Group-15 Elements: Nitrogen family

SINGLE CORRECT CHOICE TYPE QUESTIONS

1. NH_3 burns in air under suitable conditions to produce
   (A) N_2 (B) NO (C) N_2O (d) N_9O_3

2. Which of the following is not a covalent nitride?
   (A) BN (B) AlN (C) Ge_3N_4 (d) ScN

3. In the cationic parts of solid N_2O_5 and solid N_2O_4, the bond orders of N–O are, respectively
   (A) 3 and 2
   (B) 2 and 3
   (C) 2.5 and 3
   (D) 3 in both

4. The best reducing agent among the following is
   (A) NH_3 (B) SbH_3 (C) PH_3 (D) AsH_3

5. N_2H_4 reacts with conc. H_2SO_4 to produce a salt $[NH_3 - NH_3]^{2+}\ SO_4^{2-}$ in which
   (A) d_{N-N} (salt) > $d_{N-N}(N_2H_4)$
   (B) d_{N-N} (salt) < $d_{N-N}(N_2H_4)$
   (C) d_{N-N} (salt) = $d_{N-N}(N_2H_4)$
   (D) Cannot be predicted.

6. Which is not correct regarding the Holme's signal?
   (A) PH_3 catches fire on contact with air, spontaneously.
   (B) P_2H_4 catches fire on contact with air, spontaneously.
   (C) PH_3, C_2H_2 and P_2H_4 are formed together.
   (D) All the gases burn together.

7. PH_3 and NH_3 on separately reacting with bleaching powder produce respectively
   (A) P and N_2
   (B) PCl_3 and NCl_3
   (C) PCl_3 and N_2
   (D) PCl_5 and NCl_3

8. N_2 is passed through overheated CaC_2. Which of the following options is correct for the product formed?
   (I) State of hybridization of C is *sp*.
   (II) Urea is an intermediate formed during hydrolysis of the above product.
   (III) Anion present in the product is not a pseudo halide ion.
   (IV) Hydrolysis of product gives rise to NH_3 gas slowly.
   (A) I, II and III
   (B) III and IV
   (C) I, II and IV
   (D) None of the above.

9. Phosphorescence shown by P is due to
   (A) oxidation of P into P_2O_3.
   (B) oxidation of P into P_2O_5.
   (C) oxidation of luciferin by luciferase enzyme.
   (D) reduction of P into phosphide ions.

10. Which of the following compounds consist of a P–P linkage?
    (A) Hypophosphoric acid.
    (B) Pyrophosphorous acid.
    (C) Dipolyphosphoric acid.
    (D) Metaphosphoric acid.

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Which of the following properties decreases for MH_3 on descending the group from NH_3 to BiH_3?
   (A) Thermal stability
   (B) Reducing power
   (C) The ease of replacing hydrogen atoms by other groups such as Cl, Me
   (D) The lone pair donating ability

2. NH_3 gas can be detected by which of the following methods?
   (A) By its characteristic pungent smell.
   (B) By turning of moist litmus paper blue.
   (C) By forming intense white clouds of NH_4Cl with stopper from bottle of conc. HCl.
   (D) By forming a yellow-orange-brown precipitate with Nessler's solution.

3. Which of the following statements is/are true regarding N_2O?
   (A) It is used as anaesthetic by dentists.
   (B) Bond orders are fractional for N–N and N–O bonds.
   (C) It reacts with water to give HNO_3 and HNO_2.
   (D) It is a very good supporter of combustion.

4. Which of the following substances cannot be used for drying NH_3?
   (A) Anhyd. $CaCl_2$
   (B) P_2O_5
   (C) Conc.H_2SO_4
   (D) CaO

5. Which of the following properties of red P and white P are related to their structure?
   (A) Large difference in melting point.
   (B) Difference in hardness.
   (C) Ignition behaviour.
   (D) None of these.

COMPREHENSION TYPE QUESTIONS

Passage 1: For Questions 1 to 3

One of the important hydrides of nitrogen is hydrazine (N_2H_4). It is mostly used as rocket fuel. It is manufactured by Raschig process.

1. Which of the following mixtures of hydrazine or hydrazine derivatives act as a rocket fuel?
(A) $N_2H_4 + H_2O_2$
(B) $MeNHNH_2 + N_2O_4$
(C) $MeNNH_2 + N_2O_4$
(D) All of these

2. In which of the following reactions, N_2H_4 acts as an oxidizing agent?
(A) $N_2H_4 + I_2 \rightarrow$
(B) $N_2H_4 + O_2 \rightarrow$
(C) $N_2H_4 + CuSO_4 \rightarrow$
(D) $N_2H_4 + Zn/HCl \rightarrow$

3. Which of the following statements is incorrect regarding N_2H_4?
(A) It is used to characterize carbonyl compounds and sugars by forming crystalline derivative called osazones.
(B) It is prepared by oxidation of NH_3 by NaOCl in dilute aqueous solution.
(C) In its preparation by Raschig process tap water cannot be used.
(D) Structurally it exists in eclipsed form.

Passage 2: For Questions 4 to 6

When white phosphorus reacts with NaOH, it produces a gaseous mixture by the following parallel reactions.

$$P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3 \uparrow$$
$$3P_4 + 8NaOH + 8H_2O \rightarrow 8NaH_2PO_2 + 2P_2H_4 \uparrow$$

4. The gas mixture comes out and catches fire immediately due the presence of
(A) PH_3
(B) P_2H_4
(C) P_2H_6
(D) H_2

5. The correct thermal stability order is
(A) $PH_4Cl > PH_4Br > PH_4I$
(B) $PH_4I > PH_4Cl > PH_4Br$
(C) $PH_4Br > PH_4Cl > PH_4I$
(D) $PH_4I > PH_4Br > PH_4Cl$

6. The formation of PH_4^+ is difficult compared to that of NH_4^+ because
(A) the lone pair of P resides at 3*d* orbital.
(B) lone pair of P resides at almost pure *p* orbital.
(C) lone pair of P resides at sp^3 hybrid orbital.
(D) lone pair of P resides at almost pure *s* orbital.

Passage 3: For Questions 7 to 9

A white solid having garlic smell (A) $\xrightarrow[\text{Cold}]{H_2O}$ (B) $\xrightarrow[\text{heating}]{\text{on}}$ gas (C) having rotten fish smell + acid (D)

7. A is
(A) P (white)
(B) P (red)
(C) P_2O_3
(D) $(CO_2H)_2$

8. Gas (C) is passed through formaldehyde solution in the presence of HCl to produce a colourless solid which is used for making
(A) bullet proof clothing.
(B) fire proof clothing.
(C) poison sensitive clothing.
(D) None of these.

9. With increase in temperature, following heating, acid (D) produces the following products in which correct sequence?
(A) Pyroacid, metaacid, anhydride.
(B) Metaacid, pyroacid, anhydride.
(C) Metaacid, anhydride, pyroacid.
(D) Pyroacid, anhydride, metaacid.

ASSERTION–REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:
(A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
(B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
(C) If Statement I is true but Statement II is false.
(D) If Statement I is false but Statement II is true.

1. **Statement I:** White phosphorus is stored under kerosene.

Statement II: White phosphorus catches fire when exposed to air.

2. **Statement I:** NH_4NO_3 is used as an explosive.

   Statement II: On strong heating above 300°C, it causes the formation of seven volumes of gas from almost zero volume solid.

3. **Statement I:** NH_3 can be dried by quick lime.

   Statement II: Quick lime is also basic in nature and no reaction takes place with NH_3.

4. **Statement I:** N_2O is a better supporter of combustion as compared to air.

   Statement II: N_2O decomposes to ($N_2 + ½\ O_2$) which contains 33% O_2 as compared to 20% O_2 in air.

5. **Statement I:** Conc. HNO_3 can be stored in aluminium vessel.

   Statement II: The surface of aluminium vessel gets-coated with impervious layer of Al_2O_3 on reaction with conc. HNO_3.

INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

1. Find the number of P–O–P linkages in P_4O_{10}.
2. Find the oxidation state of N–atom in $[N_2H_6]SO_4$.
3. Nylon-6 has the formula of $-CO[-NH-(CH_2)_3-CO]_n-NH-$.

   Find the number of carbon atoms between two nitrogen atoms.

4. Find the number of linear molecule from the following:

   $HN_3, FN_3, ClN_3, BrN_3, IN_3$

5. In how many of the following species, the N–O bond length in greater than that in NO^+?

   N_2O, NO_2^-, NO_3^-, NOCl, NO_2^+, NO_2Cl

6. The difference in oxidation states of two nitrogen atoms of cationic part and anionic part of N_2O_5 is _____.
7. Find the maximum number of tribasic acids that may exist from the following formulas.

   $H_3PO_4, H_3PO_2, H_3PO_3, H_4P_2O_7, H_4P_2O_5, H_4P_2O_6$

8. Find the number σ-bonds in triethyl phosphate.
9. How many of the following elements form N_2O on reaction with 20% HNO_3 solution?

   Pb, Cu, Fe, Zn, Sn, Hg, Ag

10. Find the maximum number equal P–F bond lengths in PF_5.

MATRIX–MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labeled as **(A), (B), (C)** and **(D)**, while those in Column II are labeled as **(P), (Q), (R), (S)** and **(T)**. Any given statement in Column I can have correct matching with *one or more* statements in Column II.

1. Match the nitrogen oxides with their properties.

Column I	Column II
(A) N_2O	(P) Neutral towards water.
(B) NO	(Q) Acidic towards water.
(C) N_2O_3 (unsymmetrical)	(R) N–N linkage is present.
(D) N_2O_4	(S) Molecule having highest bond order of N–O bond.
(E) N_2O_5	

2. Match the compounds with their characteristics/ uses.

Column I	Column II
(A) NH_4Cl	(P) Used as fertilizer.
(B) NH_4NO_3	(Q) Can be obtained by heating camel dung.
(C) $(NH_4)_2SO_4$	(R) It is deliquescent in nature.
(D) NH_4ClO_4	(S) Used as solid fuel in rocket propellant.
	(T) Used in dry batteries.

3. Match the fertilizer with the compounds/reactions they are obtained from.

Column I	Column II
(A) Triple superphosphate	(P) Ammonium carbonate
(B) Urea	(Q) Gypsum slurry + $NH_3 + CO_2$
(C) Nitrolim	(R) Fluoroapatite
(D) Ammonium sulphate	(S) $CaC_2 + N_2$

ANSWERS

Single Correct Choice Type Questions

1. (B)	**3.** (B)	**5.** (B)	**7.** (C)	**9.** (A)
2. (D)	**4.** (B)	**6.** (A)	**8.** (C)	**10.** (A)

Multiple Correct Choice Type Questions

1. (A), (C), (D)	**2.** (A), (B), (C), (D)	**3.** (A), (B), (D)	**4.** (A), (B), (C)	**5.** (A), (B), (C)

Comprehension Type Questions

1. (D)	**3.** (D)	**5.** (D)	**7.** (C)	**9.** (A)
2. (D)	**4.** (B)	**6.** (D)	**8.** (B)	

Assertion–Reasoning Type Questions

1. (D)	**2.** (A)	**3.** (A)	**4.** (A)	**5.** (A)

Integer Answer Type Questions

1. 6	**3.** 6	**5.** 6	**7.** 2	**9.** 2
2. –2	**4.** 0	**6.** 0	**8.** 25	**10.** 3

Matrix–Match Type Questions

1. (A) → (P) (R)
(B) → (P), (S)
(C) → (Q), (R)
(D) → (Q), (R)
(E) → (Q)

2. (A) → (Q), (T)
(B) → (P), (R)
(C) → (P)
(D) → (S)

3. (A) → (R)
(B) → (P)
(C) → (S)
(D) → (Q)