Group-16 Elements: Chalcogens

SINGLE CORRECT CHOICE TYPE QUESTIONS

1. Which of the following is incorrect regarding O_3?
   (A) It is an allotrope of oxygen.
   (B) d_{O-O} is in between that of O_2 and H_2O_2.
   (C) It is an angular-shaped molecule.
   (D) It is paramagnetic like O_2.

2. Fluidity of Hg is lost on reaction with O_3 due to the formation of
   (A) Hg_2O
   (B) Hg_2O_2
   (C) HgO_2
   (D) HgO

3. Dry I_2 and moist I_2 on reaction with O_3 produces compounds A and B, respectively. Then A and B are
   (A) HIO_3 and I_4O_9
   (B) I_4O_9 and HIO_3
   (C) HIO_3 and HIO_4
   (D) HIO_4 and HIO_3

4. The compounds of sulphur obtained by reaction of sulphur and conc. hot KOH, when reacted separately with dil. HCl produce
   (A) different gases, SO_2 and H_2S.
   (B) the same gas SO_2.
   (C) sulphur back.
   (D) the same gas H_2S.

5. The best yield of H_2O_2 is obtained from BaO_2 on acidification with which of the following acids?
   (A) H_2SO_4
   (B) HNO_3
   (C) H_3PO_4
   (D) HOCl

6. H_2O_2 is used for detection of Ti^{4+} ions and the yellow solution obtained has the formula and oxidation state as
   (A) H_2TiO_4 and + 6
   (B) H_2TiO_3 and + 4
   (C) H_2TiO_4 and + 4
   (D) $TiSO_4$ and + 2

7. Which of the following species does not contain S–S linkage?
   (A) $S_2O_2^{2-}$
   (B) $S_2O_3^{2-}$
   (C) $S_2O_5^{2-}$
   (D) None of these.

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Oxygen shows several differences from the rest of the elements of the group. This is because
   (A) it has small size.
   (B) it has high electronegativity.
   (C) of the lack of suitable *d*-orbitals.
   (D) it can form strong π-bonds.

2. The weaker π-bond formation is responsible for the non-existence of which of the following compounds as discrete molecule?
   (A) CO_2 (B) CS_2 (C) CSe_2 (D) CTe_2

3. SO_2 pollution (from coal fired power station) can be controlled by
   (A) passing the flue gas through slurry of $Ca(OH)_2$.
   (B) reduction of SO_2 into S using H_2S and activated Al_2O_3 catalyst.
   (C) passing through saturated solution of SO_2.
   (D) passing through acidified $KMnO_4$ solution.

4. Gun powder is a mixture of
   (A) $NaNO_3$
   (B) KNO_3
   (C) charcoal powder
   (D) sulphur

5. The final product obtained from the electrolysis of 50% H_2SO_4 with high current density has a
   (A) S–O–O–S linkage.
   (B) –O–O–linkage.
   (C) S–S linkage.
   (D) S–O–S linkage.

6. In which of the following cases, the element is oxidized into its highest oxidation state when it reacted with O_3 under moist conditions?
   (A) S (B) I_2 (C) P (D) As

7. Which of the following compounds can be used for drying of H_2S gas?
   (A) Conc. H_2SO_4
   (B) P_2O_5
   (C) Fused $CaCl_2$
   (D) Anhydrous Al_2O_3

8. Ozone gas can be absorbed by
   (A) olive oil.
   (B) turpentine oil.
   (C) mustard oil.
   (D) oil of cinnamon

COMPREHENSION TYPE QUESTIONS

Passage 1: For Questions 1 to 3

Ozone is an allotrope of oxygen. It can be prepared by several methods but always a very small amount of conversion is observed. It forms an important layer in the upper atmosphere as it can absorb UV rays from sun. It is also a powerful oxidizing agent.

1. Which of the following substances can cause depletion of O_3 layer?
   (A) Chlorofluorocarbons
   (B) Oxides of nitrogen like NO
   (C) Halogens
   (D) All of these

2. O_3 can be prepared by
   (A) action of silent electric discharge upon O_2 in an ozonizer.
   (B) UV irradiation of O_2.
   (C) passing F_2 in water.
   (D) All of these.

3. In which of following cases, the products formed are incorrect considering the oxidizing properties of O_3?
   (A) $2K_2MnO_4 + O_3 + H_2O \rightarrow 2KMnO_4 + 2KOH + O_3$
   (B) $2Ag + O_3 \rightarrow Ag_2O + O_2$
   (C) $SO_2 + O_3 \rightarrow SO_3 + O_2$
   (D) $PbS + 4O_3 \rightarrow PbSO_4 + 4O_2$

Passage 2: For Questions 4 and 5

SO_2 can act as oxidizing agent as well as reducing agent and the major source of obtaining SO_2 is roasting of sulphide ores and by burning sulphur.

4. SO_2 is very soluble in water; 39 cc of SO_2 gas is dissolved in 1 cc of water. In this solution SO_2 is mostly present as
   (A) H_2SO_3
   (B) various hydrates like $SO_2 \cdot 6H_2O$.
   (C) Both (A) and (B) in equal amount.
   (D) H_2SO_4

5. Which of the following statements is incorrect regarding SO_2?
   (A) It can be detected by turning of moist starch iodate paper blue.
   (B) It can be estimated calorimetrically by reacting with $K_2[HgCl_4]$ followed by the reaction with the dye pararosanilline.
   (C) SO_2 can be used to bleach wool and silk.
   (D) SO_2 reduces $FeCl_2$ into Fe in strongly acidic medium.

Passage 3: For Questions 6 and 7

Contact process is used to convert SO_2 into SO_3 in the presence of platinum catalyst and the reaction is exothermic.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H = (-)ve$$

6. Now-a-days a cheaper catalyst is used instead of platinum and that catalyst is
   (A) V_2O_3 and K_2O
   (B) V_2O_4 and K_2O
   (C) V_2O_5 and K_2O
   (D) VO_3 and K_2O

7. During the conversion of SO_3 into H_2SO_4 on commercial scale, the intermediate compound is
   (A) $H_2S_2O_3$
   (B) $H_2S_2O_5$
   (C) $H_2S_2O_6$
   (D) $H_2S_2O_7$

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 and Statement II is true.

1. **Statement I:** HNO_3 oxidizes S to H_2SO_4 while Se is oxidized to H_2SeO_3.

   Statement II: The presence of ten electrons in 3*d*-subshell, causes poor shielding and finally attracts the outermost electron more strongly for Se.

2. **Statement I:** Conc. H_2SO_4 can be used for drying H_2S gas.

   Statement II: Conc. H_2SO_4 shows very good dehydrating property.

3. **Statement I:** H_2O_2 can be used as good rocket propellant when mixed with N_2H_4.

   Statement II: H_2O_2 and N_2H_4 both exist in the gauche form.

4. **Statement I:** O_3 has a fishy smell.

   Statement II: It absorbs red part of the visible light.

5. **Statement I:** In most of the reactions of O_3, O_2 is one of the products formed.

   Statement II: Only one O atom comes out easily from O_3 when it undergoes reduction accepting two electrons.

INTEGER ANSWER TYPE QUESTIONS

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

1. The sum of the oxidation states of sulphur atoms in $H_2S_2O_5$ is _____.
2. When SO_2 is dissolved in water, then number of ions that will be in equilibrium is _____.
3. The sum of oxidation states of sulphur atoms in $H_2S_nO_6$ is _____.
4. Find the number of reactions, among the following, where H_2O_2 acts as reducing agent.
   (i) $KMnO_4 + H_2O_2 \xrightarrow{H^+}$
   (ii) $NaOCl_2 + H_2O_2 \rightarrow$
   (iii) $H_2S + H_2O_2 \rightarrow$
   (iv) $K_4[Fe(CN)_6] + H_2O_2 \xrightarrow{H^+}$
   (v) $C_2O_4^{2-} + H_2O_2 \xrightarrow{\text{Amyl alcohol}}$
5. In the following reaction, find the number of *d*-orbitals involved in bonding of compound A.
   $$PCl_5 + SO_2 \rightarrow A + POCl_3$$
6. H_2S gas can be dried by how many of the following reagents?
   Anhydrous $CaCl_2$, conc. H_2SO_4, P_2O_5, KOH solution, Na_2CO_3 solution.
7. How many of the following properties increase regularly from H_2O to H_2Te?
   (i) Acidic strength
   (ii) Bond angle
   (iii) Boiling point
   (iv) Bond length
8. The oxidation state of sulphur atom in $H_2S_2O_7$ is ___.
9. The number of lone pairs in O_3 molecule is ___.
10. The sum of oxidation state of all sulphur atoms in pentathionate ion is ___.

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 labelled as **(A)**, **(B)**, **(C)** and **(D)**, while those in Column II are labelled 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 compounds with their uses.

Column I	Column II
(A) O_3	(P) Very good fluorinating agent.
(B) H_2O_2	(Q) Used for preparing mustard gas.
(C) SF_4	(R) Used as rocket fuel.
(D) SCl_2	(S) Used to purify drinking water.

2. Match the compounds with the correct statement about them.

Column I	Column II
(A) γ-SO_3	(P) Consists of S–O–S linkage.
(B) $Na_2S_4O_6$	(Q) S is in the maximum oxidation state.
(C) Caro's acid (H_2SO_5)	(R) Peroxy linkage is present.
(D) Oleum ($H_2S_2O_7$)	(S) S–S linkage is present.
	(T) It is not a ring system.

3. Match the compounds with their properties.

Column I	Column II
(A) O_3	(P) Acts as reducing agent.
(B) H_2O_2	(Q) Acts as oxidising agent.
(C) SO_2	(R) Molecule is polar.
(D) H_2S	(S) Molecule is planar.

ANSWERS

Single Correct Choice Type Questions

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

Multiple Correct Choice Type Questions

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

Comprehension Type Questions

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

Assertion–Reasoning Type Questions

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

Integer Answer Type Questions

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

Matrix–Match Type Questions

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

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

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