SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Alcohols and phenols can be distinguished by

(A) $NaHCO_3$ solution **(B)** neutral ferric chloride solution

(C) Tollen's test **(D)** ester test

2. 59 g of an amide obtained from a carboxylic acid, RCOOH on hydrolysis gave 17 g ammonia. The acid is

(A) formic acid **(B)** acetic acid **(C)** propionic acid **(D)** butyric acid

3. A compound contains 38.7% carbon, 16.13% hydrogen and 45.17% nitrogen. The formula of the compound would be

(A) CH_3NH_2 **(B)** CH_3CN **(C)** C_2H_5CN **(D)** $CH_2(NH_2)_2$

4. Benzoic acid and 2, 4-dinitrophenol can be distinguished by the reagent :

(A) aqueous $NaHCO_3$ **(B)** Fehling's solution

(C) litmus test **(D)** cerric ammonium nitrate solution

5. An organic compound weighing 20 g is subjected to combustion with oxygen and it gave 10 g of water. The percentage of hydrogen in the organic compound is

(A) 67.2% **(B)** 33.33% **(C)** 2.85% **(D)** 5.55%

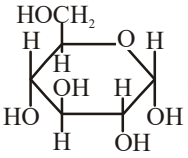
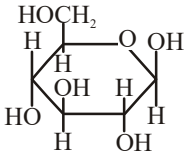
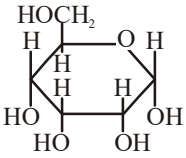
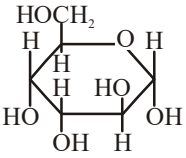
6. The percentage of sulphur in the organic compound, when 0.2595 g of a sulphur containing organic compound in a quantitative analysis by Carius method yielded 0.35 g of barium sulphate is

(A) 14.52% **(B)** 16.52% **(C)** 18.52% **(D)** 19.52%

7. 6 g of the organic compound on heating with NaOH gave NH_3, which is neutralized by 200 ml of 1 N HCl. Percentage of nitrogen in the organic compound would be

(A) 12% **(B)** 60% **(C)** 26.67% **(D)** 46.67%

8. Which of the following structures represents α-D-glucopyranose?

(A)  **(B)**  **(C)**  **(D)** 

9. Which of the following monosaccharide is not oxidised with aqueous Br_2?

(A) D-glucose **(B)** D-mannose **(C)** D-fructose **(D)** D-galactose

10. Mutarotation is characteristic for all

(A) Sugars that can reduce Tollen's reagent and Fehling's reagent

(B) Sugars that are devoid of reducing properties

(C) Polysaccharides, that are insoluble in water

(D) Polyhydric aldehydes and ketones without asymmetric centres

11. D-glucose in dilute alkaline or acidic solution contains

(A) 50% each of α-D-glucose and β-D-glucose

(B) 64% of α-D-glucose and 36% of β-D-glucose

(C) 36% of α-D-glucose and 64% of β-D-glucose

(D) 33% each of α-D-glucose, β-D-glucose and open structure

12. Denaturation of a native protein cannot be achieved by

(A) adding urea to the protein solution **(B)** adding HCl to the protein solution

(C) heating the protein solution **(D)** adding NaCl to the solution

13. If K_{a_1} and K_{a_2} are the ionization constants of $H_3\overset{+}{N}CH(R)COOH$ and $H_3\overset{+}{N}CH(R)COO^-$, respectively, the pH of the solution at the isoelectric point is :

(A) $pH = pK_{a_1} + pK_{a_2}$ **(B)** $pH = \left(pK_{a_1} pK_{a_2}\right)^{1/2}$

(C) $pH = \left(pK_{a_1} + pK_{a_2}\right)^{1/2}$ **(D)** $pH = \left(pK_{a_1} + pK_{a_2}\right)/2$

14. Natural silk is a polymer of

(A) Amino acids **(B)** Nucleoside **(C)** Nucleotide **(D)** Adipic acid

15. Vulcanised rubbers are polymers of the type .....

(A) linear **(B)** cross-linked **(C)** branch-chain **(D)** all of these

16. Which of the following compound cannot be a monomer?

(A) $CH_3 - CHOH - CH_2OH$ **(B)** $NH_2 - CH_2 - NH_2$

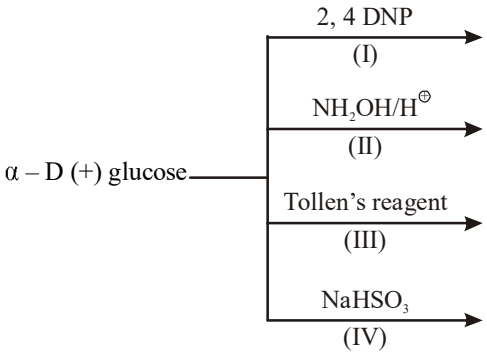
(C) $CH_3 - CH_2 - NH_2$ **(D)** $NH = CH - \underset{\displaystyle NH_2}{\underset{|}{CH}} - CH_2 - NH_2$

17. Which of the following sets contain only addition polymers?

(A) Polyethylene, polypropylene, terylene **(B)** Polyethylene, PVC, orlon

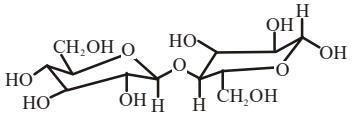
(C) Buna-S, nylon, polybutadiene **(D)** Bakelite, PVC, polyethylene

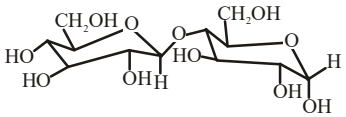
18. Observe the following laboratory tests for α-D(+) glucose and mention +ve or –ve fromthe code given below.

