PRAADIS EDUCATION
CHEMISTRY-XII
P- BLOCK ELEMENTS
OBJECTIVES

1. Which of the following represents the general electronic configuration of an element belonging to the p-block of the periodic table?
a) $(n-2)f^0(n-1)d^0ns^2\ np^{0\text{ -}6}$
b) $(n-2)f^0(n-1)d^{1\ -\ 10}\ ns^2\ np^{1\text{ -}6}$
c) $(n-2)f^0(n-1)d^0\ ns^2np^{1-6}$
d) $(n-2)f^{1\text{ -}14}(n-1)d^{1\text{ -}10}ns^2np^{1\text{ -}6}$
Answer: c
Explanation: The general configuration representation of p-block elements is $(n-2)f^0(n-1)d^0ns^2np^{1-6}$. This is because the s-subshell is completely filled, whereas, the p-subshell contains at least 1 electron. Other options are ruled out since either or both d – and f – subshell are partially filled.
2. What happens to the size of atoms of elements of p-block as we move from left to right in the same period?
a) Size increases
b) Size decreases
c) Size does not change
d) Size increases then decreases
Answer: b
Explanation: The size of the atoms of the elements decrease from left to right in the same period. Considering the row to be the same, the electrons are added to the same shell. However, the increase in atomic number reflects the increase in number of protons i.e. the positive charge. Hence, the overall effective nuclear charge increases. Consequently, the electron cloud is pulled even more closer to the nucleus of the atom. Therefore, the size decreases.

3. What is the maximum covalency of the nitrogen atom?
a) One
b) Two
c) Three
d) Four
Answer: d
Explanation: Covalency of an atom refers to the number of electrons that atom can share to form chemical bonds. Usually it is the number of bonds formed by the atom. In case of nitrogen, its atom can share up to four electrons, one in the s-subshell and the other three in the p-subshell. In addition to this, absence of d-orbitals restricts its covalency to four only.
4. Why does nitrogen show poor tendency towards catenation?
a) N atom can form multiple pπ – pπ bonds
b) Octet of N_2 is complete unlike carbon
c) The N ≡ N is unreactive at room temperature
d) The N – N single bond is weaker and unstable
Answer: d
Explanation: The N – N single bond is highly weak and unstable due to high magnitude of inter-electronic repulsions of non-bonding electrons which in turn is caused by the single bond's small bond length. As a result the catenation tendency becomes weaker due to the mentioned factors leading to instability.
5. What is the primary product of Haber-Bosch process?
a) Ammonia
b) Nitric acid
c) Nitrous acid
d) Pyridine
Answer: a
Explanation: The primary product of Haber-Bosch process is ammonia, NH_3. In this process, $N_{2(g)}$ and $H_{2(g)}$ are reacted at a

high temperature of 700 K and 200 atm pressure in presence of iron-bed catalysts. It is an exothermic process which takes place in accordance with Le Chatelier's principle. Nitric acid is produced by Ostwald's process. Nitrous acid is produced by reacting sodium nitrite with a mineral and pyridine by Chichibabin process.

6. Which gas is released when copper chips are subjected to concentrated nitric acid?

a) Nitrogen (I) oxide
b) Nitrogen (II) oxide
c) Nitrogen (III) oxide
d) Nitrogen (IV) oxide

Answer: d

Explanation: Treating copper chips with concentrated nitric acid releases toxic brown gas, NO_2, nitrogen (IV) oxide. It is a reddish-brown gas with pungent odor.

7. What shape is the HNO_3 molecule in its gaseous state?

a) Bent
b) Linear
c) Planar
d) See Saw

Answer: c

Explanation: In the gas state, the nitric acid molecule has a triangular planar shape with a steric number of 3 no lone pairs of electron. There are two major resonance forms of nitric acid.

8. Which of the following ions is the brown ring test useful for determining?

a) NO_2^-
b) NO_2^+
c) NO_2
d) NO_3^-

Answer: d
Explanation: The brown ring test is used to determine the presence of nitrate ions, NO_3^-. Dilute ferrous sulfate solution is added to solution containing nitrate ion. Following this, concentrated sulfuric acid is added along the sides of the test tube. A brown ring is formed at the junction concentrated sulfuric acid and solutions.
9. What catalyst is used for oxidation of ammonia to produce nitric acid?
a) Palladium hydride
b) Sodium amalgam
c) Platinum-Rhodium gauze
d) Vanadium (V) oxide
Answer: c
Explanation: Ammonia is oxidized to nitrogen (II) oxide in the presence of Pt/Rh gauze catalyst at a temperature of 500 K and a pressure of 9 bars. The nitrous oxide is then converted to nitrogen dioxide which is further reacted with water to produce nitric acid. The NO formed is recycled.
10. What is the oxidation state of nitrogen in di-nitrogen trioxide?
a) +1
b) +2
c) +3
d) +4
Answer: c
Explanation: Di-nitrogen trioxide is formulated as N_2O_3
The oxidation state of oxygen atom is fixed at -2 since it is the more electronegative atom in this case.
If oxidation state of nitrogen is assumed to be ‘x’, then:
$2x + (3x - 2) = 0$
$2x – 6 = 0$

