DAY FOURTEEN

Unit Test 3

(Inorganic Chemistry I)

1 Drying agent which reacts with CO_2 and removes water vapours is
(a) CaO (b) $CaCl_2$ (c) $CaCO_3$ (d) $Ca(NO_3)_2$

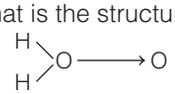
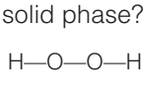
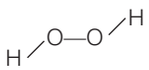
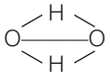
2 Hydrogen will not reduce
(a) heated aluminium oxide (b) heated cupric oxide
(c) heated ferric oxide (d) heated stannic oxide

3 The amount of H_2O_2 present in 1 L of 1.5 N H_2O_2 solution is
(a) 2.5 g (b) 25.5 g (c) 8.0 g (d) 80.0 g

4 Which of the properties of interstitial hydrides is correct?
(a) They can be used as hydrogenation catalysts
(b) On thermal decomposition they afford a source of pure hydrogen
(c) They give rise to metals fit for fabrication
(d) They generally form non-stoichiometric species

5 Water gas is an important fuel. It is a mixture of
(a) H_2O + air (b) $H_2O + CO_2$
(c) $CO + H_2$ (d) $CO + CO_2$

6 Which cannot be oxidised by H_2O_2?
(a) Na_2SO_3 (b) PbS (c) KI (d) O_3

7 What is the structure of H_2O_2 in solid phase?
(a)  (b) 
(c)  (d) 

8 A commercial sample of hydrogen peroxide is labelled as 10 volume. Its percentage strength is nearly
(a) 1% (b) 3% (c) 10% (d) 90%

9 Permanent hardness of water can be removed by adding
(a) Na_2CO_3 (b) K (c) Ca(OCl)Cl (d) Cl_2

10 The formula of calgon, used for water softening is
(a) $Na_2[Na_4(PO_3)_6]$ (b) $Na_4[Na_2(PO_3)_6]$
(c) $Na_2[Na_4(PO_4)_5]$ (d) $Na_4[Na_4(PO_4)_6]$

11 Which of the following equation depicts reducing nature of H_2O_2? **→ [NCERT Exemplar]**
(a) $2[Fe(CN)_6]^{4-} + 2H^+ + H_2O_2 \longrightarrow 2[Fe(CN)_6]^{3-} + 2H_2O$
(b) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$
(c) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + 2OH^-$
(d) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$

12 Why does H^+ ion always get associated with other atoms or molecules? **→ [NCERT Exemplar]**
(a) Ionisation enthalpy of hydrogen resembles that of alkali metals
(b) Its reactivity is similar to halogens
(c) It resembles both alkali metals and halogens
(d) Loss of an electron from hydrogen atom results in a nucleus of very small size as compared to other atoms or ions. Due to small size, it cannot exist free

13 Water is oxidised to oxygen by
(a) ClO_2
(b) $KMnO_4$
(c) H_2O_2
(d) fluorine

14 Which of the following has correct increasing basic strength?
(a) MgO < BeO < CaO < BaO
(b) CaO < BaO < BeO < MgO
(c) BaO < CaO < MgO < BeO
(d) BeO < MgO < CaO < BaO

15 The difference of water molecules in gypsum and plaster of Paris is

(a) 5/2 (b) 2 (c) $1\frac{1}{2}$ (d) 1/2

16 Bleaching powder loses its power on keeping for a long time because

(a) it changes into calcium chloride and calcium chlorate
(b) it absorbs moisture
(c) it changes into calcium hypochlorate
(d) it changes into calcium chloride and calcium hydroxide

17 The correct order of solubility of the sulphates of alkaline metals in water is

(a) Be > Ca > Mg > Ba > Sr
(b) Mg > Be > Ba > Ca > Sr
(c) Be > Mg > Ca > Sr > Ba
(d) Mg > Ca > Ba > Be > Sr

18 Molecular formula of Glauber's salt is

(a) $MgSO_4 \cdot 7H_2O$ (b) $CuSO_4 \cdot 5H_2O$
(c) $FeSO_4 \cdot 7H_2O$ (d) $Na_2SO_4 \cdot 10H_2O$