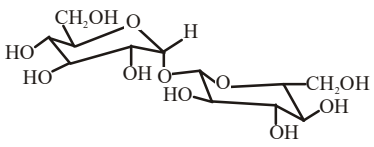


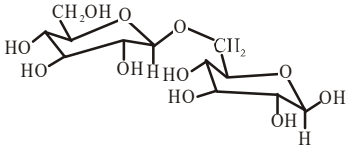
(A) + + + + **(B)** – + + – **(C)** + – + – **(D)** + + – –

19. Which of the following is a non-reducing sugar?

(A) 

(B) 

(C) 

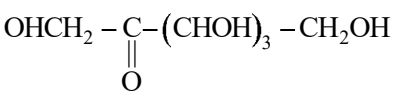
(D) 

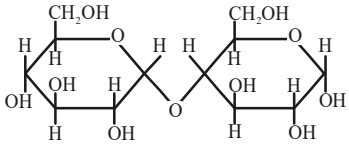
20. Basic solution of fructose contains

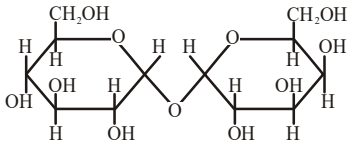
(A) Only fructose **(B)** Only glucose

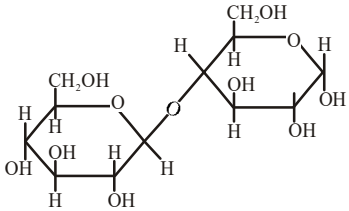
(C) Fructose and glucose **(D)** Glucose, fructose and mannose

21. Which of the following is an non-reducing sugar?

(A) 

(B) 

(C) 

(D) 

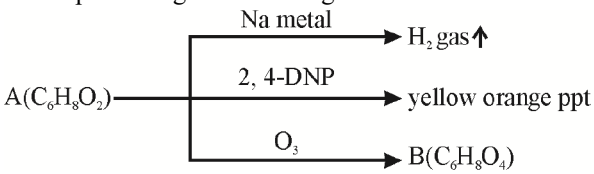
22. Compounds I and II can be distinguished by using reagent.

I. 4–Amino–2–methylbut–3–en–2–ol **II.** 4–Amino–2, 2–dimethylbut–3–yn–1–ol

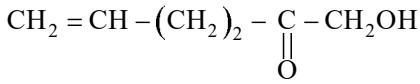
(A) $NaNO_2$ / HCl **(B)** Br_2 / H_2O

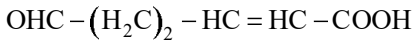
(C) HCl / $ZnCl_2$ (anhydrous) **(D)** Cu_2Cl_2 / NH_4OH

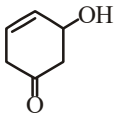
23. The compound A gives following reactions

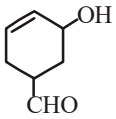


Its structure can be :

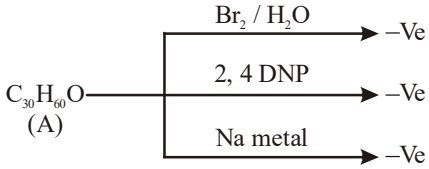
(A) 

(B) 

(C) 

(D) 

24. In compound $A(C_{30}H_{60}O)$ following tests are observed negatively, A can be :



(A) an unsaturated ether **(B)** an epoxide

(C) a cyclic ketone **(D)** a cycloalkanol

25. Softening of hard water is done using sodium aluminium silicate (zeolite). This causes

(A) Adsorption of Ca^{2+} and Mg^{2+} ions of hard water replacing Na^+ ions

(B) Adsorption of Ca^{2+} and Mg^{2+} of hard water replacing Al^{3+} ions

(C) Both (A) and (B) **(D)** None of these

26. Which of the following statements is not correct?

(A) A colloidal solution is a heterogeneous two-phase system

(B) Silver sol in water is an examples of lyophilic solution

(C) Metal hydroxides in water are examples of lyophobic solution

(D) Liquid-liquid colloidal solution is not stable system

27. A reddish brown sol (containing Fe^{3+}) is obtained by

(A) the addition of small amount of $FeCl_3$ solution to freshly prepared $Fe(OH)_3$ precipitate

(B) the addition of $Fe(OH)_3$ to freshly prepared $FeCl_3$ solution

(C) the addition of NH_4OH to $FeCl_3$ solution dropwise

(D) the addition of NaOH to $FeCl_3$ solution dropwise

28. Which is not the example of coagulation?

(A) curdling of milk **(B)** purification of water by addition of alum

(C) rubber plating and chrome tanning **(D)** formation of deltas at the river beds

29. Gold number of some lyophilic sols are:

I.	Casein	:	0.01	**II.**	Haemoglobin	:	0.03
III.	Gum Arabic	:	0.15	**IV.**	Sodium oleate	:	0.40

Which has maximum protective power?

(A) I **(B)** II **(C)** III **(D)** IV

30. Which are not purely surface phenomena?

(A) viscosity, surface tension **(B)** adsorption, absorption

(C) absorption, viscosity **(D)** adsorption, viscosity

31. The diameter of colloidal particle is of the order

(A) 10^{-3} m **(B)** 10^{-5} m **(C)** 10^{-15} m **(D)** 10^{-7} m

Paragraph for Questions 32 - 35

Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also carbohydrates. The carbohydrates which are not hydrolysed are called monosaccharides. Other carbohydrates are oligosaccharides and polysaccharides. Monosaccharides with aldehydic group are called aldoses and those with free ketonic group are called ketoses. All carbohydrates are optically active. Number of optical isomer = 2^n
Where n = number of asymmetric carbons. Carbohydrates are mainly synthesized by plants during photosynthesis

32. Maximum number of monosaccharide units present in oligosaccharides is :

(A) 8 **(B)** 10 **(C)** 15 **(D)** 40

33. Aldose sugar present in nucleic acid is :

(A) arabinose **(B)** xylose **(C)** deoxyribose **(D)** all of these

34. First member of ketose sugar is :

(A) ketotriose **(B)** ketotetrose **(C)** ketopentose **(D)** ketohexose

35. In the molecule, $HOCH_2CH(OH)CH(OH)CH(OH)CH(OH)CHO$, the number of optical isomers will be :

(A) 16 **(B)** 8 **(C)** 32 **(D)** 4

Paragraph for Questions 36 - 37

In 1953, Karl Ziegler and Giulio Natta found that the structure of a polymer could be controlled if the growing end of the chain and the incoming monomer were co-ordinated with an aluminium-titanium intiator. These initiators are now called **Ziegler-Natta catalysts**. Long, unbranched polymers with either the isotactic or the syndiotactic depends on the particular Ziegler-Natta catalyst used. High-density polyethylene is prepared using a Ziggler-Natta process.

36. Which of the following statement is incorrect about Ziegler-Natta polymerisation?

(A) It is an example of condensation polymerisaiton

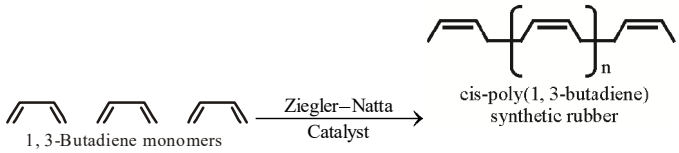
(B) It always give linear, stereo – regular polymers

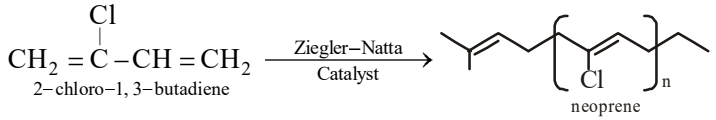
(C) They make stronger and stiffer polymers

(D) The polymers formed have great resistance to cracking and heat

37. Which of the following option correctly represent the polymerisation process?

(A) $\underset{\text{(acetylene)}}{HC \equiv CH} \xrightarrow[\text{Catalyst}]{\text{Ziegler–Natta}} -CH=CH-\underset{\text{(polyacetylene)}}{\left[CH=CH\right]_n}-CH=CH-$

(B) 

(C) 

(D) All of these

Paragraph for Questions 38 - 40

An amino acid is characterized by two pK_a values the one corresponding to the more acidic site is designated as pKa_1 and the other corresponding to the less acidic site is designated as pKa_2. The isoelectric point also called isoinoic point (pI) is the pH at which concentration of zwitter ion is maximum. pI is the average of pKa_1 and pKa_2. Generally the value of pI is slightly less than 7. Some amino acids have side chain with acidic or basic groups. These amino acids have pKa_3 value also for the side chain. Acidic amino acids have acidic side chains and basic amino acids have basic side chains. pI for acidic amino acid is average of pKa_1 and pKa_2 pI for basic amino acid is the average of pKa_2 and pKa_3

S.No.	Amino acid	pKa_1	pKa_2	pK_{a_3} (side chain)
I.	Aspartic acid	1.88	9.6	3.65
II.	Glutamic acid	2.19	9.67	4.25
III.	Lysine	2.18	8.95	10.53
IV.	Arginine	2.17	9.04	12.48

38. In the table given above the acidic amino acids are

(A) I, II **(B)** I, III **(C)** II, III **(D)** I, II & IV

39. The isoelectric point (pI) of Aspartic acid will be

(A) 6.62 **(B)** 5.74 **(C)** 2.77 **(D)** 9.74

40. The isoelectric point of lysine will be

(A) 6.35 **(B)** 9.74 **(C)** 2.77 **(D)** 10.76

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

41. Which of the following are correct statements

(A) Spontaneous adsorption of gases on solid surface is an exothermic process as entropy decreases during adsorption.

(B) Formation of micelles takes place when temperature is below Kraft Temperature (T_k) and concentration is above critical micelle concentration (CMC).

(C) A colloid of $Fe(OH)_3$ is prepared by adding a little excess (required to completely precipitate Fe^{3+} ions as $Fe(OH)_3$)) of NaOH in $FeCl_3$ solution the particles of this sol will more towards cathode during electrophoresis.

(D) According to Hardy-Schulze rules the coagulation (flocculating) value of Fe^{3+} ion will be more than Ba^{2+} or Na^{+}.

42. Compound (X) $C_9H_{10}O$ is inert to Br_2 / CCl_4. Vigorous oxidation with hot alkaline $KMnO_4 / \bar{O}H$ yields C_6H_5COOH. (X) gives precipitate with 2, 4-dinitrophenyl hydrazine. How can these isomers be distinguished by the usual chemical tests? Following are possible isomers of X .

I. $C_6H_5-CH_2-CH_2-CHO$ **II.** $C_6H_5-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CHO$

III. $C_6H_5-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3$ **IV.** $C_6H_5-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_3$

(A) I gives red ppt. with Fehling solution and II and III can be distinguished by iodoform test

(B) I and II can be distinguished by simple chemical method

(C) I and II give red ppt. with Fehling solution and III and IV can be distinguished by iodoform test

(D) II give red ppt. with Fehling solution and I and IV can be distinguished by iodoform test

43. Which is /are the correct method for separating a mixture of benzoic acid, p-methyl aniline and phenol.

(A) $\xrightarrow{\text{aq. } NaHCO_3} \xrightarrow{\text{aq. NaOH}}$ **(B)** $\xrightarrow{\text{aq. HCl}} \xrightarrow{\text{aq. } NaHCO_3}$

(C) $\xrightarrow{\text{aq. NaOH}} \xrightarrow{\text{aq. } NaHCO_3}$ **(D)** $\xrightarrow{\text{aq. NaOH}} \xrightarrow{\text{aq. HCl}}$

44. Which of the following statements are true for physisorption?

(A) Extent of adsorption increases with increase in pressure **(B)** It needs activation energy

(C) It can be reversed easily **(D)** It occurs at high temperature

45. If Cl_2 gas is enclosed in presence of powdered charcoal in a closed vessel, the pressure of the gas decreases. It is because

(A) the gas molecules are absorbed at the surface

(B) the gas molecules concentrate at the surface of the charcoal

(C) the gas molecules are adsorbed at the surface **(D)** the gas molecules are desorbed by the surface

46. When negatively charged colloids like As_2S_3 sol is added to positively charged $Fe(OH)_3$ sol in suitable amounts

(A) Both the sols are precipitated simultaneously **(B)** This process is called mutual coagulation

(C) They become positively charged colloids **(D)** They become negatively charged colloids

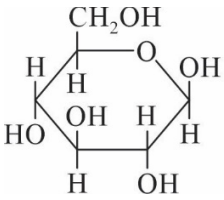
47. Which of the following are multimolecular colloids?

(A) Sulphur **(B)** Egg albumin in water **(C)** Gold sol **(D)** Soap solution

48. Which of the following are based on Tyndall effect?

(A) Ultra microscope **(B)** Deltas **(C)** Blue colour of sky **(D)** Coagulation

49.



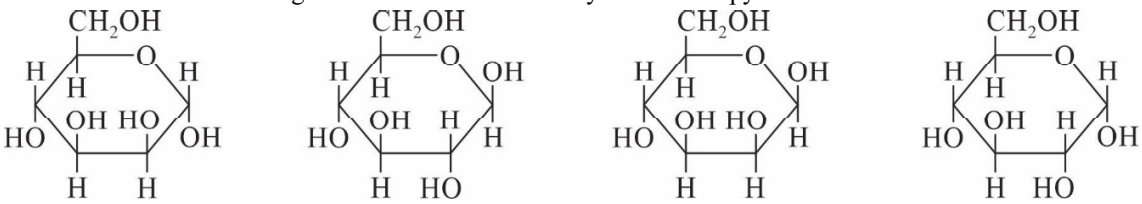
Glucose

The correct statements about above structure of glucose are :

(A) It is a Pyranose form **(B)** It is a furanose form

(C) It is a $\beta-$anomer **(D)** It is a D-sugar

50. D-Mannose differs from D-glucose in its stereochemistry at C-2. The pyranose form of D-Mannose is



(A) **(B)** **(C)** **(D)**

51. Which of the following is/are reducing sugar?

(A) Sucrose **(B)** Glucose

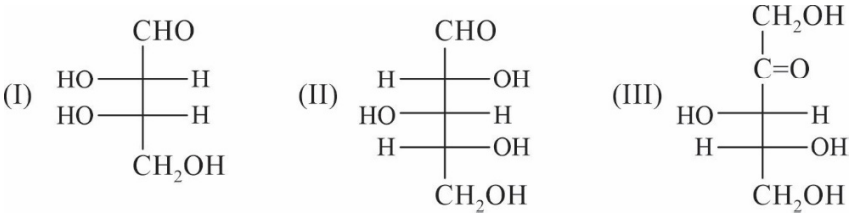
(C) Fructose **(D)** methylmaltoside

52. Which of these are polysaccharides of glucose ?

(A) Starch **(B)** Cellulose

(C) Sucrose **(D)** Lactose

53.

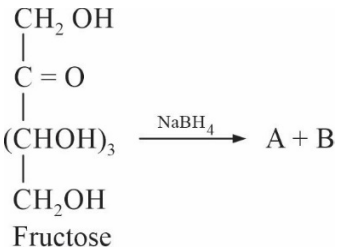


The correct statement about the sugars given above are

(A) I and II are L-Sugars **(B)** II and III are D-Sugar

(C) I and III are D-sugars **(D)** I is L-sugar

54.



The product A and B in the above reaction are

(A) Diastereomers **(B)** C-2 epimers

(C) Anomers **(D)** Optically active hexahydroxy compounds

55. The correct statements about peptides are :

(A) A dipeptide has one peptide link between two amino acids

(B) By convention N-Terminus is kept at left and C-terminus at right in the structure of a peptide

(C) If only one amino group and one carboxylic acid group are available for reaction, then only one dipeptide can forms

(D) A polypeptide with more than hundred amino acid residues (mol. Mass > 10,000) is called a protein

56. Which of the following are polyamide polymer ?

(A) protein **(B)** Nylon-6, 6

(C) Nylon-6 **(D)** Polystyrene

57. Preparation of nylon from hexamethylene diamine and adipic acid is an example of :

(A) addition polymerisation **(B)** homopolymerisation

(C) condensation polymerisation **(D)** copolymerisation

58. The correct statement(s) about starch :

(A) It is a pure single compound

(B) It is mixture of two polysaccharides of glucose

(C) it involves the $(C_1 - C_4)$ α – glycosidic linkage between two $\alpha - D$ glucose units

(D) It involves branching by $(C_1 - C_6)$ glycosidic linkage

59. Which of the following pairs is (are) correctly matched

(A) $\alpha - D(+)$ glucose and $\beta - D(+)$ glucose $\rightarrow$ C-2 epimers

(B) Glucose and fructose $\rightarrow$ C-3 epimers

(C) Glucose $\rightarrow$ mutarotation

(D) Sucrose $\rightarrow$ Glucose + fructose

60. Structures of some common polymers are given. Which are correctly presented ?

(A) Teflon $+CF_2 - CF_2 -)_n$

(B) Neoprene $\left(-CH_2 - \underset{\underset{Cl}{|}}{C} = CH - CH_2 - CH_2 - \right)_n$

(C) Terylene $+OC - C_6H_4 - COOCH_2 - CH_2 - O -)_n$

(D) Nylon – 6, 6 $+NH(CH_2)_6NHCO(CH_2)_4 - CO-]_n$

61. The correct structure of glycine at given pH are : (Isoelectric point is 6)

(A) $H_3\overset{\oplus}{N}CH_2 - \underset{\underset{O}{\|}}{C} - OH$ at pH = 2.0 **(B)** $H_3\overset{\oplus}{N}CH_2 - \underset{\underset{O}{\|}}{C} - O^{\ominus}$ at pH = 6.0

(C) $H_2NCH_2 - \underset{\underset{O}{\|}}{C} - O^{\ominus}$ at pH = 9 **(D)** $H_2NCH_2 - \underset{\underset{O}{\|}}{C} - OH$ at pH = 12

62. The correct statements about anomers are :

(A) Anomers have different stereochemistry at C-1(anomeric carbon)

(B) $\alpha-D$-glucopyranose and $\beta-D-$glucopyranose are anomers

(C) Both anomers of D-glucopyranose can be crystallised and purified

(D) When pure $\alpha-D-$glucopyranose is dissolved in water its optical rotation slowly changes

63. Which of the following are correctly matched ?

(A) Nylon-6, 6 - Condensation **(B)** Cellulose triacetate - Natural polymer

(C) Polyisoprene - Homopolymer **(D)** Sucrose - Polysaccharide

64. Correct statement about peptide linkage in a protein molecule is/are correct ?

(A) It is amide linkage **(B)** It has partial double bond character

(C) It is hydrophilic in nature **(D)** It connects protein molecules through H-bonds

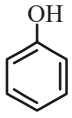
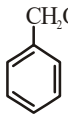
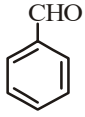
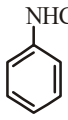
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

65. MATCH THE FOLLOWING:

	Column I (Estimation / detection of elements		**Column II (Methods)**
(A)	Estimation of halogens	**(p)**	Kjeldahl's method
(B)	Estimation of carbon and hydrogen	**(q)**	Dumas method
(C)	Estimation of nitrogen	**(r)**	Carius method
(D)	Estimation of sulphur	**(s)**	Leibig's method

66. MATCH THE FOLLOWING:

	Column I		**Column II**
(A)		**(p)**	CAN test
(B)		**(q)**	Ester test
(C)		**(r)**	Oxidation test
(D)		**(s)**	Libermann's test

67. MATCH THE FOLLOWING :

	Column I		**Column II**
(A)	α-D-glucose and β-D-glucose	**(p)**	Reducing sugar
(B)	D-glucose and D-galactose	**(q)**	Non-reducing sugar
(C)	D-glucose and D-mannose	**(r)**	Anomer
(D)	Methyl α-D-glucoside and Methyl β-D-glucoside	**(s)**	Epimer
		(t)	Shows mutarotation

68. MATCH THE FOLLOWING :

	Column I		**Column II**
(A)	Glutamic acid	**(p)**	Neutral amino acid
(B)	Arginine	**(q)**	Acidic amino acid
(C)	Asparagine	**(r)**	Polar amino acid
(D)	Phenyl alanine	**(s)**	Optically active amino acid

69. MATCH THE FOLLOWING :

	Column I		**Column II**
(A)	Nylon 6, 10	**(p)**	Polyester
(B)	Glyptal	**(q)**	Polymide
(C)	Teflon	**(r)**	Condensation polymer
(D)	Bakelite	**(s)**	Addition polymer

70. MATCH THE FOLLOWING :

	Column I		**Column II**
(A)	Polythene	**(p)**	Addition polymer
(B)	Buna-S rubber	**(q)**	Condensation polymer
(C)	Melamine-formaldehyde resin	**(r)**	Homopolymer
(D)	Poly-hydroxy butyrate-co-β- Hydroxyvalerate	**(s)**	Copolymer

71. MATCH THE FOLLOWING :

	Column I		**Column II**
(A)	Ferric hydroxide	**(p)**	Lyophobic colloid
(B)	Micelles	**(q)**	Lyophilic colloid
(C)	Gelatin	**(r)**	Associated colloid
(D)	Arsenous sulphide	**(s)**	Irreversible

72. **MATCH THE FOLLOWING :**

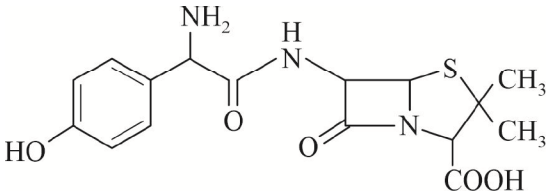
	Column I		**Column II**
(A)	Coagulation	**(p)**	Scattering of light
(B)	Dialysis	**(q)**	Washing of precipitates
(C)	Peptization	**(r)**	Purification of colloids
(D)	Tyndall effect	**(s)**	Electrolyte

SUBJECTIVE INTEGER TYPE

Each of the following question has an integer answer between 0 and 9.

73. Natural rubber is 1, 4-addition polymer of isoprene. Find out number of carbon atoms in longest continuous carbon chain of major product of reductive ozonolysis of natural rubber.

74. How many of the following observations are correct for amoxicillin (structure given below) ?



(i) It's degree of unsaturation is equal to 9

(ii) It possess four chiral carbon atoms

(iii) It possess nine sp^2 hybridized carbon atoms

(iv) It produce blood red colour with neutral $FeCl_3$ solution in Lassaigne's test

(v) It produce different colouration when treated with neutral $FeCl_3$

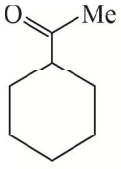
(vi) It produce brisk effervascence when reacts with $NaHCO_3$

(vii) It undergoes carbyl amine reaction

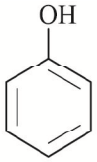
(viii) It produce four mole of CH_4 gas per mole of it on reaction with CH_3MgBr in dry ether

(ix) On complete hydrolysis it produce 2-amino-3(p-hydroxy phenyl) propanoic acid as one of the product.

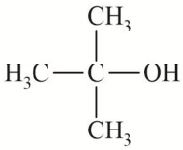
75. Observer the following compounds.



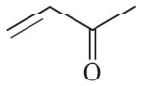
(I)



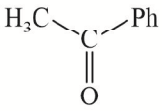
(II)



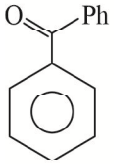
(III)



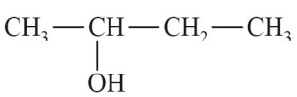
(IV)



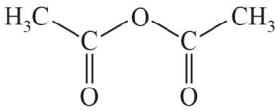
(V)



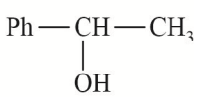
(VI)



(VII)



(VIII)

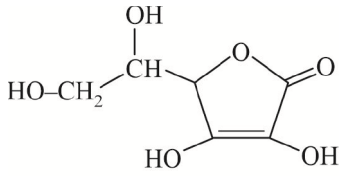


(IX)

Number of compounds which can give positive Haloform test = (x)

Number of compounds which can give positive Lucas reagent test = (y)

76. Structure of Ascorbic acid is represented as follows.



(Ascorbic acid)

How many of the following reagents can give positive test with ascorbic acid.

$Cu_2Cl_2 + NH_4OH$	2, 4-DNP	Na Metal	$HCl + ZnCl_2$	$FeCl_3$
(I)	**(II)**	**(III)**	**(IV)**	**(V)**
NaOH + Phenolpthalein	dil. $KMnO_4$	Br_2 / H_2O	$AgNO_3 + NH_4OH$	I_2 + NaOH
(VI)	**(VII)**	**(VIII)**	**(IX)**	**(X)**

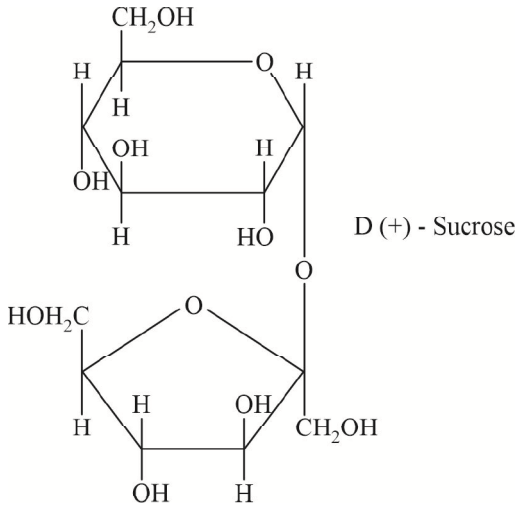
77. How many of the following compounds reacts with $NaHCO_3$ and liberate $CO_2(g)$.

1.	Salicylic acid	**2.**	Pthalic acid
3.	Picric acid	**4.**	Resorcinol
5.	Carbolic acid	**6.**	Aspirin
7.	Anisol	**8.**	Tarteric acid

78. Find the total number of tripeptides that can be formed by the combination of amino acids, glycine and alanine. (excluding stereoisomers)

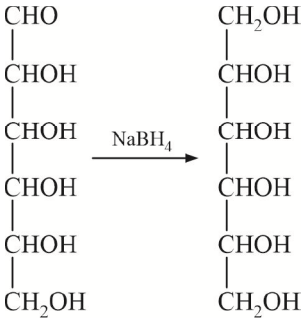
79. The condensation of two amino acids, glycine and (±) alanine yields total number of products x. Find value of x ?

80. The number of chiral centres presents in the following compound is :

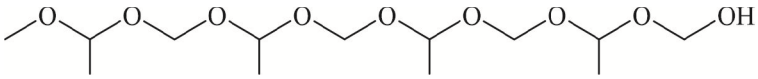


D (+) - Sucrose

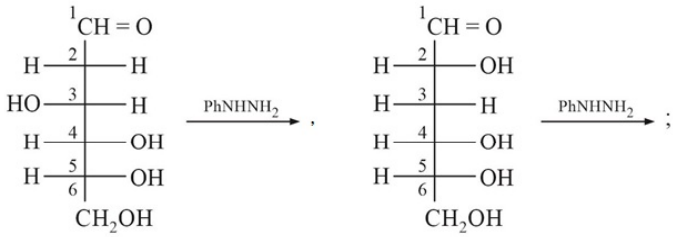
81. Observe the following reaction and find out that how many number of reactant stereoisomers can be reduced to optically inactive meso products.



82. How many moles of formaldehyde is formed by the complete hydrolysis of following compound with ?



83.



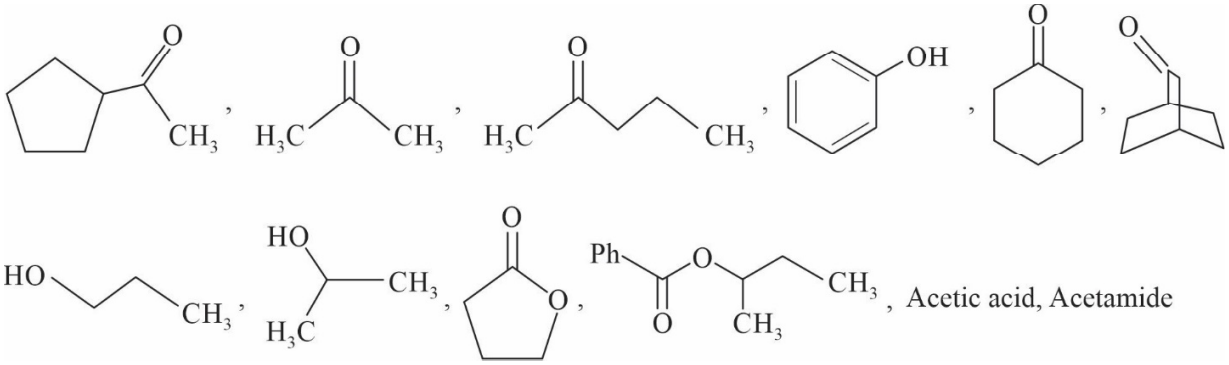
(A) D-2-Deoxy glucose **(B)** D-3-Deoxy glucose

The sum of total number of moles of $PhNHNH_2$ used with A & B _____ .

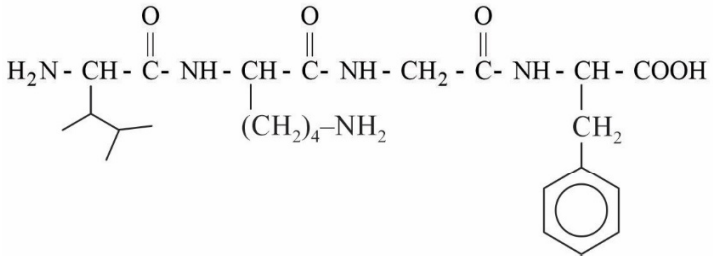
84. How many of these amino acid are negatively charged at pH = 7.0 ?

Alanine	Lysine	Cysteine	Glutamic acid
Glycine	Leucine	Aspartic acid	Arginine

85. Identify the total number of compounds that give 2, 4-DNP test

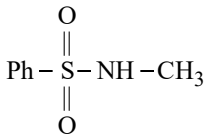


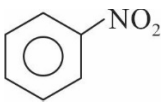
86. A polypeptide chain is given:



Number of optically active essential amino acids in this polypeptide chain is/are :

87. How many compound(s) gives blood red colour with $FeCl_3$ in Lassaigne test

(a) $PhNH_2$ **(b)** $PhSO_3H$ **(c)** 

(d) PhCl **(e)** PhBr **(f)** 

88. Graph between $\log\frac{x}{m}$ and log P is a straight line inclined at an angle 45°. When pressure of 0.5 atm and $\log k = 0.699$, the amount of solute adsorbed per g of adsorbent will be :

Advanced Problem Package	Coordination Compounds

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The pair in which both species have same magnetic moment [spin only]

(A) $\left[Cr(H_2O)_6\right]^{2+}, [CoCl_4]^{2-}$ **(B)** $\left[Cr(H_2O)_6\right]^{2+}, \left[Fe(H_2O)_6\right]^{2+}$

(C) $\left[Mn(H_2O)_6\right]^{2+}, \left[Cr(H_2O)_6\right]^{2+}$ **(D)** $[CoCl_4]^{2-}, \left[Fe(H_2O)_6\right]^{2+}$

2. An effective atomic number of $Co(CO)_4$ is 35 and hence is less stable. It attains stability by :

[Atomic number of Co = 27]

I. Oxidation of Co **II.** Reduction of Co

III. Dimerization **IV.** Trimerization

The correct option is :

(A) I, II **(B)** II, III **(C)** I, II, III **(D)** II, IV

3. Which of the following complexes exhibits geometrical isomerism? [gly = glycinato, en = ethylene diamine, Py = pyridine, ox = oxalate]

(A) $\left[Pt(gly)_2\right]^{2+}$ **(B)** $\left[Pt(en)_2\right]^{2+}$ **(C)** $\left[Pt(Py)_4\right]^{2+}$ **(D)** $\left[Pt(ox)_2\right]$

4. Which has maximum EAN of the underlined atoms? (Cr = 24, Co = 27, Fe = 26, Ni = 28)

(A) [Cr(EDTA)] **(B)** $[Co(en)_3]^{3+}$ **(C)** $[Fe(C_2O_4)_3]^{3-}$ **(D)** $[Ni(CN)_4]^{2-}$

5. Primary and secondary valency of Pt in $[Pt(en)_2Cl_2]Cl_2$ are :

(A) 2, 4 **(B)** 4, 6 **(C)** 6, 6 **(D)** 4, 4

6. Arrange the following in order of decreasing number of unpaired electrons :

(I) $[Fe(H_2O)_6]^{2+}$ (II) $[Fe(CN)_6]^{3-}$ (III) $[Fe(CN)_6]^{4-}$ (IV) $[Fe(H_2O)_6]^{3+}$

(A) IV, I, II, III **(B)** I, II, III, IV **(C)** III, II, I, IV (V) II, III, I, IV

7. Which of the following complex is diamagnetic ?

(A) Sc^{3+} (aq) **(B)** Ti^{3+} (aq) **(C)** V^{3+} (aq) **(D)** