**Answer: B**



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15. Phosphine is not obtained by the reaction

A. White P is heated with NaOH

B. Red P is heated with NaOH

C.  $Ca_3P_2$  reacts with water

D. Phosphorus trioxide is boiled with water under pressure

**Answer: B**

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16. When ammonia is oxidised by oxygen in the presence of platinum at  $800^{\circ}C$ , the gas obtained is :

A.  $N_2O$

B.  $NO$

C.  $NO_2$

D.  $N_2O_5$

**Answer: B**

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17. Substances burn more readily in  $N_2O$  than in air because  $N_2O$ :

- A. is reactive at high temperature
- B. dissociates to give more nitrogen than in air
- C. the activation energy is increased on increasing temperature
- D. dissociates more readily than  $O_2$

**Answer: D**

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**18. Which of the following is a mixed acid anhydride ?**

- A. NO
- B.  $NO_2$
- C.  $N_2O_5$
- D.  $N_2O$

**Answer: B**

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19. When an article is bleached by  $SO_2$  it loses its colour. The colour can be restored by :

- A. exposure to air
- B. heating
- C. dilution
- D. none of these

**Answer: A**



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20. The true statement for the acids of phosphorus.  $H_3PO_2$ ,  $H_3PO_3$  and  $H_3PO_4$  is:

- A.  $H_3PO_3$  on heating does not disproportionate
- B. all of them are reducing in nature

C. all of them are tribasic acids

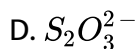
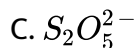
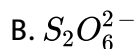
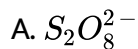
D.  $H_3PO_2$  is obtained by alkaline hydrolysis of  $P_4$  (white)

**Answer: D**

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21. Which of the following does not have S-S linkage but have O-O linkage

?



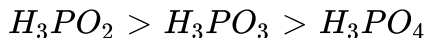
**Answer: A**

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22. The true statement for the acids of phosphorus

$H_3PO_2$ ,  $H_3PO_3$  and  $H_3PO_4$  is

A. the order of their reducing strength is



B. the hybridisation of phosphorus is  $sp^2$  in all these

C. The acidic strength order is  $H_3PO_2 > H_3PO_3 > H_3PO_4$

D. All of these

**Answer: A**

 [View Text Solution](#)

23. Hydrolysis of one mole of peroxodisulphuric acid produces

A. two moles of sulphuric acid

B. two moles of peroxymonosulphuric acid

C. one mole of sulphuric acid and one mole of peroxy monosulphuric acid

D. one mole of sulphuric acid, one mole of hydrogen peroxide

**Answer: C**

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**24.** The reaction of  $SO_2$  with  $PCl_5$  yield two oxohalides A and B. 'A' can also be prepared industrially by reaction of  $SO_3$  and  $SCl_2$ . Which of the following about A and B is incorrect ?

A. The structure of B is tetrahedral

B. The structure of A is trigonal pyramidal

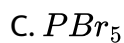
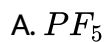
C. A reacts vigorously with water and is particularly useful for drying or dehydrating readily hydrolysable inorganic halides

D. A and B contain their respective central atoms in their highest oxidation states

**Answer: D**

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25. Which of the following cannot dissociate as  $PX_5 \rightleftharpoons PX_3 + X_2$



**Answer: A**

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26. The aqueous solution of hydrogen peroxide:

A. converts blue litmus pink



B. converts blue litmus white

C. converts red litmus blue

D. None of these

**Answer: B**



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**27. Consider the following compounds :**

(i) sulphur dioxide

(ii) hydrogen peroxide

(iii) ozone

Among these compounds, those which can act as bleaching agents would include :

A. 1 and 3

B. 2 and 3

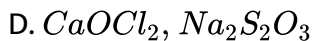
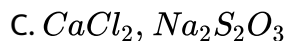
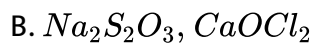
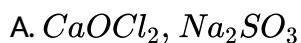
C. 1 and 2

D. 1, 2 and 3

**Answer: D**

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28. Bleaching of a fabric cloth is done using A and excess of chlorine is removed using B. A and B are :



**Answer: D**

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29. Aqueous hypo solution on reaction with aqueous  $AgNO_3$  gives :

- A. yellow precipitate changing to black
- B. white precipitate changing to black
- C. orange precipitate to blue
- D. no precipitate

**Answer: B**

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## Exercise 2 Part II Single And Double Value Integer Type

1. What is the sum of highest and lowest oxidation states for oxygen family

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2. How many of the following is correct order of specified property

(a)	$N > P > As > Sb > Bi$	(First ionisation enthalpy)
(b)	$N > P > As > Sb$	(Electronegativity)
(c)	$N-N < P-P < As-As$	(Single bond length)
(d)	$As^{3+} > Sb^{3+} > Bi^{3+}$	(Stability of +3 oxidation state)
(e)	White > Red > Black	(Reactivity of allotropes of phosphorus)
(f)	$H_3PO_2 < H_3PO_3 < H_3PO_4$	(Proticity of acids)
(g)	$H_3PO_2 < H_3PO_3 < H_3PO_4$	(Reducing power of acids)

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3. How many of the following properties increase down the group for nitrogen family

- (a) Atomic size (b) Acidic character of oxides (c) Boiling point of hydrides  
(d) Reducing power of hydrides (e) Extent of  $p\pi - p\pi$  overlap (f) Metallic character  
(g) Basic character of hydrides

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4. Given below are some properties. How many of these can hold good for phosphorous

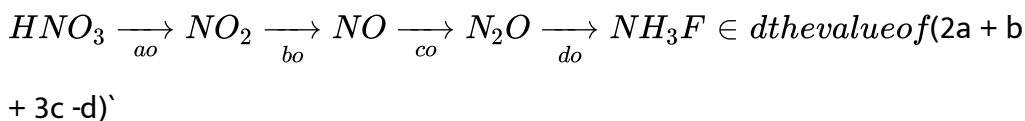
(a) Metal (b) Non-metal (c) Metalloid (d) Exhibits allotropy

(e) Catenation property (f) Solid (g) Good conductor of electricity

(h) Least dense among nitrogen family elements

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5. Below reaction sequence illustrates the various stages of reduction of nitric acid where a, b, c, d are the number of electrons involved in the reduction of 1 mole N-atoms



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6. A yellow coloured crystalline substance gave a colourless gas  $X$  on reaction with fluorine, which is thermally stable and has octahedral geometry.  $X$  can be

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7. Sulphur can form dihalide, tetrahalide and hexahalide with fluorine. One mole of each of these three compounds is mixed with water. The total number of moles of product molecules obtained is \_\_\_\_\_. If no reaction occurs, count zero

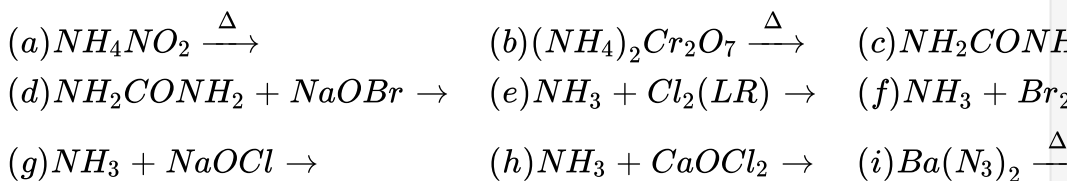
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8. Number of halides undergoing complete reaction in presence of water under normal conditions is :

(i)  $BF_3$  (ii)  $BCl_3$  (iii)  $NCl_3$  (iv)  $AlCl_3$  (v)  $CCl_4$  (vi)  $PCl_3$  (vii)  $AsCl_3$

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9. In how many of the following reactions  $N_2$  gas may be released



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10. (i)  $NH_3$  (ii)  $N_2H_4$  (iii)  $HN_3$  (iv)  $PH_3$  (v)  $H_2S$  (vi)  $AsH_3$

(vii)  $SbH_3$  (viii)  $H_2Se$  (ix)  $H_2Te$

Number of molecules in which lone pair of electrons on the central atom is present in pure s-orbital

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11.  $NH_3 + NaOCl \xrightarrow{\text{gelatin or } EDTA^+}$  products

The number of moles of  $N - H$  bonds present in one mole of the strongest nucleophile present in the product is:

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12. Number of acidic oxides among the following is:

(a)  $N_2O$  (b)  $NO$  (c)  $N_2O_3$  (d)  $N_2O_4$  (e)  $N_2O_5$  (f)  $P_4O_6$

(g)  $P_4O_{10}$  (h)  $SO_3$  (i)  $B_2O_3$  (j)  $CO$





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13. Number of gaseous oxides among the following at room temperature is:

(a)  $N_2O$  (b)  $NO$  (c)  $N_2O_3$  (d)  $NO_2$  (e)  $N_2O_5$  (f)  $P_4O_6$

(g)  $P_4O_{10}$  (h)  $SO_2$  (i)  $SO_3$



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14. The number of O atoms having  $sp^2$  hybridisation in  $P_4O_{10}$  molecule is:



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15.

$N_2O_4$ ,  $(HPO_2)_2$ ,  $H_2CO_3$ ,  $SO_2$ ,  $SO_3$ ,  $P_4O_{10}$ ,  $H_2SO_4$ ,  $N_2O_3$ ,  $HNO_3$ ,  $H_3PO_3$

(a) Among the above compounds, compounds having at least one  $p\pi - p\pi$  bond are x.



(b) Among the above compounds, compounds having at least one  $d\pi - p\pi$  bond are  $y$ .

Given the answer as  $x + y$

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16. Number of acids having central atom in +3 oxidation state among the following is

(a)  $HNO_2$  (b)  $HNO_3$  (c)  $H_3PO_2$  (d)  $H_3PO_3$  (e)  $H_3PO_4$  (f)  $H_4P_2O_5$

(g)  $H_4P_2O_7$  (h)  $H_2SO_3$  (i)  $H_2S_2O_7$  (j)  $H_2S_2O_8$  (k)  $H_2SO_4$

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17. Cold conc.  $HNO_3$  will completely dissolve:

(i) Pb (ii)  $Pb_3O_4$  (iii) Fe (iv) Sn (v) Mg (vi) MgO (vii) Hg (viii) Au (ix) Ag (x) Pt

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18. Cold dil.  $H_2SO_4$  will completely dissolve :

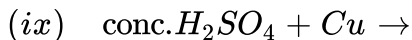
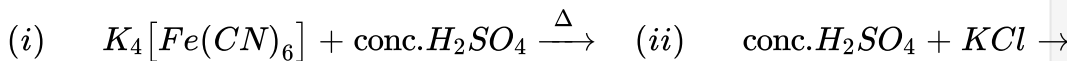
(i) Pb (ii)  $Fe_3O_4$  (iii) Fe (iv) Cu (v) Mg (vi) MgO

(vii)  $CoCO_3$  (viii)  $CuCO_2$  (ix)  $SrCO_3$

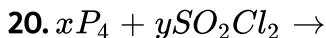


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19. How many are redox reaction-



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then  $y/x$  ?



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21. Complete hydrolysis product of 1 mole each of following will need how many total number of moles of NaOH for complete neutralisation?

$SOCl_2$ ,  $SO_2Cl_2$ ,  $PCl_3$ ,  $PCl_5$ ,  $NCl_3$

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22. Aqueous solution of how many of the following species turn blue limtus red ?

(i)  $SF_4$  (ii)  $PCl_3$  (iii)  $H_2O$  (iv)  $NO_2Cl$  (v)  $SF_6$  (vi)  $SeF_6$

(vii)  $AsCl_3$  (viii)  $POCl_3$  (ix)  $SO_2$  (x)  $SO_2Cl_2$  (xi)  $SOCl_2$  (xii)  $COCl_2$

(viii)  $CCl_4$

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23. How many of the following compounds are possible products when chlorine is passed through hypo solution

(i) S (ii) HCl (iii)  $Na_2S$  (iv)  $Na_2SO_4$  (v)  $Na_2S_4O_6$  (vi)  $HClO_4$

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24. The difference in the oxidation numbers of two types of sulphur atoms in  $Na_2S_4O_6$  is.....

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25. How many compound(s) or iron (s) can be oxidised by  $H_2O_2$  among the following

(i)  $AsO_3^{2-}$  (ii)  $SO_4^{2-}$  (iii)  $Fe_2(SO_4)_3$  (iv)  $NH_2 - NH_2$  (v)  $H_2S$

(vi)  $PbS$  (vii)  $O_3$

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26. A gas is pale blue in colour on liquifaction, the colour arises from electronic transitions. This transition is forbidden in gaseous state. The gas does not burn but is a strong supporter of combustion. Given the molar mass of this gas.

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## Exercise 2 Part Iii One Or More Than One Option Correct Type

1. As, Sb and Bi show little or no tendency to form negative ions of the type  $M^{3-}$ . This is because

- A. these elements are less electronegative
- B. metallic character increases down the group
- C. they are unable to hold the added electrons due to inert pair effect
- D. they do not possess half filled np subshells

**Answer: A::B**



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2. The correct statement(s) is/are

- A. The  $PF_4^-$  ion exists

B. The  $NF_4^-$  ion does not exist

C. N can form  $p\pi - p\pi$  bonds with itself and with other elements having small size and high E.N.

D. The catenation tendency is weaker in N than P

**Answer: A::B::C::D**

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**3. Correct statements about allotropy ?**

A. Plastic sulphur exists as zig-zag chains of sulphur

B. Monoclinic sulphur is soluble in water and insoluble in  $CS_2$

C. Milk of sulphur gradually changes to Rhombic sulphur

D. Milk of sulphur is used in medicines

**Answer: A::C::D**

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4. Which of the following statements is/are correct ?

- A. The hydrides of group 15 elements act as oxidising agents
- B. The hydrides of group 15 elements act as reducing agents
- C. The oxidising power increases in going from  $NH_3$  to  $BiH_3$
- D. The reducing power increases in going from  $NH_3$  to  $BiH_3$

Answer: B::D



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5. Ammonium dichromate on heating liberates a gas. The same gas will be obtained by :

- A. heating  $NaNO_2$  and  $NH_4Cl$
- B. treating  $H_2O_2$  and  $NaNO_2$
- C. passing ammonia gas over red hot CuO

D. treating ammonia with  $KMnO_4$  in neutral medium

**Answer: A::C**

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6. Nitrogen differs from rest of the members on the account of various factors. Which of the following properties can be classified as anomalous properties of nitrogen ?

A. Bond enthalpy of  $N \equiv N$  is 941.4 kJ/mol

B. Hydride of nitrogen i.e., ammonia has appreciable boiling point as compared to the other members like P, As.

C.  $NH_3$  can form unstable complexes by donating its lone pair

D. Molecular nitrogen comprises 78% by volume of the atmosphere

**Answer: A::B**

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7. Which of the following elements react with metals to form their binary compounds exhibiting  $-3$  oxidation state ?

A. N

B. P

C. As

D. Bi

**Answer: A::B::C::D**



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8. White Phosphorus may be removed from red Phosphorus by

A. sublimation under reduced pressure

B. dissolving in water

C. dissolving in  $CS_2$

D. heating with an alkali solution

**Answer: A::C::D**



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9. The compound which on strong heating gives oxygen is :

A.  $AgNO_3$

B.  $BaO_2$

C.  $Pb(NO_3)_2$

D.  $CaCO_3$

**Answer: A::B::C**



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10. Which of the following is//are true for oxygen.

- A.  $KMnO_4(S)$  on strong heating given oxygen gas
- B. Oxygen mixed with helium is used for artificial respiration
- C. It has two unpaired electrons in bonding  $\pi$  molecular orbitals
- D. Fractional distillation of liquefied air is used as an industrial method for the preparation of oxygen gas

**Answer: A::B::D**

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11. The correct statements(s) regarding hydrides ( $H_2E$ ) of group -16 is/are

- A. The acidic character increases from  $H_2O$  to  $H_2Te$
- B. The bond ( $H - E$ ) dissociation enthalpy decreases down the group
- C. The thermal stability of hydrides decreases down the group

D. The reducing character of hydrides increases down the group

Answer: A::B::C::D

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12. The correct statements regarding ozone is/are

A. Ozone is thermodynamically less stable with respect to oxygen

B. It acts as powerful oxidising agent

C. It rapidly react with  $NO_{(g)}$  and form  $NO_{2(g)}$  and  $O_{2(g)}$

D. It is toxic substance

Answer: A::B::C::D

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13. The incorrect statement(s) regarding oxides of group-16 elements is/are

- A. Reducing property of dioxide decreases from  $SO_2$  to  $TeO_2$
- B. All these elements form oxides of the  $EO_2$  and  $EO_4$  types
- C. Selenium and tellurium do not form  $SeO_3$  and  $TeO_3$
- D.  $SO_2$  is an oxidising agent while  $TeO_2$  is a reducing agent

Answer: B::C::D



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14. Which of the following ions dissolve in excess of aq.  $NH_3$

- A.  $Al^{3+}$
- B.  $Cu^{2+}$
- C.  $Ag^+$
- D.  $Zn^{2+}$

Answer: B::C::D

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15. Which of the following is/are incorrect statements(s) for phosphine ?

- A. It is less basic than  $NH_3$
- B. It is less poisonous than  $NH_3$
- C. The solution of copper sulphate given no precipitate with  $PH_3$
- D. Phosphine burns in air forming predominantly  $H_3PO_4$

Answer: B::C::D

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16. Which of the following process(es) can given sulphur ?

- A.  $H_2S$  gas is passed through nitric acid

- B.  $Cl_2$  gas is passed into water saturated with hydrogen sulphide
- C. Hydrogen sulphide is passed through sodium bisulphate solution
- D.  $H_2S$  gas is passed through acidified  $KMnO_4$  solution

**Answer: A::B::C::D**

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17. How is  $H_2S$  prepared in laboratory ?

- A.  $FeS + H_2SO_4$
- B.  $FeSO_4 + H_2SO_4$
- C.  $FeS + HCl$
- D. Elemental  $H_2$  + elemental  $S_8$

**Answer: A::C**

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18. A gas is obtained on heating ammonium nitrate. Which of the following statements are incorrect about this gas

- A. causes laughter
- B. brings tears to the eyes
- C. is acidic in nature
- D. is basic in nature

Answer: B::C::D

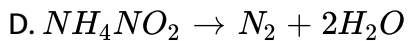


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19. Which of the following represents correct dissociation of nitrate salts on heating

- A.  $2LiNO_3 \rightarrow Li_2O + 2NO_2 + \frac{1}{2}O_2$
- B.  $Pb(NO_3)_2 \rightarrow PbO + 2NO_2 + \frac{1}{2}O_2$
- C.  $NH_4NO_3 \rightarrow N_2O + 2H_2O$

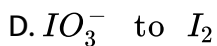
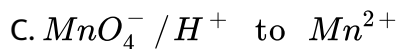
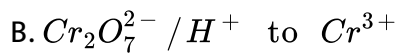
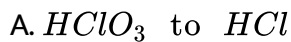




Answer: A::B::C::D

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20.  $SO_2$  can reduce :



Answer: A::B::C::D

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21. A white crystalline oxide (A) having garlic smell reacts with cold water to form a compound (B). On heating, (B) gives compound (C) & gas (D).

Which of the following are correct statements:

- A. Solution of gas (D) does not turn red litmus blue
- B. The gas (D) can also be produced by reaction of NaOH with red phosphorus
- C. Gas (D) exists in dimeric form
- D. Compound (B) can act as a reducing agent but (C) cannot

**Answer: A::D**



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22. Select the correct statement

- A. Ostwald's method of preparation of  $HNO_3$  is based upon catalytic oxidation of  $NH_3$  by atmospheric oxygen

B.  $HNO_2$  can act as both oxidising and reducing agent

C.  $NO_2$  reacts with  $O_3$  to form  $N_2O_5$

D.  $HNO_3$  can be used both as oxidising and reducing agent

**Answer: A::B::C**

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**23.** Which of the following statements is (are) correct ?

A. Antimony on reaction with conc.  $HNO_3$  gives antimonic acid

B. Manganese on reaction with cold and dilute  $HNO_3$  gives  $NO_2$  gas

C.  $HNO_2$  disproportionate to give  $HNO_3$  and  $NO$

D.  $HNO_3$  on reaction with  $P_4O_{10}$  give  $N_2O_5$

**Answer: A::C::D**

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24. Concentrated sulphuric acid acts as

- A. dehydrating agent
- B. sulphonating agent
- C. reducing agent
- D. oxidising agent

**Answer: A::B::D**

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25. Which among the following is/are peroxo acid (s) ?

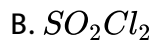
- A.  $H_2S_2O_3$
- B.  $H_2SO_3$
- C.  $H_2S_2O_7$
- D.  $H_2S_2O_8$

**Answer:**



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26. Which of the following are used as chlorinating agents in organic synthesis of compounds ? (Like acid converted to acid chloride)



**Answer: A::B::C::D**



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27. Select the correct statement(s) regarding reaction of  $SO_2$  with  $PCl_5$

A. It is a redox reaction

B. One of the product is sulphuryl chloride

C. Both the products on addition of water produce strongly acidic solution

D. both the products have same hybridisation of central atom

**Answer: C::D**

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28.  $(P) \xrightarrow{NaH} (Q) \uparrow \xrightarrow{CuSO_4} (R) \downarrow$  black precipitate, (P) may be

A.  $SCl_2$

B.  $PCl_3$

C.  $NCl_3$

D. HCl

**Answer: A::B**



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29. What is true for hydrogen peroxide and ozone ?

- A.  $H_2O_2$  acts as a stronger reducing agent in alkaline medium than in acidic medium
- B.  $H_2O_2$  and  $O_3$  both are oxidising agents as well as bleaching agents
- C.  $H_2O_2$  forms a hydrate,  $H_2O_2 \cdot H_2O$
- D. Ozone is used in the manufacture of potassium permanganate from pyrolusite

Answer: A::B::C::D



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30. Which of these statement is true for sodium thiosulphate ?

- A. it acts as an antichlor
- B. it is used as a reducing agent in iodometric titration
- C. it reacts with hydrochloric acid to form  $SO_2$  and sulphur
- D. it is used in photography as hypo to dissolve excess of AgBr as a soluble complex

**Answer: A::B::C::D**



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**31.** Which of the following statements are correct for  $H_2O_2$  ?

- A. it is neutral towards litmus, but bleaches litmus white
- B. It is more acidic than  $H_2O$
- C. Density and dielectric constant are higher than dilute solution of  $H_2O$
- D.  $H_2O_2$  is produced by auto oxidation of 2-ethyl anthraquinol

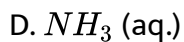
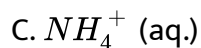
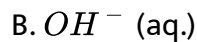
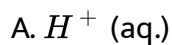


**Answer: A::B::C::D**



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**32.** A solution of ammonia in water contains



**Answer: A::B::C::D**



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**Exercise 2 Part Iv Comprehension**

1. Nitrogen forms the largest number of oxides as it is capable of forming stable multiple bonds with oxygen. They range of  $N_2O$  (O.S of nitrogen +1) through  $NO$ ,  $N_2O_3$ ,  $NO_2$ ,  $N_2O_4$  "to"  $N_2O_5$  (O.S of nitrogen +5).

Following points are important regarding the study of oxides of nitrogen.

(a) All oxides of nitrogen except  $N_2O_5$  are endothermic as a large amount of energy is required to dissociate the stable molecule of oxygen and nitrogen.

(b) The small electronegativity difference between oxygen and nitrogen make N-O bond easily breakable to give oxygen and hence oxides of nitrogen are said to be better oxidising agents.

(c) Except  $N_2O_5$ , all are gases at ordinary temperature.  $N_2O_3$  is stable only at lower temperature (253K).

(d) Except  $N_2O$  and  $NO$  which are neutral oxides, all are acidic oxides which dissolve in water forming corresponding oxy acids.

(e) They are also good example for illustrating the concept of resonance.

The gas which is acidic in nature is :

A.  $NO$

B.  $N_2O$

C.  $NO_2$

D. both A and C

**Answer: C**



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2. Nitrogen forms the largest number of oxides as it is capable of forming stable multiple bonds with oxygen. They range from  $N_2O$  (O.S of nitrogen +1) through  $NO$ ,  $N_2O_3$ ,  $NO_2$ ,  $N_2O_4$ , to  $N_2O_5$  (O.S of nitrogen +5).

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(a) All oxides of nitrogen except  $N_2O_5$  are endothermic as a large amount of energy is required to dissociate the stable molecule of oxygen and nitrogen.

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(d) Except  $N_2O$  and NO which are neutral oxides, all are acidic oxides which dissolve in water forming corresponding oxy acids.

(e) They are also good example for illustrating the concept of resonance

Which of the following statements is correct for the oxides of nitrogen ?

- A. Dinitrogen trioxide dissolves in potassium hydroxide forming potassium nitrate
- B. Aqueous solution of nitrogen dioxide behaves both as a reducing agent and as an oxidising agent
- C. Nitrous oxide is fairly soluble in cold water and turns blue litmus red
- D. Nitrogen dioxide is not acidic oxide

**Answer: B**



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3. An inorganic iodide (A) on heating gives gases (B) and (C). (B) is neutral towards litmus while (C) is acidic (B) gives back dense white fumes of (A) when cooled with (C). (A) functions as a strong acid in water. (C) is also obtained by action of (D) on water. (D) can be obtained when (B) reacts with  $I_2$  in presence of anhydrous  $CaCl_2$ . (B) is poisonous, has smell of rotten fish and it is sparingly soluble in water. Now answer the following question

Select the correct statement from the following for the gas (B)

- A. It produces dense white fumes with  $HCl$
- B. It produces dense violet fumes on combustion
- C. It produces dense white fumes with  $BF_3$
- D. It can act as oxidising agent

**Answer: C**



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4. An inorganic iodide (A) on heating gives gases (B) and (C). (B) is neutral towards litmus while (C) is acidic (B) gives back dense white fumes of (A) when cooled with (C). (A) functions as a strong acid in water. (C) is also obtained by action of (D) on water. (D) can be obtained when (B) reacts with  $I_2$  in presence of anhydrous  $CaCl_2$ . (B) is poisonous, has smell of rotten fish and it is sparingly soluble in water. Now answer the following question

The compound (A)

- A. turns moist red litmus blue
- B. reacts completely with water
- C. is used as a dehydrating agent
- D. All of these

**Answer: B**



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5. An inorganic iodide (A) on heating gives gases (B) and (C). (B) is neutral towards litmus while (C) is acidic (B) gives back dense white fumes of (A) when cooled with (C). (A) functions as a strong acid in water. (C) is also obtained by action of (D) on water. (D) can be obtained when (B) reacts with  $I_2$  in presence of anhydrous  $CaCl_2$ . (B) is poisonous, has smell of rotten fish and it is sparingly soluble in water. Now answer the following question

What is true compound (D) ?

- A. The oxidation number of central atom of (D) is + IV
- B. Compound (D) produces a yellow precipitate with silver nitrate solution
- C. Compound (D) dissolves in water forming an acid which with sodium hydroxide forms three series of salts
- D. Both (B) and (C)

**Answer: D**



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6. Oxygen differs from the other elements of the group. Compounds of oxygen with metals are more ionic in nature and hydrogen bonding is more important for oxygen compounds. Oxygen is never more than divalent because when it has formed two covalent bonds, there are no low energy orbitals which can be used for forming further bonds. However, the elements S, Se, Te and Po have empty d-orbitals which may be used for bonding, and they can form four or six bonds by unpairing electrons. The higher oxidation states become less stable on descending the group.

The bond between S and O, or Se and O, are much shorter than might be expected for a single bond owing to  $p\pi - d\pi$  interaction between the p-orbital of oxygen and d-orbital of S or Se.

Which of the following statements is incorrect ?

A. Oxo-anions of sulphur have little tendency to polymerise compared with the phosphates and silicates.

B. In pyrosulphurous acid ( $H_2S_2O_5$ ), the oxidation states of both the sulphur atoms are not same, they are +V and +III



C. Concentrated  $HNO_3$  oxidises both sulphur and selenium to

$H_2SO_4$  (+ VI) and  $H_2SeO_4$  (+ VI) respectively

D. Most metal oxides are ionic and basic in nature while non-metallic

oxides are usually covalent and acidic in nature

**Answer: C**

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7. Oxygen differs from the other elements of the group. Compounds of oxygen with metals are more ionic in nature and hydrogen bonding is more important for oxygen compounds. Oxygen is never more than divalent because when it has formed two covalent bonds, there are no low energy orbitals which can be used for forming further bonds. However, the elements S, Se, Te and Po have empty d-orbitals which may be used for bonding, and they can form four or six bonds by unpairing electrons. The higher oxidation states become less stable on descending the group.

The bond between S and O, or Se and O, are much shorter than might be

expected for a single bond owing to  $p\pi - d\pi$  interaction between the p-orbital of oxygen and d-orbital of S or Se.

Which one of the following orders represents the correct order for the properties indicated against them?

- A.  $H_2O < H_2S < H_2Se < H_2Te$  – acidic character
- B.  $H_2O < H_2S < H_2Se < H_2Te$  - thermal stability
- C.  $H_2S > H_2Se < H_2Te < H_2O$  – reducing character
- D.  $H_2S < H_2Se < H_2O < H_2Te$  – boiling point

**Answer: A**



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8. The property of hydrides of p-block elements mostly depends on :

- (i) electronegativity difference between central atom and hydrogen.
- (ii) size of central atom
- (iii) number of valence electrons in central atom

Some undergo hydrolysis in which central is less electronegative, react

with  $\text{OH}^-$  to give hydrogen. while acidic property of hydride in a period depends on electronegativity of central atoms. i.e. more electronegative is the atom, more acidic is hydride. In a group, acidic property is proportional to size of central atom. Some electron deficient hydride behaves as Lewis acid while only one hydride of an element in p-block behaves as Lewis base with central atom's electronegativity is close to hydrogen has no reaction with water.

Which one is the weakest acid among the following ?

- A. HF
- B. HCl
- C. HBr
- D. HI

**Answer: A**



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9. The property of hydrides of p-block elements mostly depends on :

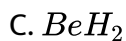
(i) electronegativity difference between central atom and hydrogen.

(ii) size of central atom

(iii) number of valence electrons in central atom

Some undergo hydrolysis in which central is less electronegative, react with  $OH^-$  to give hydrogen. while acidic property of hydride in a period depends on electronegativity of central atoms. i.e. more electronegative is the atom, more acidic is hydride. In a group, acidic property is proportional to size of central atom. Some electron deficient hydride behaves as Lewis acid while only one hydride of an element in p-block behaves as Lewis base with central atom's electronegativity is close to hydrogen has no reaction with water.

Which hydride has no reaction with water ?



**Answer: B**



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**10.** The property of hydrides of p-block elements mostly depends on :

- (i) electronegativity difference between central atom and hydrogen.
- (ii) size of central atom
- (iii) number of valence electrons in central atom

Some undergo hydrolysis in which central is less electronegative, react with  $OH^-$  to give hydrogen. while acidic property of hydride in a period depends on electronegativity of central atoms. i.e. more electronegative is the atom, more acidic is hydride. In a group, acidic property is proportional to size of central atom. Some electron deficient hydride behaves as Lewis acid while only one hydride of an element in p-block behaves as Lewis base with central atom's electronegativity is close to hydrogen has no reaction with water.

Which one is strongest base ?

A.  $OH^-$

B.  $HS^-$

C.  $HSe^-$

D.  $The^-$

Answer: A



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Observe the three columns in which column-1 represents chemical reactions, column-2 represents nature of substance with colour and physical state while column-3 represents differentiate products.

Column-1		Column-2		Column-3	
(I)	Cu + dil. $HNO_3$	(i)	Colourless gas, Neutral	(P)	NO
(II)	Cu + conc. $HNO_3$	(ii)	Blue solid, Acidic	(Q)	$NO_2$
(III)	Zn + dil. $HNO_3$	(iii)	Brown gas, Acidic	(R)	$N_2O$
(IV)	Zn + conc. $HNO_3$	(iv)	Colourless solid, Acidic	(S)	$N_2O_3$

11.

Which of the following set of combination is correct ?

A. I, iv, S

B. II, ii, Q

C. II, iii, Q

D. IV, iv, S

Answer: C

Observe the three columns in which column-1 represents chemical reactions, column-2 represents nature of substance with colour and physical state while column-3 represents differentiate products.

	Column-1	Column-2	Column-3
(I)	Cu + dil. $\text{HNO}_3$	(i) Colourless gas, Neutral	(P) NO
(II)	Cu + conc. $\text{HNO}_3$	(ii) Blue solid, Acidic	(Q) $\text{NO}_2$
(III)	Zn + dil. $\text{HNO}_3$	(iii) Brown gas, Acidic	(R) $\text{N}_2\text{O}$
(IV)	Zn + conc. $\text{HNO}_3$	(iv) Colourless solid, Acidic	(S) $\text{N}_2\text{O}_3$

12.

Which of the following set of combination is incorrect ?

- A. (III), (i), (R)
- B. (I), (i), (P)
- C. (IV), (iii), (Q)
- D. (III), (iv), (S)

Answer: D

Observe the three columns in which column-1 represents chemical reactions, column-2 represents nature of substance with colour and physical state while column-3 represents differentiate products.

	Column-1	Column-2	Column-3
(I)	Cu + dil. $\text{HNO}_3$	(i) Colourless gas, Neutral	(P) NO
(II)	Cu + conc. $\text{HNO}_3$	(ii) Blue solid, Acidic	(Q) $\text{NO}_2$
(III)	Zn + dil. $\text{HNO}_3$	(iii) Brown gas, Acidic	(R) $\text{N}_2\text{O}$
(IV)	Zn + conc. $\text{HNO}_3$	(iv) Colourless solid, Acidic	(S) $\text{N}_2\text{O}_3$

13.

Which of the following set of combination is correct ?

A. (I), (ii), (P)

B. (IV), (iii), (Q)

C. (IV), (ii), (Q)

D. (I), (iii), (P)

**Answer: B**

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### Exercise 3 Part I Jee Advanced

1. The number of P-O-P bonds in cyclic trimetaphosphoric acid is :

A. zero

B. two

C. three

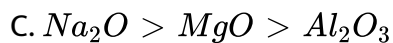
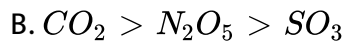
D. four



**Answer: C**

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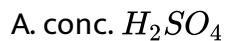
**2. The correct order of acidic strength is**



**Answer: A**

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**3. Ammonia can be dried by :**



B.  $P_4O_{10}$

C.  $CaO$

D. anhydrous  $CaCl_2$

**Answer: C**

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4. Give reason, why elemental nitrogen exists as a diatomic molecule, whereas elemental phosphorus is a tetratomic molecule.

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5. Polyphosphates are used as water softening agents because they

A. form soluble complexes with anionic species

B. precipitate anionic species

C. form soluble complexes with cationic species

D. precipitate cationic species

**Answer: C**

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6. For  $H_3PO_3$  and  $H_3PO_4$  the correct choice is

A.  $H_3PO_3$  is dibasic and reducing

B.  $H_3PO_3$  is dibasic and non-reducing

C.  $H_3PO_4$  is tribasic and reducing

D.  $H_3PO_3$  is tribasic and non-reducing

**Answer: A**

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7.  $(NH_4)_2Cr_2O_7$  on heating gives a gas which is also given by :

A. heating  $NH_4NO_2$

B. heating  $NH_4NO_3$

C. treating  $Mg_3N_2$  with  $H_2O$

D. treating Na (compound) with  $H_2O_2$

**Answer: A**

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8. A pale blue liquid is obtained by equimolar mixture of two gases at  $-30^\circ C$ .

A.  $N_2O$

B.  $N_2O_3$

C.  $N_2O_4$

D.  $N_2O_5$

**Answer: B**

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9. Thermodynamically most stable allotrope of phosphorus is :

- A. Red
- B. White
- C. Black
- D. Yellow

**Answer: C**

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10. (a) What amount of CaO in grams is required to neutralise 852g of  $P_4O_{10}$ .

(b) Write the structure of  $P_4O_{10}$ .

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11. There are some deposits of nitrated and phosphates in the earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under laboratory conditions but microbes do it easily. Ammonia forms a large number of complexes with transition metal ions. Hybridisation easily explains the ease of sigma donation capability of  $NH_3$  and  $PH_3$ . Phosphine is a flammable gas and is prepared from white phosphorous.

Which of the following statement is correct ?

- A. phosphates have no biological significance in humans
- B. between nitrates and phosphates, phosphates are less a abundant in earth's crust
- C. between nitrates and phosphates, nitrates are less abundant in earth's crust
- D. oxidation of nitrates is possible in soil

**Answer: C**



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12. There are some deposits of nitrated and phosphates in the earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under laboratory conditions but microbes do it easily. Ammonia forms a large number of complexes with transition metal ions. Hybridisation easily explains the ease of sigma donation capability of  $NH_3$  and  $PH_3$ . Phosphine is a flammable gas and is prepared from white phosphorous.

Which of the following statement is correct ?

- A. between  $NH_3$  and  $PH_3$ ,  $NH_3$  is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional
- B. between  $NH_3$  and  $PH_3$ ,  $PH_3$  is a better electron donor because the lone pair of electrons occupies  $sp^3$  orbital and is more directional
- C. between  $NH_3$  and  $PH_3$ ,  $NH_3$  is a better electron donor because the lone pair of electrons occupies  $sp^3$  orbital and is more directional

D. between  $NH_3$  and  $PH_3$ ,  $PH_3$  is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional

**Answer: C**

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**13.** There are some deposits of nitrates and phosphates in the earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under laboratory conditions but microbes do it easily. Ammonia forms a large number of complexes with transition metal ions. Hybridisation easily explains the ease of sigma donation capability of  $NH_3$  and  $PH_3$ . Phosphine is a flammable gas and is prepared from white phosphorous. White phosphorous on reaction with  $NaOH$  gives  $PH_3$  as one of the products. This is a.

A. dimerization reaction

B. disproportionation reaction



C. condensation reaction

D. precipitation reaction

**Answer: B**

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14. The reaction of  $P_4$  with X leads selectively to  $P_4O_6$ . The X is :

A. Dry  $O_2$

B. A mixture of  $O_2$  and  $N_2$

C. Moist  $O_2$

D.  $O_2$  in the presence of aqueous NaOH

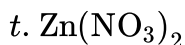
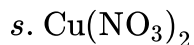
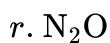
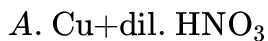
**Answer: B**

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15. Match each of the reaction given in Column I with the corresponding product(s) given in Column II.

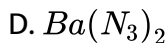
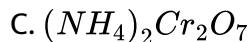
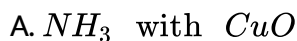
Column I

Column II



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16. Extra pure  $\text{N}_2$  can be obtained by heating



Answer: D



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17. Among the following, the number of compounds that can react with  $PCl_5$  to give  $POCl_3$  is  $O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}$ .

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18. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen ?

A.  $HNO_3, NO, NH_4Cl, N_2$

B.  $HNO_3, NO, N_2, NH_4Cl$

C.  $HNO_3, NH_4Cl, NO, N_2$

D.  $NO, HNO_3, NH_4Cl, N_2$

**Answer: B**

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19. Concentrated nitric acid upon long standing turns yellowish-brown due to the formation of :

A. NO

B.  $NO_2$

C.  $N_2O$

D.  $N_2O_4$

**Answer: B**



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20. The pair(s) of reagents that yield paramagnetic species is/are

A. Na and excess of  $NH_3$

B. K and excess of  $O_2$

C. Cu and dilute  $HNO_3$

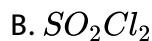
D.  $O_2$  and 2-ethylanthraquinol

**Answer: A::B::C**



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21. The product formed in the reaction of  $SOCl_2$  (thionyl chloride) with white phosphorous is.

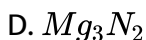
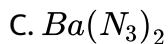
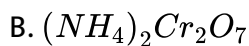


**Answer: A**



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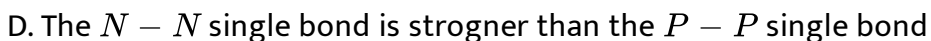
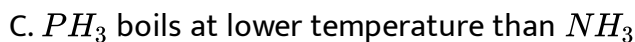
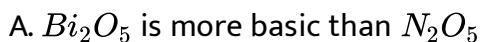
22. The compound (s) which generate (s)  $N_2$  upon thermal decomposition is (are) :



**Answer: B::C**

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**23.** Based on the compounds of group 15 elements, the correct statement (s) is (are)



**Answer: A::B::C**

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24. Amongst  $H_2O$ ,  $H_2S$ ,  $H_2Se$  and  $H_2Te$  the one with highest boiling point is :

- A.  $H_2O$  because of H-bonding
- B.  $H_2Te$  because of higher molecular weight
- C.  $H_2S$  because of H-bonding
- D.  $H_2Se$  because of lower molecular weight

**Answer: A**

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25. The number of S-S bonds in sulphur trioxide trimer ( $S_3O_9$ ) is

- A. three
- B. two

C. one

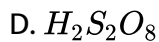
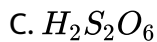
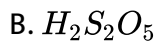
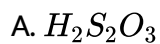
D. zero

**Answer: D**



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**26.** Which of the following oxoacids of sulphur has -O-O- linkage ?



**Answer: D**



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27. Which of the following will not be oxidised by  $O_3$ ?

A. KI

B.  $KMnO_4$

C.  $K_2MnO_4$

D.  $FeSO_4$

**Answer: B**



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28. Which gas is evolved when  $PbO_2$  is treated with conc  $HNO_3$  ?

A.  $NO_2$

B.  $O_2$

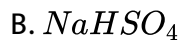
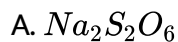
C.  $N_2$

D.  $N_2O$

**Answer: B**

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29. Aqueous solution of  $Na_2S_2O_3$  on reaction with  $Cl_2$ , gives



**Answer: B**

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30. Hydrogen peroxide in its reaction with  $KIO_4$  and  $NH_2OH$  respectively, is acting as a

- A. reducing agent, oxidising agent
- B. reducing agent, reducing agent
- C. oxidising agent, oxidising agent
- D. oxidising agent, reducing agent

**Answer: A**

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**31.** The nitrogen containing compound produced in the reaction of  $HNO_3$  with  $P_4O_{10}$

- A. can also be prepared by reaction of  $P_4$  and  $HNO_3$
- B. is diamagnetic
- C. contains one  $N - N$  bond
- D. react with Na metal producing a brown gas

**Answer: B::D**

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32. Upon heating  $KClO_3$  in presence of catalytic amount of  $MnO_2$ , a gas  $W$  is formed. Excess amount of  $W$  reacts with white phosphorus to given  $X$ . The reaction of  $X$  with pure  $HNO_3$  gives  $Y$  and  $Z$ .

Y and Z are, respectively

- A.  $N_2O_4$  and  $PHO_3$
- B.  $N_2O_4$  and  $H_3PO_3$
- C.  $N_2O_3$  and  $H_3PO_4$
- D.  $N_2O_5$  and  $HPO_3$

**Answer: D**

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33. Upon heating  $KClO_3$  in presence of catalytic amount of  $MnO_2$ , a gas  $W$  is formed. Excess amount of  $W$  reacts with white phosphours to given

X. The reaction of X with pure  $HNO_3$  gives Y and Z.

W and X are, respectively

A.  $O_2$  and  $P_4O_{10}$

B.  $O_2$  and  $P_4O_6$

C.  $O_3$  and  $P_4O_6$

D.  $O_3$  and  $P_4O_{10}$

**Answer: A**



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### Exercise 3 Part II Jee Main

1. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorus acid is

A. zero

B. two

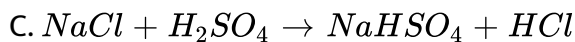
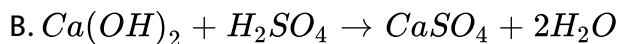
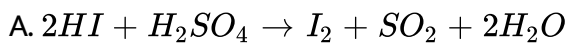
C. one

D. three

**Answer: B**

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2. Which of the following chemical reactions depicts the oxidizing behaviour of  $H_2SO_4$  ?



**Answer: A**

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3. Repeated use of which one of the following fertilizers would increase the acidity of the soil?

A. Superphosphate of lime

B. Ammonium sulphate

C. Potassium nitrate

D. Urea

**Answer: B**



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4. Which of the following statement is wrong ?

A. The stability of hydrides increase from  $NH_3$  to  $BiH_3$  in group 15 of the periodic table

B. Nitrogen cannot form  $d\pi - p\pi$  bond

C. Single  $N - N$  bond is weaker than the single  $P - P$  bond

D.  $N_2O_4$  has two resonance structure

**Answer: A::D**

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5. Which of the following statements regarding sulphur is incorrect?

A.  $S_2$  molecule is paramagnetic

B. The vapour at  $200^\circ C$  consists mostly of  $S_8$  rings

C. At  $600^\circ C$  the gas mainly consists of  $S_2$  molecules

D. The oxidation state of sulphur is never less than +4 in its compounds

**Answer: D**

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6. Which of the following is the wrong statements ?

- A.  $\text{ONCl}$  and  $\text{ONO}^-$  are not isoelectronic
- B.  $\text{O}_3$  molecule is bent
- C. Ozone is violet -black in solid state
- D. Ozone is diamagnetic gas

**Answer: A**



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7. Which of the following properties is not shown by NO ?

- A. It is diamagnetic in gaseous state
- B. It is a neutral oxide
- C. It combines with oxygen to form nitrogen dioxide
- D. Its bond order is 2.5

**Answer: A**

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8. From the following statements regarding  $H_2O_2$ , choose the incorrect statements:

- A. It can act only as an oxidizing agent
- B. It decomposed on exposure to light
- C. It has to be stored in plastic or wax lined glass bottles in dark
- D. It has to be kept away from dust

**Answer: A**

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9. Statement I Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.

Statement II The reaction between nitrogen and oxygen requires high temperature.

- A. Both assertion and reason are correct, and the reason is the correct explanation for the assertion
- B. Both assertion and reason are correct, but the reason is not the correct explanation for the assertion
- C. The assertion is incorrect, but the reason is correct
- D. Both assertion and reason are incorrect

**Answer: A**



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10. The pair in which phosphorus atoms have a formed oxidation state of +3 is

- A. Pyrophosphorous and hypophosphoric acids

B. Orthophosphorous and hypophosphoric acids

C. Pyrophosphorous and pyrophosphoric acids

D. Orthophosphorous and pyrophosphorous acids

**Answer: D**

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11. The reaction of zinc with dilute and concentrated nitric acid, respectively, produce

A.  $NO_2$  and  $NO$

B.  $NO$  and  $N_2O$

C.  $NO_2$  and  $N_2O$

D.  $N_2O$  and  $NO_2$

**Answer: D**

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12. Hydrogen peroxide oxidises  $[Fe(CN)_6]^{4-}$  to  $[Fe(CN)_6]^{3-}$  in acidic medium but reduces  $[Fe(CN)_6]^{3-}$  to  $[Fe(CN)_6]^{4-}$  in alkaline medium. The other products formed are, respectively

- A.  $H_2O$  and  $(H_2O + O_2)$
- B.  $H_2O$  and  $(H_2O + OH^-)$
- C.  $(H_2O + O_2)$  and  $H_2O$
- D.  $(H_2O + O_2)$  and  $(H_2O + OH^-)$

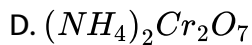
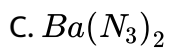
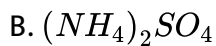
**Answer: A**



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13. The compound that does not produce nitrogen gas by the thermal decomposition is

- A.  $NH_4NO_2$



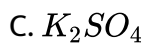
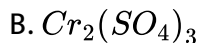
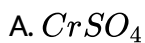
**Answer: B**



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### Exercise 3 Jee Main Online Problems

1. Which of the following is not formed when  $H_2S$  reacts acidic  $K_2Cr_2O_7$  solution ?

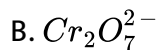
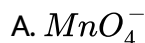


**Answer: A**



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2. Hydrogen peroxide acts both as an oxidising and as a reducing agent depending upon the nature of the reacting species. In which of the following cases  $H_2O_2$  acts as a reducing agent in acid medium ?



**Answer: A**



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3. Which of these statements is not true ?

A.  $NO^+$  is not isoelectronic with  $O_2$

B. B is always covalent in its compounds

C. In aqueous solution, the  $Tl^+$  ions is much more stable than T(III)

D.  $LiAlH_4$  is a versatile reducing agent in organic synthesis

**Answer: A**

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4. The non-metal that does not exhibit positive oxidation state is:

A. Fluorine

B. Oxygen

C. Chlorine

D. Iodine

**Answer: A**

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5. Identify the incorrect statement :

- A. Rhombic and monoclinic sulphur have  $S_8$  molecules
- B.  $S_8$  ring has a crown shape
- C.  $S_2$  is paramagnetic like oxygen
- D. The  $S - S - S$  bond angle in the  $S_8$  and  $S_6$  rings are the same

**Answer: D**



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6. Identify the pollutant gases largely responsible for the discoloured and lustreless nature of marble of the Taj Mahal.

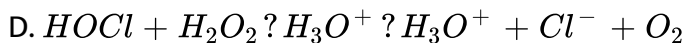
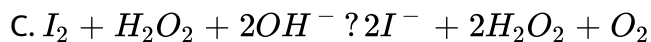
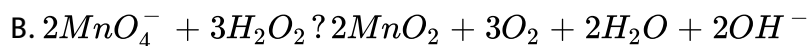
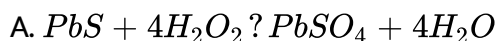
- A.  $SO_2$  and  $NO_2$
- B.  $SO_2$  and  $O_3$
- C.  $O_3$  and  $CO_2$

D.  $CO_2$  and  $NO_2$

**Answer: A**

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7. In which of the following reactions, hydrogen peroxide acts as an oxidizing agent ?

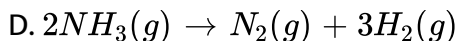
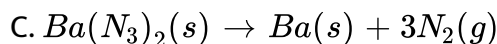
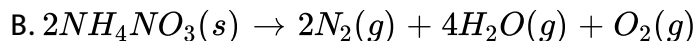
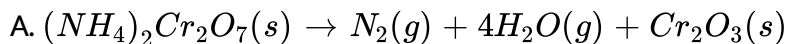


**Answer: A**

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8. For per gram of reactant, the maximum quantity of  $N_2$  gas is produced in which of the following thermal decomposition reactions ?

(Given : Atomic wt :  $Cr = 52u$ ,  $Ba = 137u$ )



**Answer: D**



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9. Good reducing nature of  $H_3PO_2$  is attributed to the presence of :

A. one  $P - H$  bond

B. One  $P - OH$  bond

C. Two  $P - OH$  bonds

D. Two  $P - H$  bonds

**Answer: D**

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10. The chemical nature of hydrogen peroxide is :

- A. Oxidising agent in acidic medium, but not in basic medium
- B. Oxidising and reducing agent in both acidic and basic medium
- C. Reducing agent in basic medium, but not in acidic medium
- D. Oxidising and reducing agent in acidic medium, but not in basic medium

**Answer: B**

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11. iodine reacts with concentrated  $HNO_3$  to yield Y along with other products, the oxidation state of iodine in Y, is :

- A. 7
- B. 3
- C. 1
- D. 5

**Answer: D**

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Apsp

1. There is considerable increase in covalent radius from N to P. However, from Sb to Bi only small increase (of 7 pm) in covalent radius is observed.

This is due to

- A. poor shielding by completely filled d-and f-orbitals in Bi
- B. similar electronegativity of Sb and Bi
- C. the Bi being last element of the group
- D. similar densities of Sb and Bi

**Answer: A**

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2. Which of the following phosphorus is the most reactive?

- A. Violet phosphorus
- B. Scarlet phosphorus
- C. Red phosphorus
- D. White phosphorus

**Answer: D**

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3. Which of the following elements shows highest number of allotropes:

A. N

B. P

C. S

D. O

**Answer: C**



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4. Nitrogen gas is prepared :

A. by heating ammonium nitrate

B. by reacting excess chlorine with liquor ammonia

C. by passing  $HNO_3$  vapours on red hot copper

D. by heating lead nitrate

**Answer: C**

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5. With reference to protonic acids, which of the following statements is correct

A.  $PH_3$  is more basic than  $NH_3$

B.  $PH_3$  is less basic than  $NH_3$

C.  $PH_3$  is equally basic as  $NH_3$

D.  $PH_3$  is amphoteric while  $NH_3$  is basic

**Answer: B**

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6. Phosphorus is manufactured by heating in an electric furnace a mixture of

- A. Bone ash and coke
- B. Bone ash and silica
- C. Bone ash, silica and coke
- D. None of these

**Answer: C**



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7. Which of the following may ignite spontaneously in air ?

- A. White phosphorous
- B. Red phosphorus
- C. Black Phosphorus
- D. Nitrogen

**Answer: A**



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**8. Ozone is obtained from oxygen**

A. By oxidation at high temperature

B. By oxidation using a catalyst

C. By silent electric discharge

D. By conversion at high pressure

**Answer: C**



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**9. Crown shape of  $S_8$  molecule is present in**

A. Rhombic sulphur

B. Monoclinic sulphur

C. Both 1 & 2

D. None of these

**Answer: C**

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**10.** Presence of ozone in a gas sample may be detected by

A.  $H_2O_2$

B.  $SO_2$

C.  $Hg$

D. KI

**Answer: C**

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11. Amongst  $H_2O$ ,  $H_2S$ ,  $H_2Se$  and  $H_2Te$  the one with highest boiling point is :

- A.  $H_2O$  because of hydrogen bonding
- B.  $H_2Te$  because of higher molecular weight
- C.  $H_2S$  because of hydrogen bonding
- D.  $H_2Se$  because of lower molecular weight

**Answer: A**



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12. When ammonia is passed over heated copper oxide, the metallic copper is obtained. The reaction shows that ammonia is :

- A. A dehydrating agent
- B. An oxidising agent
- C. A reducing agent

D. A nitrating agent

**Answer: C**

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13. phosphine is generally prepared in the laboratory

A. By heating phosphorus in a current of hydrogen

B. By heating white phosphorus with aqueous of caustic potash

C. By decomposition of  $P_2H_4$  at  $110^\circ C$

D. By heating red phosphorus with an aqueous solution of caustic  
soda

**Answer: B**

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14. Cyanamide process is used in the formation of



**Answer: C**



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15. Ammonium nitrate decomposes on heating into

A. Ammonia and nitric acid

B. Nitrous oxide and water

C. Nitrogen, hydrogen and ozone

D. Nitric oxide, nitrogen dioxide and hydrogen

**Answer: B**

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16. Which one of the following combines with  $Fe(II)$  ions to form a brown complex ?

A.  $N_2O$

B.  $NO$

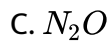
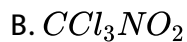
C.  $CO$

D.  $SO_2$

**Answer: B**

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17. Formula for tear gas is



D. None of these

**Answer: B**



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**18.** In  $P_4O_{10}$ , the number of oxygen atoms bonded to each phosphorus atom are

A. 2

B. 3

C. 4

D. 5

**Answer: C**



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19. In the reaction,  $H_2SO_4 + P_2O_5 \xrightarrow{\Delta} (X) + SO_3$ , the product (X) is :

A.  $PH_3$

B.  $H_3PO_4$

C.  $HPO_3$

D.  $H_4P_2O_7$

**Answer: C**

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20. Bleaching action of  $SO_2$  is due to :

A. its reducing nature

B. its oxidising nature

C. its acidic nature

D. its both oxidising as well as reducing nature

**Answer: A**

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21. Ortho phosphoric acid on heating above  $300^{\circ}C$  gives :

A. hypophosphorus acid

B. hypophosphoric acid

C. metaphosphoric acid

D. phosphorous acid

**Answer: C**

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22. 1 mol of  $H_3PO_2$ ,  $H_3PO_3$  and  $H_3PO_4$  will neutralise x mol  $NaOH$ , y mol of  $Ca(OH)_2$  and z mol of  $Al(OH)_3$  respectively (assuming all as strong electrolytes). x, y, z are in the ratio of:

A. 3:1.5:1

B. 1:2:3

C. 3:2:1

D. 1:1:1

Answer: D



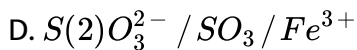
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23. Which of the following can convert acidified  $Cr_2O_7^{2-}$  to green ?

A.  $SO_2 / H_2SO_3 / H_2SO_4$

B.  $SO_3 / H_2SO_3 / H_2S$

C.  $SO_3^{2-} / H_2S / Fe^{2+}$



**Answer: C**

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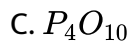
24. Which of the following statements is true for  $HNO_2$ ?

- A. It can be prepared by acidifying an aqueous solution of nitrite
- B. It is unstable weak acid which is known only in aqueous solution
- C.  $N_2O_3$  is an anhydride of  $HNO_2$
- D. All of these

**Answer: D**

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25. The compound which has ionic nature in solid state is

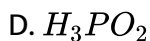
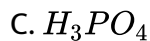
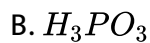


**Answer: A**



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26. Phosphorus trichloride,  $PCl_3$  undergoes, hydrolysis at room temperature to produce an oxoacid. It has the formula :



**Answer: B**

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27. Which of the following dissolves in water but does not give any oxyacid solution?

A.  $SO_2$

B.  $OF_2$

C.  $SCl_4$

D.  $SO_3$

**Answer: B**

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28. Hypo is used in photography to

A. Reduce  $AgBr$  grains to metallic silver

B. Convert the metallic silver to silver salt

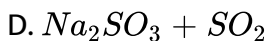
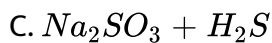
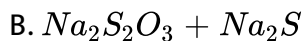
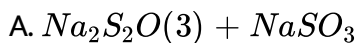
C. Remove undecomposed silver bromide as a soluble complex

D. Remove reduced silver

**Answer: C**

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29. Sulphur on boiling with  $NaOH$  solution gives



**Answer: B**

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1. Sodium thiosulphate is prepared by

- A. reducing  $Na_2SO_3$  solution with  $H_2S$
- B. Boiling  $Na_2SO_3$  with S in alkaline medium
- C. Neutralising  $H_2S_2O_3$  solution with NaOH
- D. Boiling  $Na_2SO_3$  with S in an acidic medium

**Answer: B**



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2. Which element of group V A shows maximum oxidation states ?

- A. bismuth
- B. phosphorus
- C. nitrogen
- D. arsenic

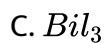
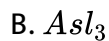


**Answer: C**



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**3. Which of the halide is unstable ?**



**Answer: A**



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**4. Platinum metal (Pt) dissolves in aqua-regia but not in concentrated HCl or  $HNO_3$  because**

- A. HCl oxidises Pt in the presence of  $HNO_3$
- B.  $HNO_3$  reacts with HCl to form chlorine which attacks Pt
- C.  $HNO_3$  oxidises Pt which is followed by formation of a chloro complex
- D. HCl and  $HNO_3$  together give  $O_2$  that oxidises Pt

**Answer: B**

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5. The reaction  $3O_{2(g)} \rightarrow 2O_{3(g)}$  is endothermic. What can be concluded about the average per bond in  $O_2$  and  $O_3$  ?

- A. the average energy per bond in  $O_2$  greater than that in  $O_3$
- B. the average energy per bond in  $O_2$  is less than in  $O_3$
- C. the average energy per bond in  $O_2$  is equal to that in  $O_3$

D. on conclusion can be drawn about the average bond energies from  
this information alone

**Answer: A**

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6. The anhydride of nitric acid is

A. nitric oxide

B. nitrous oxide

C. dinitrogen trioxide

D. dinitrogen pentoxide

**Answer: D**

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7. The geometry of ammonia molecule can be best described as

- A. nitrogen at one vertex of a regular tetrahedron, the other three vertices being occupied by the three hydrogens
- B. nitrogen at the centre of the tetrahedron, three of the vertices being occupied by three hydrogens
- C. nitrogen at the centre of an equilateral triangle, three corners being occupied by three hydrogens
- D. nitrogen at the junction of a T, three open ends being occupied by three hydrogens

**Answer: B**



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8. Bone glow in the dark. This is due to

- A. the presence of red phosphorus
- B. conversion of white phosphorus into red phosphorus
- C. the presence of calcium carbonate
- D. the presence of calcium phosphate

**Answer: D**

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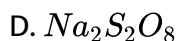
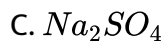
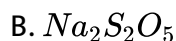
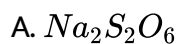
9. Inert pair effect plays an important role in the case of

- A. P
- B. Bi
- C. Sb
- D. As

**Answer: B**

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10. In the presence of an anthraquinone derivatives as a catalyst, the aqueous solution of sodium dithionite  $Na_2S_2O_4$  (Fieser's solution) effectively remove oxygen and forms



**Answer: A**



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11. In the above reaction (in Q.99)  $Na_2S_2O_4$  acts as a

A. 2 electron reducing agent

B. 1 electron reducing agent

C. 3 electron reducing agent

D. 4 electron reducing agent

**Answer: A**



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12. The ozone hole in the upper atmosphere of the earth is due to the breakdown of ozone to oxygen. The reaction is catalyzed by

A. chlorofluorocarbons

B. oxygen generated during the reaction

C. carbon dioxide present in the atmosphere

D. chlorine formed by the decomposition of chlorofluorocarbons

**Answer: D**



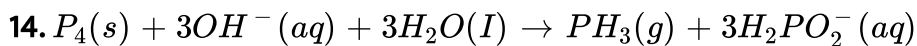
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13. The electron -pair geometry of the central oxygen atom of ozone is

- A. linear
- B. trigonal planar
- C. tetrahedral
- D. trigonal bipyramidal

**Answer: B**

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In the above equation, the species getting oxidized and reduced respectively are

- A.  $P_4$  and  $OH^-$
- B.  $OH^-$  and  $P_4$
- C.  $P_4$  and  $H_2O$



D.  $P_4$  and  $P_4$

**Answer: D**



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**15.** The compound which can act as an oxidizing agent as well as reducing agent is

A.  $HNO_2$

B. HI

C. HCN

D. HCOOH

**Answer: A**



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16. When an inert atmosphere is required in metallurgical operation nitrogen is commonly used. However in the extraction of titanium from  $TiCl_4$  using magnesium, helium is used as nitrogen reacts with

- A.  $TiCl_4$  to form titanium nitride
- B. magnesium to form magnesium nitride
- C. titanium to form titanium nitride
- D. chlorine to form nitrogen chloride which inhibits the reaction

**Answer: B**



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17. The nitrogen compound formed when  $CaCN_2$  reacts with steam or hot water is

- A.  $N_2O$
- B. NO

C.  $NO_2$

D.  $NH_3$

**Answer: D**

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18. The element that has the highest tendency to catenate is

A. silicon

B. germanium

C. sulphur

D. boron

**Answer: C**

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19. The chemical formula of 'laughing gas' is

A. NO

B.  $N_2O$

C.  $N_2O_4$

D.  $N_2O_5$

**Answer: B**



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20. Phosphine is prepared by the action of

A.  $P$  and  $HNO_3$

B.  $P$  and  $H_2SO_4$

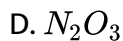
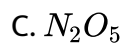
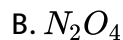
C.  $P$  and  $NaOH$

D.  $P$  and  $H_2S$

**Answer: C**

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**21.** The reddish -brown gas formed when nitric oxide is oxidized by air is



**Answer: A**

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**22.** Which of the following salt/s of  $H_3PO_3$  exists ?

(I)  $NaH_2PO_3$  (II)  $Na_2HPO_3$  (III)  $Na_3PO_3$

A. I and II only

B. I, II and III

C. II and III only

D. III only

**Answer: A**

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**23.** Acidity of diprotic acids in aqueous solutions increases in the order

A.  $H_2S < H_2Se < H_2Te$

B.  $H_2Se < H_2S < H_2Te$

C.  $H_2Te < H_2S < H_2Se$

D.  $H_2Se < H_2Te < tH_2S$

**Answer: A**

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24. Upon long standing concentrated  $HNO_3$

- A. remains colourless, but gives out NO
- B. turns yellow brown due to formation  $NO_2$
- C. turns yellow brown due to the formation of  $N_2O_4$
- D. remains colourless, but gives  $N_2O$

**Answer: B**



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25. The reaction that does not produce nitrogen is :

- A. heating  $(NH_4)_2Cr_2O_7$
- B.  $NH_3 +$  excess of  $Cl_2$
- C. heating of  $NaN_3$

D. heating of  $NH_4NO_3$

**Answer: B**

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26. White phosphorous on reaction with  $NaOH$  gives  $PH_3$  and

A.  $Na_2HPO_3$

B.  $NaH_2PO_2$

C.  $NaH_2PO_3$

D.  $Na_3PO_4$

**Answer: B**

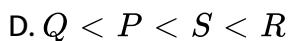
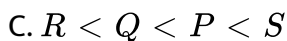
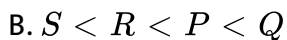
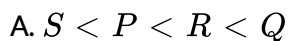
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27. P, Q, R and S are four metals whose typical reaction are given below

- (I)
- (II) When Q is added to a solution containing the ions of the other metals, metallic P, R, and S are formed
- (III) P reacts with concentrated  $HNO_3$  but S does not

The correct order of their reducing character is



**Answer: A**



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28. The following compounds are heated (i)  $KNO_3$  (ii)  $Cu(NO_3)_2$  (iii)  $Pb(NO_3)_2$  (iv)  $NH_4NO_3$  . Which of the following statement/s is/are

correct ?

- A. (ii) and (iii) liberate  $NO_2$
- B. (iv) liberates  $N_2O$
- C. (i), (ii) and (iii) liberate  $O_2$
- D. All statements are correct

**Answer: D**

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**29.** Nitrogen exists as diatomic molecule and phosphorus as  $P_4$ . Why ?

- A.  $N_2$  has valence electrons only in bonding and nonbonding orbitals, while P has valence electrons in both bonding and antibonding orbitals
- B. higher electronegativity of N favours formation of multiple bonds
- C. bigger size of P does not favour multiple bonds

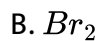
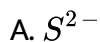
D. P has preference to adapt structures with small bond angles

**Answer: C**



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**30.** Which of the following cannot act as an oxidising agent ?



**Answer: A**



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1. An unknown substance (P) functions as weak base in water. It produces silver mirror test. It reacts with dilute  $HCl$  to produce (Q) which turns blue litmus red (P) may be:

- A.  $NH_3$
- B.  $PH_3$  is less basic than  $NH_3$
- C.  $NH_2OH$
- D.  $HPO_3$

**Answer: C**



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2. The compound which gives oxygen on moderate heating is

- A. Cupric oxide
- B. Mercuric oxide
- C. Zinc oxide

D. Aluminium oxide

**Answer: B**

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3. Which of the following compounds does give  $N_2$  on heating ?

A.  $NH_4NO_2$

B.  $NH_4NO_3$

C.  $NaN_3$

D. Both (A) and (C)

**Answer: D**

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4. Which of the following cannot result in the formation of  $NO$  ?

A.  $N_2 + O_2$  (Electric arc)

B.  $NH_3 + O_2$ , (Pt/Rh catalyst/1200 K)

C.  $NaNO_3 / HCl$

D. None of these

**Answer: C**

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5. A gaseous substance dissolve in water giving a pale blue solution which decolourises  $KMnO_4$  and oxidises  $KI$  to  $I_2$  in acidic medium :

A.  $N_2O_5$

B.  $NH_3$

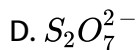
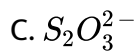
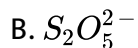
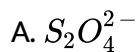
C.  $N_2O_3$

D.  $HNO_3$

**Answer: C**

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6. Which of the following will not decolourise acidified  $KMnO_4$  ?



**Answer: D**

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7. Which of the following statements is not true about ozone ?

A. It is a pale blue gas at room temperature

B. It oxidises sulphur and phosphorus evolving oxygen gas

C. It is odourless

D. It turns dry KOH red

**Answer: C**

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8. Sulphuric acid reacts with  $PCl_5$  to give

- A. Thionyl chloride
- B. Sulphur monochloride
- C. Sulphuryl chloride
- D. Sulphur tetrachloride

**Answer: C**

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9. Which is greater for  $P_4$  (white) than  $P_4$  (red)



- A. Molar entropy
- B. Melting point
- C. Solubility in  $CS_2$
- D. Ignition temperature

**Answer: A::C**

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**10.** What is//are not true about phosphine ( $PH_3$ )?

- A. It turns red litmus blue
- B. It reacts with  $HCl$  (aq.) to give  $PH_4Cl$
- C. Phosphonium compounds are obtained when anhydrous phosphine reacts with anhydrous  $HBr$  or  $HI$
- D. It is prepared by hydrolysis of metal phosphides with acids

**Answer: A::B**



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11. Which of the following is/are correct regarding nitrogen family

- A. Nitrogen is restricted to a maximum covalency of 4 as only four orbitals are available for bonding
- B. The single  $N - N$  bond is weaker than the single  $P - P$  bond
- C. The catenation tendency is weaker in nitrogen as compared to phosphorous
- D. Nitrogen forms  $p\pi - p\pi$  bond as well as  $p\pi - d\pi$  bonds

Answer: A::B::C



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12.  $P_2O_5$  can dehydrate

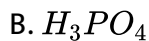
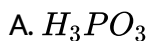
- A.  $H_2SO_4$



**Answer: A::B::C**

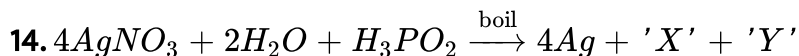
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13. What products are formed when  $H_3PO_2$  is heated at  $415K$  and at  $435K$  respectively.



**Answer: A::B::D**

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If X is oxyacid of nitrogen and Y is oxyacid of phosphorous then correct statement(s) is/are

A. X is  $HNO_2$

B. Y is  $H_3PO_4$

C.  $H_3PO_2$  act as good reducing agent

D. The oxidation number of 'P' change from +1 to +5

**Answer: B::C::D**



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15. Cold dilute nirtic acid would dissolved how many of the following without significant evolution of any gas:

$Pb, Mg, Sb, Au, Ag, Fe, Mn, Sn, P_4$



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16. Which of the following on heating will produce an oxide of nitrogen

$(NH_4)_2SO_4$ ,  $(NH_4)_2Cr_2O_7$ ,  $NH_4NO_3$ ,  $KNO_3$ ,  $Pb(NO_3)_2$ ,  $(NH_4)_2HPO_4$ .

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17.  $NaPO_3$  can significantly react with how many of the following ?

$CaCl_2$ ,  $MgSO_4$ ,  $CaO$ ,  $Na_2CO_3$ , dry  $HCl$ ,  $(HCO_3)_2$ ,  $Na_3PO_4$

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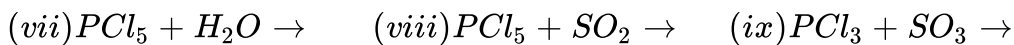
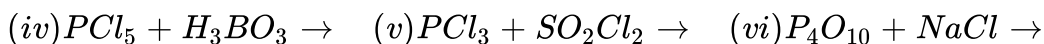
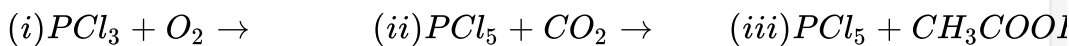
18. One mole of  $PCl_3$  is dissolved in excess of water. No. of moles of NaOH required to neutralise this solution completely is

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19. When hypo solution react with  $CuSO_4$  and produce soluble complex, then how many no. moles of atoms present in one mole of soluble complex in co-ordination sphere

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20. How many of the following reaction yield  $POCl_3$  ?



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21. An orange solid (A) on heating gives a green residue (B), a colourless gas (C) and water vapours. The dry gas (C) on passing over heated Mg gave a white solid (D). (D) on reaction with water gave a gas (E) which formed black precipitate with mercurous nitrate solution.

Select the incorrect statement.

- A. The central atom (s) of the anion of solid (A) has  $sp^3$  hybridisation
- B. The orange solid (A) is diamagnetic in nature
- C. The anion of organic solid (A) is oxidising in nature
- D. All metal oxygen bond lengths are equal in anion of solid (A)

**Answer: D**

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22. An orange solid (A) on heating gives a green residue (B), a colourless gas (C) and water vapours. The dry gas (C) on passing over heated Mg gave a white solid (D). (D) on reaction with water gave a gas (E) which formed black precipitate with mercurous nitrate solution.

which of the following is true of the gas (E)?

- A. It gives a deep blue colouration with  $CuSO_4$  solution
- B. It is oxidised to a colourless gas (neutral oxide) at 1200 K in presence of a catalyst Pt/Rh in air

C. It gives the same gas (C) with potassium permanganate solution

D. It gives black precipitate with  $HgCl_2$

Answer: D

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23. Match the reaction listed in column-I with characteristic(s) listed in column-II

Column-I	Column-II
(1) $2NO_2 \xrightarrow{\text{Cool}}$	(p) One of the products is a mixed anhydride.
(2) $ClO_2 + O_3 \xrightarrow{h\nu}$	(q) One of the products is an acidic oxide.
(3) $K_4[Fe(CN)_6] + H_2SO_4(\text{conc.}) + H_2O \xrightarrow{\Delta}$	(r) The oxidation state of the central atom of one of the products is +6.
(4) $KOH + O_3 \longrightarrow$	(s) One of the products is a colourless paramagnetic gas.

A. 1 - p, q, 2 - p, q, s, 3 - r, 4 - s

B. 1 - p, q, 2 - p, q, r, s, 3 - r, 4 - s

C. 1 - p, 2 - p, q, r, s, 3 - r, 4 - s

D. 1 - p, q, 2 - q, r, s, 3 - s, 4 - r

Answer: B





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