

Chapter 7: The P-Block Elements

NCERT Exemplar · Class 12 · Chemistry

I. Multiple Choice Questions (Type-I)

Question 1

On addition of conc. H_2SO_4 to a chloride salt, colourless fumes are evolved but in case of an iodide salt, violet fumes come out. This is because

A.

H_2SO_4 reduces HI to I_2

B.

HI is of violet colour

C.

HI gets oxidised to I_2

D.

HI changes to HIO_3

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 2

In qualitative analysis when H_2S is passed through an aqueous solution of salt acidified with dil. HCl , a black precipitate is obtained. On boiling the precipitate with dil. HNO_3 , it forms a solution of blue colour. Addition of excess of aqueous solution of ammonia to this solution gives _____.

A.

a deep blue precipitate of $\text{Cu}(\text{OH})_2$

B.

a deep blue solution of $[\text{Cu}(\text{NH}_3)_4]^{2+}$

C.

a deep blue solution of $\text{Cu}(\text{NO}_3)_2$

D.

a deep blue solution of $\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{NO}_3)_2$

Answer

Correct option: B

Solution

Option (ii) is the answer.

Question 3

In a cyclotrimetaphosphoric acid molecule, how many single and double bonds are present?

Solution;

Option (iii) is the answer.

A.

3 double bonds; 9 single bonds

B.

6 double bonds; 6 single bonds

C.

3 double bonds; 12 single bonds

D.

Zero double bonds; 12 single bonds

Solution

Solution coming soon.

Question 4

Which of the following elements can be involved in $p\pi-d\pi$ bonding?

A.

Carbon

B.

Nitrogen

C.

Phosphorus

D.

Boron

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 5

Which of the following pairs of ions are isoelectronic and isostructural?

Option (i) is the answer.

A.

CO_3^{2-} , NO_3^-

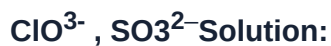
B.



C.



D.



Solution

Solution coming soon.

Question 6

Affinity for hydrogen decreases in the group from fluorine to iodine. Which of the halogen acids should have the highest bond dissociation enthalpy?

A.



B.



C.



D.



Answer

Correct option: A

Solution

Option (i) is the answer.

Question 7

Bond dissociation enthalpy of E—H (E = element) bonds are given below. Which of the compounds will act as the strongest reducing agent?

Compound	NH ₃	PH ₃	AsH ₃	SbH ₃
$\Delta_{\text{diss}}(\text{E—H})/\text{kJ mol}^{-1}$	389	322	297	255

A.

NH₃

B.

PH₃

C.

AsH₃

D.

SbH₃

Answer

Correct option: D

Solution

Option (iv) is the answer.

Question 8

On heating with concentrated NaOH solution in an inert atmosphere of CO₂, white phosphorus gives a gas. Which of the following statement is incorrect about the gas?

A.

It is highly poisonous and has smelled like rotten fish.

B.

It's a solution in water decomposes in the presence of light.

C.

It is more basic than NH_3

D.

It is less basic than NH_3

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 9

Which of the following acids forms three series of salts?

A.

H_3PO_2

B.

H_3BO_3

C.

H_3PO_4

D.

H_3PO_3

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 10

Strong reducing behaviour of H_3PO_2 is due to

Option (iii) is the answer.

A.

The low oxidation state of phosphorus

B.

Presence of two -OH groups and one P-H bond

C.

Presence of one -OH group and two P-H bonds

D.

High electron gain enthalpy of phosphorus

Solution:

Solution

Solution coming soon.

Question 11

On heating lead, nitrate forms oxides of nitrogen and lead. The oxides formed are _____.

Solution;

Option (ii) is the answer.

A.

N_2O , PbO

B.

NO₂, PbO

C.

NO, PbO

D.

NO, PbO₂

Solution

Solution coming soon.

Question 12

Which of the following elements does not show allotropy?

A.