19 Which of the following compounds does not give a precipitate with excess of NaOH?

(a) $ZnSO_4$ (b) $FeSO_4$ (c) $AgNO_3$ (d) $HgCl_2$

20 When CO_2 is bubbled through a solution of barium peroxide in water

(a) O_2 is released (b) carbonic acid is formed
(c) H_2O_2 is formed (d) no reaction occurs

21 The correct order of stability for the following superoxides is

(a) $KO_2 > RbO_2 > CsO_2$ (b) $RbO_2 > CsO_2 > KO_2$
(c) $CsO_2 > RbO_2 > KO_2$ (d) $KO_2 > CsO_2 > RbO_2$

22 $\underset{\text{Dry}}{Ca(OH)_2} \xrightarrow[-H_2O]{Cl_2} A \xrightarrow{\text{Auto-oxidation}} CaCl_2 + B$

Identify *B*, in the above reaction.

(a) $CaOCl_2$ (b) $Ca(ClO_3)_2$ (c) $Ca(OH)_2$ (d) $Ca(ClO_2)_2$

23 Sodium hypohalite when dissolved in water will turn

(a) blue litmus red (b) red litmus blue
(c) red litmus green (d) No change

24 Lithophone is

(a) $ZnSO_4 + PbS$ (b) $BaSO_4 + ZnS$
(c) PbO_2 (d) $ZnSO_4$

25 Which of the following on thermal decomposition yields a basic as well as an acidic oxide?

(a) $KClO_3$ (b) Na_2CO_3 (c) $NaNO_3$ (d) $CaCO_3$

26 Which of the following is a use of alum?

(a) Making explosives (b) Bleaching clothes
(c) Water softening (d) All of these

27 In which of the following, the hydration energy is higher than the lattice energy?

(a) $BaSO_4$ (b) $MgSO_4$ (c) $RaSO_4$ (d) $SrSO_4$

28 In diborane, the two H—B—H angles are nearly

(a) 60°, 120° (b) 97°, 120°
(c) 95°, 150° (d) 120°, 180°

29 Which of the following cuts ultraviolet rays?

(a) Soda glass (b) Crooke's glass
(c) Pyrex (d) None of these

30 Which gas is used in aerated water?

(a) CO_2 (b) SO_2
(c) CO (d) Water vapours

31 Which of the following reactions will not give the anhydrous $AlCl_3$?

(a) By heating $AlCl_3 \cdot 6H_2O$
(b) By passing dry HCl gas on heated aluminium powder
(c) By passing dry chloride gas on heated aluminium powder
(d) By passing dry chloride gas over a heated mixture of alumina and coke

32 In the preparation of amorphous silicon, HF acid is used to remove

(a) Mg (b) SiO_2
(c) Si (d) None of these

33 Gas *A* is bubbled through slaked lime when a white precipitate is formed. On prolonged bubbling, the precipitate is dissolved. On heating the resultant solution, the white precipitate reappears with the evolution of gas *B*. The gases *A* and *B* respectively are

(a) CO_2 and CO (b) CO and CO_2
(c) CO and CO (d) CO_2 and CO_2

34 In laboratory burners, we use

(a) producer gas (b) oil gas (c) gobar gas (d) coal gas

35 SiO_2 is reacted with sodium carbonate. What is the gas liberated?

(a) CO (b) O_2 (c) CO_2 (d) O_3

36 Match compounds (in Column I) with their associated uses (in Column II) and choose the correct codes given below.

	Column I		Column II
A.	Magnesium chloride	1.	As a purgative
B.	Barium sulphate	2.	As a fertilizer
C.	Magnesium sulphate	3.	As a constituent of sorrel cement
D.	Calcium cyanamide	4.	In the preparation of lithophone

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	4	2	1	3
(c)	3	4	1	2	(d)	2	3	4	1

Direction (Q. Nos. 37-38) *In the following questions more than one answers given may be correct. Select the correct answers and mark it according to the codes.*

Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct
(c) 2 and 4 are correct (d) 1 and 3 are correct

37 Industrially H_2O_2 is obtained from

1. H_2SO_4
2. 2-ethyl anthraquinol
3. BaO_2
4. Na_2O_2

38 In compounds of type ECl_3, where E = B, P, As or Bi, the angles Cl—E—Cl for different E are in the order

(a) B > P = As = Bi
(b) B > P > As > Bi
(c) B < P = As = Bi
(d) B < P < As < Bi

39 **Assertion** NaOH cannot be stored in a vessel made of Al or Zn.