x = +3
The oxidation state of nitrogen is +3.
11. Which of the following compounds can be used to obtain free nitrogen?
a) $NaNO_2$
b) HNO_2
c) HNO_3
d) Ba_3N_2
Answer: a
Explanation: $NaNO_2$, sodium nitriteis the only convenient compound that can be used to obtain free nitrogen, even in laboratories. Sodium nitrite can be reacted with ammonium chloride, both in aqueous form, producing NaCl and nitrogen, N_2 along with water and small traces of HNO_3 and NO.
12. How many stable isotopes does the nitrogen atom have?
a) 16
b) 20
c) 2
d) 3
Answer: c
Explanation: The nitrogen atom has two stable isotopes: ^{14}N and ^{15}N, 99.6% and 0.4% (by mass) respectively. There are also fourteen known radioisotopes with one additional nuclear isomer.
13. Nitrogen atom is represented at $^{14}_{7}N$. How many electrons does it need to attain the noble gas configuration?
a) 1
b) 2
c) 3
d) 4
Answer: c
Explanation: With five electrons in its outer most shell, it needs three more electrons to have a complete shell consisting

of eight electrons which is the noble electronic configuration. The ion formed by the nitrogen atom is N^{3-}. It attains the electronic configuration on neon.

14. Why does nitrogen show anomalous properties with respect to other elements in group 15?

a) Nitrogen has low ionization enthalpy

b) Nitrogen atomhas high inter-electronic repulsions

c) Nitrogen molecule bears a triple bond

d) Absence of vacant d-orbitals

Answer: d

Explanation: Nitrogen shows anomalous properties compared to other elements of group 15 because of the absence of vacant d-orbitals. In addition to this, anomalous properties are a result of nitrogen atom's smaller size, highest electronegativity and highest ionization energy with respect to all the elements in group 15.

15. Why is nitrogen preferably used in welding process and cooling of substances?

a) It's a gas and can easily be handled

b) It has an extremely low freezing point

c) It is an inert gas

d) It is non-toxic

Answer: c

Explanation: Gases like argon is also nontoxic. However, nitrogen gas is still the most preferred since it eliminates all the possibilities of unwanted oxidation and explosions. In the welding industry this prevents metals from corroding. Nitrogen is used in the food industry for packaging since it provides a pressurized atmosphere that reduces package collapse.

16. Which oxide of nitrogen is released from car engines?

a) Nitrogen dioxide

b) Nitric oxide

c) Nitrous oxide
d) Nitrogen tetroxide
Answer: b
Explanation: Car engines release only nitric oxides. Nitrogen and oxygen from the air combine at high temperatures in the engine to produce nitrogen (II) oxide by the reaction $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$. Nitric oxides rise in the atmosphere and are oxidized to nitrogen dioxide, NO_2 which dissolves in the precipitating water to form acid rain.
17. What is the name of the natural process that is responsible for replenishing N_2 back in the atmosphere from NO_3^-?
a) Nitrification
b) Nitrogen fixation
c) De-nitrification
d) Nitrate fixation
Answer: c
Explanation: All the mentioned steps are critical in the nitrogen cycle. However, de-nitrification is that particular step where microbes in the soil reduce nitrate ions, NO_3^-, to free nitrogen gas, N_2. It also releases few nitrogen oxides as by-products.
18. When liquid nitrogen is poured onto the hand, it slips away without affecting the hand actually. What is this phenomenon called?
a) Kaye effect
b) Kinetic isotope effect
c) Kondo effect
d) Leiden frost effect
Answer: d
Explanation: The Leiden frost effect creates a small layer of insulating vapor layer just at the instant when the liquid particle strikes a surface comparatively a lot hotter than liquid. Liquid nitrogen is at -196°C and the human body at 38°C.

This insulating vapor layer prevents the liquid to further come in contact with the body which then slips away.

19. Which group does the name ‘pnictogens’ refer to?

a) Group 11

b) Group 13

c) Group 15

d) Group 14

Answer: c

Explanation: The group 15 of periodic table is better known as the ‘pnicogens’. Pnicogen means ‘to choke’. Since all the elements in this group is choking in nature, including the choking property of nitrogen. Group 11 does not have a specific name; group 13 is referred to as the Boron group. Group 14 is known as the Carbon group.