Nitrogen

B.

Bismuth

C.

Antimony

D.

Arsenic

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 13

Maximum covalency of nitrogen is _____.

A.

3

B.

5

C.

4

D.

6

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 14

Which of the following statements is wrong?

with transition elements.

A.

Single N–N bond is stronger than the single P–P bond.

B.

PH₃ can act as a ligand in the formation of a coordination compound

C.

NO₂ is paramagnetic.

D.

Covalency of nitrogen in N_2O_5 is four

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 15

A brown ring is formed in the ring test for NO_3^-

–

ion. It is due to the formation of

A.



B.



C.



D.



Answer

Correct option: A

Solution

Option (i) is the answer.

Question 16

Elements of group-15 form compounds in +5 oxidation state. However,

bismuth forms only one well-characterised compound in +5 oxidation state.

The compound is

A.

Bi_2O_5

B.

BiF_5

C.

BiCl_5

D.

Bi_2S_5

Answer

Correct option: B

Solution

Option (ii) is the answer.

Question 17

On heating ammonium dichromate and barium azide separately we get

A.

N_2 in both cases

B.

N_2 with ammonium dichromate and NO with barium azide

C.

N₂O with ammonium dichromate and N₂ with barium azide

D.

N₂O with ammonium dichromate and NO₂ with barium azide

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 18

In the preparation of HNO₃, we get NO gas by catalytic oxidation of ammonia.

The moles of NO produced by the oxidation of two moles of NH₃

will be _____.

A.

2

B.

3

C.

4

D.

6

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 19

The oxidation state of a central atom in the anion of compound NaH_2PO_2 will

be _____.

A.

+3

B.

+5

C.

+1

D.

-3

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 20

Which of the following is not tetrahedral in shape?

Option (iii) is the answer.

A.

NH_4^+

B.

SiCl₄

C.

SF₄

D.

SO₄²⁻–Solution:

Solution

Solution coming soon.

Question 21

Which of the following are peroxyacids of sulphur?

A.

H₂SO₅ and H₂S₂O₈

B.

H₂SO₅ and H₂S₂O₇

C.

H₂S₂O₇ and H₂S₂O₈

D.

H₂S₂O₆ and H₂S₂O₇

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 22

Hot conc. H_2SO_4 acts as a moderately strong oxidising agent. It oxidises both metals and nonmetals. Which of the following element is oxidised by conc H_2SO_4 into two gaseous products?

A.

Cu

B.

S

C.

C

D.

Zn

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 23

A black compound of manganese reacts with a halogen acid to give greenish yellow gas. When an excess of this gas reacts with NH_3 an unstable trihalide is formed. In this process the oxidation state of nitrogen changes from _____.

A.

– 3 to +3

B.

– 3 to 0

C.

– 3 to +5

D.

0 to – 3

Answer

Correct option: A

Solution

Option (i) is the answer.

Question 24

In the preparation of compounds of Xe, Bartlett had taken $\text{O}_2 + \text{Pt F}_6$ as a base compound. This is because

Option (iii) is the answer.

A.

both O_2 and Xe has the same size.

B.

both O_2 and Xe has the same electron gain enthalpy.

C.

both O_2 and Xe has almost same ionisation enthalpy.

D.

both Xe and O_2 are gases.

Solution

Solution coming soon.

Question 25

In solid state PCl_5 is a _____.

A.

covalent solid

B.

octahedral structure

C.

ionic solid with $[\text{PCl}_6]^+$ octahedral and $[\text{PCl}_4]^-$ tetrahedra

D.

ionic solid with $[\text{PCl}_4]^+$ tetrahedral and $[\text{PCl}_6]^-$ octahedral

Answer

Correct option: D

Solution

Option (iv) is the answer.

Question 26

Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidising power.

Ion	ClO_4^-	IO_4^-	BrO_4^-
Reduction potential E°/V	$E^\circ = 1.19\text{V}$	$E^\circ = 1.65\text{V}$	$E^\circ = 1.74\text{V}$

A.

$\text{ClO}_4^- \rightarrow \text{IO}_4^- \rightarrow \text{BrO}_4^-$

B.

$\text{IO}_4^- \rightarrow \text{BrO}_4^- \rightarrow \text{ClO}_4^-$

C.

$\text{BrO}_4^- \rightarrow \text{IO}_4^- \rightarrow \text{ClO}_4^-$

D.



Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 27

Which of the following is isoelectronic pair?

A.



B.



C.



D.



Answer

Correct option: B

Solution

Option (ii) is the answer.

II. Multiple Choice Questions (Type-II)

Question 28

If chlorine gas is passed through a hot NaOH solution, two changes are observed in the oxidation number of chlorine during the reaction. These are _____ and _____.

- (i) 0 to +5
- (ii) 0 to +3
- (iii) 0 to -1
- (iv) 0 to +1

Solution

Option (i) and (iii) are the answers.

Question 29

Which of the following options are not in accordance with the property mentioned against them?

- (i) $F_2 > Cl_2 > Br_2 > I_2$ Oxidising power.
- (ii) $MI > MBr > MCl > MF$ Ionic character of metal halide.
- (iii) $F_2 > Cl_2 > Br_2 > I_2$ Bond dissociation enthalpy.
- (iv) $HI < HBr < HCl < HF$ Hydrogen-halogen bond strength.

Solution

Option (ii) and (iii) are the answers

Question 30

Which of the following is correct for P_4 the molecule of white phosphorus?

- (i) It has 6 lone pairs of electrons.
- (ii) It has six P-P single bonds.
- (iii) It has three P-P single bonds.

(iv) It has four lone pairs of electrons.

Solution

Option (ii) and (iv) are the answers.

Question 31

Which of the following statements are correct?

(i) Among halogens, radius ratio between iodine and fluorine is maximum.

(ii) Leaving F—F bond, all halogens have weaker X—X bond than X—X' bond in interhalogens.

(iii) Among interhalogen compounds, the maximum number of atoms are present in iodine fluoride.

(iv) Interhalogen compounds are more reactive than halogen compounds.

Solution

Option (i), (iii) and (iv) are the answers.

Question 32

Which of the following statements are correct for SO₂ gas?

(i) It acts as a bleaching agent in moist conditions.

(ii) Its molecule has linear geometry.

(iii) It's dilute solution is used as a disinfectant.

(iv) It can be prepared by the reaction of dilute H₂SO₄ with metal sulphide.

Solution

Option (i) and (iii) are the answers.

Question 33

Which of the following statements are correct?

- (i) All three N—O bond lengths in HNO_3 are equal.
- (ii) All P—Cl bond lengths in PCl_5 molecule in the gaseous state are equal.
- (iii) P_4 molecule in white phosphorus have angular strain therefore white phosphorus is very reactive.
- (iv) PCl is ionic in the solid-state in which cation is tetrahedral and the anion is octahedral.

Solution

Option (iii) and (iv) are the answers.

Question 34

Which of the following orders are correct as per the properties mentioned against each?

- (i) $\text{As}_2\text{O}_3 < \text{SiO}_2 < \text{P}_2\text{O}_3 < \text{SO}_2$ Acid strength.
- (ii) $\text{AsH}_3 < \text{PH}_3 < \text{NH}_3$ Enthalpy of vaporization.
- (iii) $\text{S} < \text{O} < \text{Cl} < \text{F}$ More negative electron gain enthalpy.
- (iv) $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$ Thermal stability.

Solution

Option (i) and (iv) are the answers.

Question 35

Which of the following statements are correct?

- (i) S—S bond is present in $\text{H}_2\text{S}_2\text{O}_6$
- (ii) In peroxosulphuric acid (H_2SO_5) sulphur is in +6 oxidation state.
- (iii) Iron powder along with Al_2O_3 and K_2O is used as a catalyst in the preparation of NH_3 by Haber's process.
- (iv) Change in enthalpy is positive for the preparation of SO_3 by catalytic oxidation of SO_2

Solution

Option (i) and (ii) are the answers.

Question 36

In which of the following reactions conc. H_2SO_4 is used as an oxidising reagent?



Solution

Option (ii) and (iii) are the answers.

Question 37

Which of the following statements are true?

(i) The only type of interactions between particles of noble gases is due to weak dispersion forces.

(ii) Ionisation enthalpy of molecular oxygen is very close to that of xenon.

(iii) Hydrolysis of XeF_6

is a redox reaction.

(iv) Xenon fluorides are not reactive.

Solution

Option (i) and (ii) are the answers.

III. Short Answer Type

Question 38

In the preparation of H_2SO_4 by Contact Process, why is SO_3 not absorbed directly in water to form H_2SO_4 ?

Solution

Dissolution of SO_3 in water is highly exothermic. This leads to the formation of a mist of tiny droplets which are highly corrosive and they can even attack the lead pipelines (lead pipelines are used to cover the tower in contact process).

Question 39

Write a balanced chemical equation for the reaction showing catalytic oxidation of NH_3 by atmospheric oxygen.

Solution

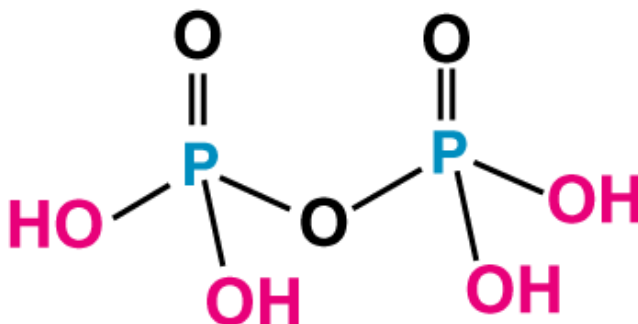


Pt gauze reacts as a catalyst, which is added to increase the rate of reaction.

Question 40

Write the structure of pyrophosphoric acid.

Solution



Question 41

PH_3 forms bubbles when passed slowly in water but NH_3 dissolves. Explain why?

Solution

PH₃ does not form hydrogen bonding with water. Therefore it is not soluble in water and it escapes as a gas and forms bubbles whereas ammonia forms hydrogen bonding and is soluble in water.

Question 42

In PCl₅, phosphorus is in sp³d hybridised state but all its five bonds are not equivalent. Justify your answer with reason.

Solution

The size of axial bonds is greater than the size of equatorial bonds to overcome repulsion because the three equatorial bonds cause more repulsion. Therefore two axial P-Cl bonds are longer and different from equatorial bonds.

Question 43

Why is nitric oxide paramagnetic in gaseous state but the solid obtained on cooling it is diamagnetic?

Solution

Nitric oxide in the gaseous state exists in monomer form. It consists of only one unpaired electron therefore it is paramagnetic. In solid-state, it exists as a dimer (N₂O₂). There is no unpaired electron in its dimer form, therefore it is diamagnetic.

Question 44

Give the reason to explain why ClF₃ exists but FCl₃ does not exist.

Solution

Chlorine has vacant d orbitals hence it can show an oxidation state of +3. Fluorine has no d orbitals, it cannot show a positive oxidation state. Fluorine shows only -1 oxidation state. Therefore FCl₃ does not exist.

Question 45

Out of H₂O and H₂S, which one has a higher bond angle and why?

Solution

H₂O has higher bond angle than H₂S because as we move from oxygen to sulphur the size of the central atom increases and electronegativity decreases due to which bond pair goes away from the central atom which results in a decrease in bond pair repulsion and hence bond angle decreases.

Question 46

SF₆ is known but SCl₆ is not. Why?

Solution

Fluorine is the strongest oxidizing agent and it can oxidize sulphur to its maximum oxidation state +6 to form SF₆. Chlorine is not a good oxidizing agent, it cannot oxidize sulphur to its maximum oxidation state. Chlorine can oxidize sulphur to only +4 oxidation state. Hence it can form SCl₄ but not SCl₆.

Question 47

On reaction with Cl₂, phosphorus forms two types of halides 'A' and 'B'. Halide A is a yellowish-white powder but halide 'B' is a colourless oily liquid. Identify A and B and write the formulas of their hydrolysis products.

Solution

Halide A is PCl₅ because it is a yellowish-white powder

Halide B is PCl₃ because it is a colourless oily liquid.



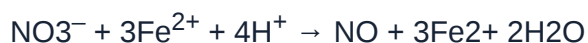
PCl₅ undergoes a violent hydrolysis



Question 48

In the ring test of NO₃[–] ion, Fe²⁺ ion reduces nitrate ion to nitric oxide, which combines with Fe²⁺ (aq) ion to form the brown complex. Write the reactions involved in the formation of a brown ring.

Solution



Thus the complex formed is brown.

Question 49

Explain why the stability of oxoacids of chlorine increases in the order given below:



Solution

As the electronegativity of halogen decreases, the tendency of XO₃ group (X = halogens) to withdraw electrons of the O-H bond towards itself decreases and hence the acid strength of the perhalic acid decreases.

Question 50

Explain why ozone is thermodynamically less stable than oxygen.

Solution

Ozone is thermodynamically less stable because it decomposes into oxygen and this decomposition leads result in the liberation of heat, so its entropy is positive and free energy is negative.

Question 51

P₄O₆ reacts with water according to equation $\text{P}_4\text{O}_6 + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_3$.

Calculate the volume of 0.1 M NaOH solution required to neutralise the acid formed by dissolving 1.1 g of P₄O₆ in H₂O.

Solution



Overall reaction :



Moles of $P_4O_6 = 1.1/220 = 0.5$

Acid formed by one mole of P_4O_6 requires = 8 mol

Acid formed by 0.005 mol of NaOH is present in 100mL solution

0.04 of NaOH is present in solution = $1000/0.1 \times 0.04 = 400\text{mL}$

Question 52

White phosphorus reacts with chlorine and the product hydrolyses in the presence of water. Calculate the mass of HCl obtained by the hydrolysis of the product formed by the reaction of 62 g of white phosphorus with chlorine in the presence of water.

Solution

When white phosphorous reacts with chlorine:



Moles of white P = $62/124 = 0.5\text{mol}$

1mol of white P_4 produces HCl = 12mol

0.5 mol of white P_4 will produce HCl = $12 \times 0.5 = 6\text{mol}$

Mass of HCl = $6 \times 36.5 = 219.0\text{g}$

Question 53

Name three oxoacids of nitrogen. Write the disproportionation reaction of that oxoacid of nitrogen in which nitrogen is in +3 oxidation state.

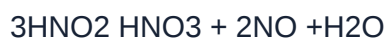
Solution

There are three oxoacids of nitrogen.

Nitric acid(HNO_3), Nitrous acid (HNO_2), Hyponitrous acid ($H_2N_2O_2$)

+ 3 oxidation is shown by HNO_2 , Therefore it undergoes disproportion reaction,

To calculate the oxidation state, consider the oxidation state of N is x.



The oxidation state of nitrogen in HNO_2 is +3

$$X + (+1) + 2(-2) = 0, x = +3$$

The oxidation state of nitrogen in HNO_3 is +5

$$X + (+1) + 3(-2) = 0, x = 5$$

The oxidation state of nitrogen in NO is +2

$$X + (-2) = 0, x = 2$$

Therefore +3 oxidation state changes to +5 and +2 oxidation states.

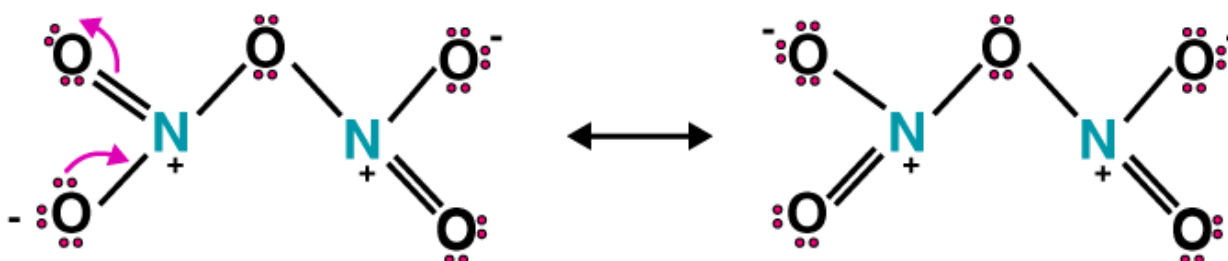
Question 54

Nitric acid forms an oxide of nitrogen on reaction with P_4O_{10} . Write the reaction involved. Also, write the resonating structures of the oxide of nitrogen formed.

Solution



White phosphorous is very reactive as compared to red phosphorous due to angular strain in white phosphorous.



Question 55

Phosphorus has three allotropic forms — (i) white phosphorus (ii) red phosphorus and (iii) black phosphorus. Write the difference between white and red phosphorus on the basis of their structure and reactivity.

Solution

1. White phosphorus

(i) It is soft waxy solid having garlic order

(ii) It is poisonous

(iii) Has low melting point and boiling point because P_4 molecules are held together by weak van der Waal forces of attraction

2. Red Phosphorus

(i) It is hard, crystalline, odourless solid

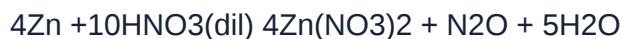
(ii) It is non-poisonous

(iii) It has a high melting point because of its polymeric structure.

Question 56

Give an example to show the effect of concentration of nitric acid on the formation of oxidation product.

Solution

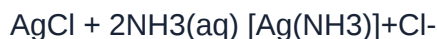


Question 57

PCl_5 reacts with finely divided silver on heating and a white silver salt is obtained, which dissolves on adding excess aqueous NH_3 solution. Write the reactions involved to explain what happens.

Solution

PCl₅ reacts with silver to form white silver salt(AgCl). Which than dissolves on adding excess aqueous NH₃ to form a soluble complex



Question 58

Phosphorus forms a number of oxoacids. Out of these oxoacids phosphinic acid has strong reducing property. Write its structure and also write a reaction showing its reducing behaviour.

Solution



Class 12 Chemistry NCERT Exemplar for The p Block Elements

This chapter is one of the most important chapters for the CBSE Class 12 board examination. Every year, approximately 4 questions are asked from this chapter. To answer all questions related to the chapter, students are advised to solve the NCERT Exemplar Class 12 Chapter 7 The P Block Elements. The important topics discussed in the chapter are

1. Group 15 Elements
2. Dinitrogen
3. Ammonia
4. Oxides of Nitrogen
5. Nitric Acid
6. Phosphorus — Allotropic Forms
7. Phosphine
8. Phosphorus Halides
9. Oxoacids of Phosphorus
10. Group 16 Elements
11. Dioxygen
12. Simple Oxides
13. Ozone
14. Sulphur — Allotropic Forms

- 15. Sulphur Dioxide
- 16. Oxoacids of Sulphur
- 17. Sulphuric Acid
- 18. Group 17 Elements
- 19. Chlorine
- 20. Hydrogen Chloride
- 21. Oxoacids of Halogens
- 22. Interhalogen Compounds
- 23. Group 18 Elements

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