Reason A protective layer of oxide is formed on the surface of the metal.

(a) Assertion is true, Reason is true; Reason is the correct explanation for Assertion
(b) Assertion is true, Reason is true; Reason is not the correct explanation for Assertion
(c) Assertion is true, Reason is false
(d) Assertion is false, Reason is true

ANSWERS

1 (a)	**2** (a)	**3** (b)	**4** (d)	**5** (c)	**6** (d)	**7** (c)	**8** (b)	**9** (a)	**10** (a)
11 (b)	**12** (d)	**13** (d)	**14** (d)	**15** (c)	**16** (a)	**17** (c)	**18** (d)	**19** (a)	**20** (c)
21 (c)	**22** (b)	**23** (b)	**24** (b)	**25** (d)	**26** (c)	**27** (b)	**28** (b)	**29** (b)	**30** (a)
31 (a)	**32** (b)	**33** (d)	**34** (b)	**35** (c)	**36** (c)	**37** (b)	**38** (a)	**39** (c)	

Hints and Explanations

1 Calcium oxide, CaO reacts with CO_2 and removes water vapours.

$$CaO + CO_2 \longrightarrow CaCO_3$$
$$CaO + H_2O \longrightarrow Ca(OH)_2$$

2 Hydrogen will not reduce heated aluminium oxide, because reduction potential of aluminium is lower than hydrogen.

3 Weight = normality × eq. mass
= 1.5 × 17 (eq. mass of H_2O_2 = 17)
= 25.5 g

4 Unlike saline hydrides, they are almost always non–stoichiometric, being deficient in hydrogen. They have metallic lattice and hydrogen is present at the interstitial sites.

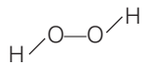
5 Water gas is a mixture of CO + H_2.

6 Na_2SO_3 is oxidised by H_2O_2 to Na_2SO_4 · PbS is oxidised by H_2O_2 to $PbSO_4$ · KI is oxidised by H_2O_2 to I_2

O_3 cannot be oxidised by H_2O_2 but it is reduced to O_2 by H_2O_2.

$$H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$$

7 In the structure of H_2O_2, the two O—H bonds are in different planes due to the repulsion between different bonding and anti–bonding orbitals.



hydrogen peroxide

8 10 volume solution of H_2O_2 means that 1L of this H_2O_2 solution will give 10 L of oxygen at STP.

$$\underset{\substack{234\text{ g}\\68\text{ g}}}{2H_2O_2(l)} \longrightarrow \underset{22.7\text{ L at STP}}{O_2(g)} + H_2O\ (l)$$

On the basis of above equation 22.7L of O_2 is produced from 68gH_2O_2 at STP. 10 L of O_2 at STP is produced from

$$\frac{68 \times 10}{22.7}\ g = 29.9g \simeq 30g\ H_2O_2$$

Therefore, strength of H_2O_2 in 10 volume H_2O_2 solution

= 30g / L = 3% H_2O_2 solution.

9 Washing soda, ($Na_2CO_3 \cdot 10H_2O$) is used to remove permanent hardness of water. It converts Ca^{2+} and Mg^{2+} salts (soluble) to carbonates (insoluble).

$$CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3 \downarrow + Na_2SO_4$$
$$MgCl_2 + Na_2CO_3 \longrightarrow MgCO_3 \downarrow + 2NaCl$$

10 Calgon is water softener and formula is $Na_2[Na_4(Po_3)_6] / Na_6O_{18}P_6^-$.

11 $H_2O_2 + I_2 \longrightarrow HOOI + HI$

$$OH^{\ominus} + HOOI \longrightarrow \underset{\text{(reduced in } I_2)}{I^{\ominus}} + H_2O + O_2$$

12 Hydrogen loses electron and converted into hydrogen ion which has very small size.

13 Fluorine being a good oxidising agent, oxidises H_2O to O_2.

$$2F_2 + 2H_2O \longrightarrow O_2 + 4HF$$

∴ Water is oxidised to O_2 by F_2.

14 Basic strength of oxides of alkaline earth metals increases on moving down the group.

15 Plaster of Paris = $CaSO_4 \cdot \frac{1}{2} H_2O$;

Gypsum = $CaSO_4 \cdot 2H_2O$

Difference of water molecules between these two compounds

$$= 2 - \frac{1}{2} = 1\frac{1}{2}.$$

16 Due to the conversion of bleaching powder into a mixture of calcium chloride and calcium chlorate, it loses its power on keeping for a long time.

$$6CaOCl_2 \longrightarrow 5CaCl_2 + Ca(ClO_3)_2$$

17 Order of solubility in decreasing order is

$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

As the size of cation increases, the heat of hydration decreases while lattice energy remains the same.

18 Sodium sulphate decahydrate ($Na_2SO_4 \cdot 10H_2O$) is also known as Glauber's salt.

19 On adding sodium hydroxide to the $ZnSO_4$ solution, first the white precipitate of zinc hydroxide is obtained, which

dissolves in excess of NaOH due to the formation of sodium zincate.

$$ZnSO_4 + 2NaOH \longrightarrow \underset{\text{White (insoluble)}}{Zn(OH)_2} + Na_2SO_4$$

$$Zn(OH)_2 + 2NaOH \longrightarrow \underset{\text{Sodium zincate (soluble)}}{Na_2ZnO_2} + 2H_2O$$

20 This is Merck's process of preparing hydrogen peroxide. When CO_2 is passed through aqueous solution of BaO_2, $BaCO_3$ is precipitated and H_2O_2 is formed.

$$BaO_2 + CO_2 + H_2O \longrightarrow BaCO_3 \downarrow + H_2O_2$$

H_2O_2 can also be prepared by reaction of H_2SO_4 with hydrated barium peroxide.

$$BaO_2 \cdot 8H_2O + H_2SO_4 \longrightarrow BaSO_4 + 8H_2O + H_2O_2$$

21 With progressive increase in the size of alkali metal ions, the stability of superoxides increases because the size of superoxide ion is large and larger cation can be stabilised more by larger anion. Hence, the order of stability of superoxides of alkali metals is

$$CsO_2 > RbO_2 > KO_2$$

22 Calcium hydroxide or slaked lime, $[Ca(OH)_2]$ reacts with Cl_2 to give bleaching powder, $CaOCl_2$. Bleaching powder on auto-oxidation gives calcium chlorate, $[Ca(ClO_3)_2]$.

$$\underset{\text{Dry}}{Ca(OH)_2} \xrightarrow[-H_2O]{Cl_2} \underset{\substack{\text{Bleaching powder}\\(A)}}{CaOCl_2} \xrightarrow{\text{Auto-oxidation}} 5CaCl_2 + \underset{\substack{\text{Calcium chlorate}\\(B)}}{Ca(ClO_3)_2}$$

23 Sodium hypoclorite when dissolved in water forms an alkaline solution. Thus it turns red litmus blue.

24 Lithophone is a mixture of $BaSO_4$ and ZnS. It is used in wall paints and enamel paints. It is quite cheap and possesses good covering power.

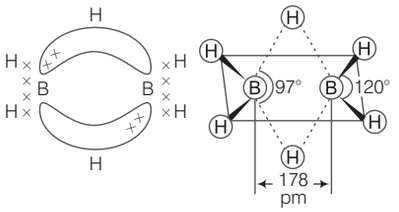
25 $CaCO_3 \xrightarrow{\Delta} \underset{\text{Basic oxide}}{CaO} + \underset{\text{Acidic oxide}}{CO_2}$

CaO is a basic oxide as it is the oxide of alkaline earth metal (Except BeO all alkaline earth metal oxides are basic in nature).

26 Alums are used as water-softner. These are also used in tanning of leather, as mordant in dyeing and to stop bleeding.

27 Hydration energy of sulphates decreases from top to bottom in a IInd group. Mg^{2+} is smaller than other ions of the group so Mg^{2+} is readily hydrated. Thus, $MgSO_4$ has higher hydration energy than lattice energy.

28 Structure of diborane is as follows



Thus, the H — B — H angles are nearly 97°, 120°.

29

Glass	Uses
Soda glass	Laboratory instruments, bottle, tube.
Crooke's glass	Lens (it cuts ultraviolet rays)
Pyrex glass	High quality laboratory instruments, oven

31 Hydrated aluminium chloride undergoes hydrolysis to form Al_2O_3 on heating.

$$2AlCl_3 \cdot 6H_2O \longrightarrow 2Al(OH)_3 + 6HCl$$

$$2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$$

32 Amorphous silicon is prepared by the reduction of silica (rocks). Extra pure silicon is obtained by the removal of SiO_2 by HF.

$$SiO_2 + 4HF \longrightarrow SiF_4 + 2H_2O$$

33 According to the question,

$$\underset{(A)}{Ca(OH)_2} + CO_2 \xrightarrow{\Delta} \underset{\text{White ppt}}{CaCO_3} \downarrow + H_2O$$

$$CaCO_3 + H_2O + CO_2 \longrightarrow \underset{\text{Soluble}}{Ca(HCO_3)_2}$$

$$Ca(HCO_3)_2 \xrightarrow{\Delta} CaO \downarrow + H_2O + \underset{(B)}{2CO_2}$$

$\therefore$ (A) and (B) both are CO_2.

35 When silica is heated with metal carbonate, it forms silicates.

$$SiO_2 + Na_2CO_3 \xrightarrow{\Delta} Na_2SiO_3 + CO_2 \uparrow$$

37 Industrially H_2O_2 is obtained by

1. Electrolysis of sulphuric acid

$$H_2SO_4 \xrightarrow{\text{Electrolysis}} H^+ + HSO_4^-$$

At cathode

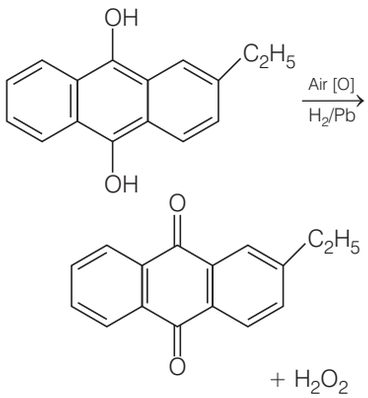
$$2H^+ + 2e^- \longrightarrow H_2$$

At anode

$$2HSO_4^- \longrightarrow H_2S_2O_8 + 2e^-$$

$$H_2S_2O_8 + 2H_2O \longrightarrow H_2O_2 + 2H_2SO_4$$

2. 2-ethyl anthraquinol oxidised by air gives H_2O_2 and 2-ethyl anthraquinone. This 2-ethyl anthraquinone reduced by H_2/Pd into 2-ethyl anthraquinol.



(c,d) H_2O_2 may be prepared by BaO_2 or Na_2O_2, but these are lab methods instead of industrial method of preparation.

38 In BCl_3, $H = \frac{1}{2}(3 + 3 + 0 - 0) = 3; sp^2$ hybridisation (bond angle = 120°). Similarly PCl_3, $AsCl_3$ and $BiCl_3$ are found to have sp^3 hybridised central atom with one lone pair of electrons on the central atoms belong to the same group, the bond angle of the chlorides decreases as we go down the group. Thus, the order of bond angle is $BCl_3 > PCl_3 > AsCl_3 > BiCl_3$.

39 NaOH forms soluble salt of sodium aluminate or sodium zincate when stored in a vessel made of aluminium or zinc respectively. Hence, reason is false.