20. How many allotropes does nitrogen have?

a) Zero

b) One

c) Two

d) Three

Answer: a

Explanation: Nitrogen atom does not exhibit allotropy. This is because of its relatively small size and high inter-electronic repulsion due to which the N – N becomes extremely weak. However, theoretically there are two predicted forms of allotropes of nitrogen. First, alpha nitrogen assumes a cubic structure and exists only below 35.6 K which is a whooping -237.55°C. Beta nitrogen exists from 35.6 K to 63.15 K. After that, it melts.

21. What is the chemical formula of ammonia?

a) NH_2

b) NH_3

c) NH_4^+

d) NH_5

Answer: a
Explanation: Ammonia is a tri-hydride of nitrogen. It is a colorless gas with a highly pungent smell that causes nasal irritation. It is the most stable hydride of any element in group 15.
22. What kind of smell is ammonia recognized by?
a) Acidic
b) Sweet
c) Rotten
d) Pungent
Answer: d
Explanation: Ammonia has a highly pungent smell. With a sharp, pinching smell, it causes severe irritation in the nose and throat. This pungent smell of ammonia is used as a means to identify the presence of ammonium cation, NH_4^+ in salt analysis.
23. How many unshared pair of electrons does an ammonia molecule have?
a) 1
b) 2
c) 3
d) 4
Answer: a
Explanation: The nitrogen atom in NH_3 (ammonia) bears one lone pair of electron. Each single electron of hydrogen is bonded to the nitrogen atom. Three of out five electrons of nitrogen are involved in bonding whereas the unbounded two electrons make up the single unshared pair of electron.
24. What happens when sodium is put in a solution of ammonia?
a) It generates a lot of heat
b) It does not dissolve
c) It produces deep blue color

d) Ammonia liquid evaporates due to heat
Answer: c
Explanation: When sodium is introduced to liquid ammonia, it separates into sodium ion and a single electron ($Na \rightarrow Na^+ + e^-$). The single electron produces the deep blue color due to solvation effect producing $e^-[NH_3]_n$.
25. What is one method of qualitatively analyzing a given salt for presence of ammonia?
a) Solution turns blue litmus red
b) Heating the salt causing decrepitation
c) Using a reagent to obtain dirty brown precipitate
d) Addition of NaOH causing white gelatinous precipitate
Answer: c
Explanation: Typically, Nessler's reagent is used to test for ammonia. Nessler's reagent is an alkaline solution of potassium tetraiodomercurate (II). When it combines with ammonia it gives dirty brown precipitate due to the formation of $[OHg_2.NH_2]I$. Another method is to add a strong base and heat the mixture. The gas given off is pungent and turns red litmus blue.

26. What is the most acidic of all?
a) NH_3
b) NaOH
c) KOH
d) Alkaline $KMnO_4$
Answer: a
Explanation: In the listed options, except ammonia, every other compound is a strong base which automatically makes ammonia the most acidic relative to the mentioned compounds. Although it is a weak base, compared to NaOH, KOH and alkaline $KMnO_4$ it is the most acidic amongst the four options.

27. In the Haber-Bosch process, what is formed by the reaction of natural gas and steam?
a) Ammonia
b) Nitrogen
c) Oxygen
d) Hydrogen
Answer: d
Explanation: The reaction of natural gas and steam is known as the steam reformation of methane. It is an utmost important step in the Bosch-Haber (industrial process to produce ammonia), which produces hydrogen gas, H_2, one of the two reactants alongside nitrogen to produce ammonia in presence of iron catalyst.

28. Which of the following conditions would improve the yield of ammonia production from Bosch-Haber process?
a) High temperature, high pressure
b) High temperature, low pressure
c) Low temperature, low pressure
d) Low temperature, high pressure
Answer: d
Explanation: Following the Le Chatelier's principle, since the forward reaction is exothermic (i.e. $N_2 + 3H_2 \rightarrow 2NH_3$), low temperatures would increase the rate of reaction in turn producing more ammonia. In addition to this, since the total number of molecules on the product side lesser, high pressures will increase the rate of reaction.
29. Nitrogen in plants is taken in what form?
a) Ammonia
b) Amide
c) Nitrate
d) Nitrite
Answer: c
Explanation: Plants take up nitrogen predominantly in the

form of nitrate ions, along side ammonium ions. This is made available to them through fertilizers, whose typical examples usually include Ammonium Phosphate, calcium ammonium nitrate.

30. Dinitrogen oxide is also called laughing gas.

a) True

b) False

Answer: a

Explanation: Dinitrogen oxide (N_2O) or Nitrogen(I) oxide or nitrous oxide is also known as laughing gas. It is called so because of its intoxicating effects when inhaled. It is used in dentistry and surgery for its anaesthetic and analgesic effects.

31. What is the range of the oxidation states shown by nitrogen in its oxides?

a) +1 to +3

b) +2 to +4

c) +1 to +2

d) +1 to +5

Answer: d

Explanation: Nitrogen in the ground state has a valency of 3 in its ground state and it has a valency of 5 in its excited state. Hence, it forms oxides with a wide range of oxidation states where the oxidation states vary from +1 to +5.

32. Which of the following is true about dinitrogen oxide?

a) It is yellow in colour

b) The oxidation state of nitrogen is +5

c) It is basic in nature

d) It is a colourless gas

Answer: d

Explanation: Dinitrogen oxide (N_2O) or Nitrogen (I) oxide is an oxide of nitrogen where nitrogen has an oxidation state of +1. It is a colourless gas which is neutral in nature and which has a sweet odour.

33. Nitrogen monoxide reacts with oxygen to form nitrogen dioxide.
a) True
b) False
Answer: a
Explanation: Nitrogen monoxide or Nitrogen(II) oxide or nitric oxide is a very reactive compound due to the presence of an odd electron(paramagnetic nature). It instantly reacts with oxygen to form nitrogen dioxide.
34. What does dinitrogen oxide on reaction with sodamide produce?
a) Nitrogen gas
b) Nitric acid
c) Nitrogen dioxide
d) Sodium azide
Answer: b
Explanation: Dinitrogen oxide (N_2O) or Nitrogen(I) oxide, commonly called laughing gas, reacts with liquid sodamide or sodium amide ($NaNH_2$) at a temperature of 473K in order to produce sodium azide (NaN_3) and water.
35. What temperature does dinitrogen oxide dissociate at?
a) 543K
b) 600K
c) 873K
d) 435K
Answer: c
Explanation: At a temperature of about 873K, dinitrogen oxide gas dissociates. Two molecules of dinitrogen oxide gas (N_2O) dissociate to form oxygen gas (O_2) and nitrogen gas (N_2) in the ratio 1:2 respectively.
36. What is the IUPAC name of NOCl?
a) Nitrogen monoxy chloride
b) Chloroxy nitrogen

c) Nitroxy chlorine
d) Nitrosyl chloride
Answer: d
Explanation: Nitrosylchloride is the IUPAC name with the formula (NOCl). It is a yellow coloured gas which is a strong oxidizing agent. Nitrogen monoxide reacts with chlorine in order to form nitrosyl chloride.
37. Which of the following is not an alternative name of dinitrogen trioxide?
a) Nitrogen sesquioxide
b) Nitrogen (III) oxide
c) Anhydride of nitrous acid
d) Nitrogen peroxide
Answer: d
Explanation: Dinitrogen trioxide is an oxide of nitrogen which can also be called as nitrogen sesquioxide, nitrogen (III) oxide or anhydride of nitrous acid. Nitrogen dioxide is also known as nitrogen peroxide.
38. What colour does the compound dinitrogen trioxide appear in its liquid state?
a) It is colourless
b) Blue
c) Green
d) Yellow
Answer: b
Explanation: Dinitrogen trioxide (N_2O_3) is found to be blue in colour in both its liquid and solid state. The blue colouration tends to appear because dinitrogen trioxide is a radical pair of nitric oxide and nitrogen dioxide that tend to absorb strongly in the visible region to appear bright blue.
39. Which of the following compounds can be identified as nitryl fluoride?
a) NO_2F

b) NOF
c) NF_3
d) N_2F
Answer: a
Explanation: Nitrogen dioxide (NO_2), also known as nitrogen peroxide or nitrogen (IV) oxide, is paramagnetic in nature. So, it reacts with fluorine (F_2) and chlorine (Cl_2) forming their respective nitryl compounds. The chemical representation of nitryl fluoride is NO_2F.
40. Which of the following oxide can act as both reducing and oxidising agent?
a) Dinitrogen oxide
b) Nitric oxide
c) Nitrogen dioxide
d) Dinitrogen pentoxide
Answer: b
Explanation: Nitric oxide acts as both an oxidising agent and a reducing agent whereas all the other oxides of nitrogen act as oxidising agents only. The oxidising nature of nitric acid can be observed in its reaction with hydrogen sulphide while its reducing nature can be observed in its reaction with acidified potassium permanganate.
41. Which of the following oxides of nitrogen is a neurotransmitter?
a) N_2O
b) N_2O_4
c) NO_2
d) NO
Answer: d
Explanation: Although nitric acid (NO) is very reactive and harmful, it occurs in small traces in biological systems. It acts as a neurotransmitter and helps in controlling blood pressure by relaxing blood vessels.

42. What are the complexes formed by nitric oxide with transition metals called?
a) Nitrones
b) Nitriles
c) Nitrates
d) Nitrosyls
Answer: d
Explanation: Nitric oxide (NO) readily forms complexes with transition metals. These complexes are called nitrosyls. Two important nitrosyl complexes are sodium nitroprusside and the nitroprusside anion.
43. Which of the following statements is incorrect regarding dinitrogen pentoxide?
a) It is basic in nature
b) It is also known as the anhydride of nitric acid
c) It exists as a colourless solid below 273K
d) The oxidation state of nitrogen is +5
Answer: a
Explanation: Dinitrogen pentoxide (N_2O_5), also known as nitrogen (V) oxide or anhydride of nitric acid, is an oxide of nitrogen which is acidic in nature. The oxidation state of nitrogen in it is +5. It exists as a solid below 273K and decomposes to form nitrogen dioxide, nitric oxide and oxygen above a temperature of 273K.
44. What is the bond angle between the oxygen atoms in nitrogen dioxide?
a) 120°
b) 124°
c) 130°
d) 134°
Answer: d
Explanation: Ideally, according to its structure, the bond angle between the two oxygen atoms in nitrogen dioxide should be

120°. But, the one lone electron on the nitrogen atom exerts a less repulsion than normal on the two oxygen atoms. So, they spread out more, to form a bond angle of 134°.

45. Which of the following is not an oxo-acid of nitrogen?

a) Hyponitric acid

b) Hyponitrous acid

c) Nitrous acid

d) Nitric acid

Answer: a

Explanation: Hyponitric acid does not exist. The rest three mentioned are commonly occurring oxoacids of nitrogen. Hyponitrous acid, $H_2N_2O_2$ is an isomer tautomer of nitramide, with the structure of the former being HON = NOH. Nitrous acid, HNO_2 is usually formed in the atmosphere prior conversion to nitric acid. It is highly unstable.

46. Which of the following is true regarding nitric acid?

a) It is a strong reducing agent

b) It is a weak oxidizing agent

c) Its basicity is unity

d) It is non-planar in gaseous state

Answer: b

Explanation: Nitric acid is a very weak reducing agent since it has a polar O – H bond. This breaks to donate the H^+ ion which is why it is a strong oxidizing agent and a strong acid. Since there is only one cleavable O – H bond, the basicity of nitric acid is unity (one HNO_3 molecule can donate only 1 H^+ ion). It exists as a planar molecule in vapor phase.

47. Which of the following reactions best represents lab scale preparation of nitric acid?

a) $3HNO_2 \rightarrow HNO_3 + H_2O + 2NO$

b) $NO_2 + O_2 \rightarrow NO_3$

c) $NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$

d) $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

Answer: c
Explanation: The most appropriate lab scale preparation method of nitric acid, HNO_3 is using an alkali nitrate salt and react it with concentration nitric acid in a glass retort. Nitrous acid being highly unstable decomposes into nitric acid. The other two sets of reaction represent the industrial process of manufacturing nitric acid i.e. Ostwald's process.
48. What is the name of the industrial process to manufacture nitric acid?
a) Contact process
b) Haber-Bosch process
c) Solvay process
d) Ostwald's proces
Answer: d
Explanation: Ostwald's process is the name of the industrial process to manufacture nitric acid in bulk. It involves the oxidation of ammonia which forms nitric oxide. This is then reacted with more oxygen to produce nitrogen dioxide. Subsequently, nitrogen dioxide is dissolved in water to produce adequate concentrations of nitric acid. Contact process is used to produce sulfuric acid. Solvay is used to obtain sodium carbonate and Haber-Bosch to obtain ammonia.

49. What is the catalyst used in the industrial manufacture of nitric acid?
a) Powdered iron (III) oxide
b) Vanadium (V) oxide
c) Zinc-mercury amalgam
d) Platinum-Rhodium gauze sheet
Answer: d
Explanation: Pt-Rh gauze sheet is widely used as the catalyst in ammonic oxidation, the first step of Ostwald's process. Fe_2O_3 is used in Haber's process; V_2O_5 in contact process and Zn (Hg) is used in Clemmensen reduction of aldehydes.

50. What is the nitric acid – water composition by mass, respectively, for the components to form an azeotrope?
a) 70% – 30%
b) 68% – 32%
c) 30% – 70%
d) 32% – 68%
Answer: b
Explanation: Experimentally, it is determined that nitric acid and water form a constant boiling azeotrope at 68% – 32% by mass composition, respectively. Here, it becomes impossible to separate water and nitric acid by distillation methods. Thus, concentrated sulfuric acid is used for dehydration and removal of water.
51. Which of these gases is released upon treating zinc with diluted and then concentrated nitric acid?
a) Nitrogen dioxide and nitrous oxide
b) Nitric oxide and nitrous oxide
c) Nitrous oxide and nitrogen dioxide
d) Nitrous oxide and nitric oxide
Answer: c
Explanation: The products released depend on the concentration of nitric acid. In case of zinc metal, diluted nitric acid treatment release nitrous oxide and concentrated nitric acid causes the release of nitrogen dioxide.
52. What product(s) is/are formed when aluminum metal is treated with concentrated nitric acid?
a) $Al(NO_3)_3$
b) $Al(NO_2)_3 + H_2$
c) Al_2O_3
d) Al_4O_3
Answer: c
Explanation: Aluminum does not dissolve in nitric acid. This is because treatment with nitric acid results in the formation of

a tough oxide layer. This oxide layer prevents it from further reacting with the oxide. Hence, the compound formed is Al_2O_3 i.e. aluminum (III) oxide.

53. Which reagent is predominantly used in pickling of stainless steel?

a) Iodic acid

b) Nitric acid

c) Phosphoric acid

d) Sulfuric acid

Answer: b

Explanation: Pickling of stainless steel is the process of removal of a thin layer of the alloyed metal from the surface. The common reagent used is nitric acid along with calculated amounts of hydrofluoric acid.

54. How many moles of nitric acid is required to convert 1 mole of sulfur to sulfuric acid?

a) 10

b) 4

c) 48

d) 20

Answer: c

Explanation: 1 mole of sulfur, S_8 requires 48 moles of concentrated nitric acid. The reaction is given by $S_8 + 48HNO_3 \rightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$. 10, 4 and 20 moles of concentrated nitric acid is required to produce iodic acid, carbon dioxide and phosphoric acid from 1 mole of iodine, carbon and phosphorus, respectively.

55. Which allotrope of phosphorus is the most stable?

a) White phosphorus

b) Red phosphorus

c) Black phosphorus

d) Phosphine

Answer: c
Explanation: Black phosphorus is thermodynamically, the most stable allotrope of phosphorus and does not burn in air even up to 673 K. It has a sharp melting point of 860 K. Like graphite, it is fairly a good conductor of electricity.

56. Which allotrope of phosphorus is the most reactive?
a) White phosphorus
b) Metal phosphorus
c) Red phosphorus
d) Beta-black phosphorus
Answer: a
Explanation: The three allotropic forms of phosphorus differ widely in their chemical reactivity in which white phosphorus is the most reactive while black and red phosphorus are less reactive. White phosphorus is made up of discrete P_4 tetrahedra which are subjected to very high angular strain as the angles is 60 degrees. This high angular strain makes white phosphorus unstable and highly reactive.
57. Red phosphorus is kept under water to protect it from air.
a) True
b) False
Answer: b
Explanation: White phosphorus is a highly reactive clement and must be stored underwater for safekeeping to prevent it from catching fire spontaneously in the air. In water, white phosphorus reacts with oxygen within hours or days. In water with low oxygen, white phosphorus may degrade to a highly toxic compound called phosphine, which eventually evaporates to the air and is changed to less harmful chemicals.
58. From which type of phosphorus is alpha -black phosphorus formed?
a) Phosphide
b) White phosphorus

c) Black phosphorus
d) Red phosphorus
Answer: d
Explanation: Alpha-black phosphorus is the most stable allotrope of black phosphorus. Alpha-black phosphorus is produced from red phosphorus. When red phosphorus is heated in a sealed tube at 803 K, it forms alpha-black phosphorus.
59. Beta-black phosphorus is prepared by heating white phosphorus.
a) True
b) False
Answer: a
Explanation: Yes, Beta-black phosphorus is prepared by heating white phosphorus at 473 K under high pressure(4000-12000 atm) in an inert atmosphere. It has layered structure in which each phosphorus atom is covalently bonded to three neighbouring phosphorus atoms.

60. Like white phosphorus, which phosphorus also exists as P_4?
a) Black phosphorus
b) Red phosphorus
c) Phosphine
d) Beta-black phosphorus
Answer: b
Explanation: Like white phosphorus, red phosphorus also exists as P_4 tetrahedra but these are joined together through covalent bonds to give a polymeric structure. Because of polymeric structure, its melting point (883 K) is much higher than that of white phosphorus(317 K).
61. Which allotrope of phosphorus does not catch fire easily?
a) White phosphorus
b) Alpha- black phosphorus

c) Beta- black phosphorus
d) Red phosphorus
Answer: d
Explanation: Red phosphorus is a relatively stable allotrope of phosphorus at room temperature. Its ignition temperature(543 K) is much higher than that of white phosphorus(303 K). As a result, it does catch fire easily.
62. White phosphorus can be reconverted to red phosphorus.
a) True
b) False
Answer: a
Explanation: Yes, red phosphorus sublimes on heating giving vapours which are the same as by white phosphorus. When these vapours are condensed, white phosphorus is obtained. This gives us simple method of reconverting red phosphorus into white phosphorus.
63. Which allotrope of phosphorus is also called yellow phosphorus?
a) Black phosphorus
b) Red phosphorus
c) Beta- black phosphorus
d) White phosphorus
Answer: d
Explanation: White phosphorus on exposure to light, it turns yellow. It glows greenish in the dark (when exposed to oxygen) and is highly flammable and pyrophoric (self-igniting) upon contact with air. Therefore it is called yellow phosphorus.
64. What is the allotrope of phosphorus in which P-atom completes its octet?
a) Alpha-black phosphorus
b) Beta-black phosphorus
c) White phosphorus

d) Red phosphorus
Answer: c
Explanation: White phosphorus exists as P_4 units. The four sp^3 hybridized phosphorus atoms lie at the corners of a regular tetrahedron with an angle of 60 degree. Each phosphorus atom is linked to three other P-atoms by covalent bonds so that each p-atom completes it octet.
65. Which of the following is not true about phosphine?
a) Phosphine is a colorless gas
b) Phosphine has a rotten fish smell
c) Phosphine is inflammable
d) Phosphine is highly poisonous
Answer: c
Explanation: Phosphine is a colorless gar with rotten fish smell and is highly poisonous. In pure state, phosphine is non-flammable but becomes inflammable owing to the presence of P_2H_4 or White phosphorous (P_4) vapours.
66. Phosphine acts as a Lewis acid.
a) True
b) False
Answer: b
Explanation: Phosphine acts as a Lewis base and reacts with acidic species to form phosphinium salts.
$PH_3 + HBr \rightarrow PH_4Br$
Phosphine reacts with hydrogen bromide to form phosphinium salts which is a property of a base.
67. Phosphine is prepared from which of the following methods?
a) By reacting calcium phosphide with water or dilute HCl
b) By directly reacting phosphorous with hydrogen
c) By passing dry chlorine over P_2H_4
d) Heating while phosphorous with halides

Answer: a
Explanation: Phosphine is prepared by the reaction of calcium phosphide with water or dilute HCl.
With water: $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$
With dilute HCl: $Ca_3P_2 + 6HCl \rightarrow 2PH_3 + 3CaCl_2$.

68. Which of the following is a property of phosphine?
a) It is insoluble in water
b) It is inflammable
c) The solution of phosphine in water decomposes in the presence of light
d) It acts as a Lewis acid
Answer: c
Explanation: Phosphine is slightly soluble in water and is non-flammable in pure form. It is a Lewis base and the solution of phosphine in water decomposes in the presence of light giving red phosphorous and hydrogen gas.
69. Which of the following gas is used as Holmes signal?
a) Hydrogen per oxide
b) Nitrogen
c) Acetylene
d) Phosphine
Answer: d
Explanation: When a mixture of calcium carbide and calcium phosphide placed in a container is made to react with water, it produces the gases phosphine and acetylene. This signal produced due to the burning gases is called Holmes signal.
70. What is the reaction involved in Holmes signal?
a) $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$
b) $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 \rightarrow P_2H_4 + P_4O_6$ and $CaC_2 + H_2O \rightarrow C_2H_2$
c) $Ca_3P_2 + 6HCl \rightarrow 2PH_3 + 3CaCl_2$
d) $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$
Answer: b

Explanation: The reactions involved in Holmes signal are: $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 \rightarrow P_2H_4 + P_4O_6$ and $CaC_2 + H_2O \rightarrow C_2H_2$
Calcium carbide and calcium phosphide both react with water to give acetylene and phosphine respectively. These gases burn to give the signal.
71. What is the hybridization of phosphine?
a) sp^2 hybridized
b) sp^3 hybridized
c) sp hybridized
d) No hybridization
Answer: d
Explanation: The hybridization of phosphine seems like sp^2 but in reality the molecule has no hybridization as it forms all bonds using its pure p orbitals. This can be proved from its bong angle data which shows that its bond angles are 93.5°.
72. What is the structure of phosphine?
a) Trigonal pyramidal
b) Trigonal bi-pyramidal
c) Rhombohedral
d) Pyramidal
Answer: a
Explanation: Phosphine has a trigonal pyramidal structure with molecular symmetry. The length of the bond between phosphorous and hydrogen is 1.42×10^{-10} m and the bond angles are equal and are known to be 93.5°.
73. Which of the following compounds react with water to give phosphine?
a) Phosphorous trichloride
b) Phosphorous pentachloride
c) Black phosphorous
d) Aluminium phosphide
Answer: d

Explanation: Metal phosphides such as aluminium phosphide reacts with water to from phosphine and metal hydroxide.
Reaction: $AlP + 3H_2O \rightarrow PH_3 + Al(OH)_3$.
74. Phosphine like ammonia has very high affinity for water.
a) True
b) False
Answer: b
Explanation: The ammonia molecule has the capability to form a dative bond due to the lone pair of electrons. There is a formation of H-bond due to strong dipole-dipole attraction between ammonia and water molecules where as in phosphine the H-bond is weak and the P-H bond is non-polar so, it is only slightly soluble in water but highly soluble in non-polar solvents.
75. Phosphorus does not form oxoacids.
a) True
b) False
Answer: b
Explanation: Similar to the other elements in group 15 of the periodic table, and especially nitrogen, phosphorus does form oxoacids. It forms oxoacids with varying basicity and where the oxidation number pf phosphorus varies too.
76. What is the range of the oxidation states shown by phosphorus in its oxoacids?
a) +1 to +3
b) +2 to +4
c) +1 to +2
d) +1 to +5
Answer: d
Explanation: Phosphorus in the ground state has a valency of 3 and it has a valency of 5 in its excited state. Hence, it forms oxoacids with a wide range of oxidation states where the oxidation states vary from +1 to +5.

77. Which of the following is incorrect about Hypophosphorous acid?
a) It is also called phosphonic acid
b) The oxidation state of phosphorus is +1
c) It is monobasic
d) It is represented by the formula H_3PO_2
Answer: a
Explanation: Hypophosphorous acid, also known as phosphinic acid, is an oxoacid of phosphorus in which, the oxidation state of phosphorus is +1. It is monobasic in nature, that is, it dissociates to produce one hydrogen ion. It is represented by the formula H_3PO_2.
78. Orthophosphorous acid can be made from phosphorous trioxide.
a) True
b) False
Answer: a
Explanation: Orthophosphorous acid, also known as phosphonic acid, is an oxoacid of phosphorus. It can be prepared by adding phosphorus trioxide (P_4O_6) to water (H_2O) in the ratio 1:6 resulting in the formation of 4 molecules of phosphonic acid.
79. How many P-H bonds does hypophosphorous acid contain?
a) 1
b) 2
c) 3
d) 4
Answer: b
Explanation: Hypophosphorous acid, also called as phosphinic acid, has one P – OH bond, 2 P – H bonds and one P = O bond. It is monobasic in nature due to the presence of the one P – OH bond.

80. What is the basicity of pyrophosphoric acid?
a) Monobasic
b) Tribasic
c) Dibasic
d) Tetrabasic
Answer: c
Explanation: Pyrophosphoric acid, represented chemically as $H_4P_2O_5$, is an oxoacid of phosphorus. It is dibasic in nature. This is due to the presence of two P – OH bonds that are present in the molecule which help release two H^+ ions.
81. What is the total number of atoms or groups surrounding each phosphorus atom in its oxoacids?
a) 5
b) 6
c) 3
d) 4
Answer: d
Explanation: In all of the oxoacids of phosphorus, the phosphorus atom is tetrahedrally surrounded by four other atoms or groups. The phosphorus atoms can form both double and single bonds in its oxoacids.
82. What is the oxidation state of phosphorus in hypophosphoric acid?
a) +1
b) +2
c) +3
d) +4
Answer: d
Explanation: Hypophosphoric acid, represented chemically as $H_4P_2O_6$, is an oxoacid of phosphorus. The oxidation state of phosphorus in hypo phosphoric acid is +4. The two phosphorus atoms in total form 4 single bonds with OH

group, two double bonds with oxygen and one single bond between the two phosphorus atoms.

83. What is the temperature at which orthophosphoric acid forms pyrophosphoric acid?

a) 673 K

b) 523 K

c) 423 K

d) 700 K

Answer: b

Explanation: At a temperature of about 523 K, orthophosphoric acid forms pyrophosphoric acid. At 523 K, two molecules of ortho phosphoric acid (H_3PO_4) react with each other to form pyro phosphoric acid and water.

84. Which of the following compounds contain phosphorus with an oxidation state of +5?

a) Peroxodiphosphoric acid

b) Hypophosphorous acid

c) Orthophosphorous acid

d) Hypophosphoric acid

Answer: a

Explanation: The oxidation state of phosphorus in peroxodiphosphoric acid is +5. The oxidation state of phosphorus in hypo phosphorus acid is +1, in ortho phosphorous acid is +3 and in hypo phosphoric acid is +4.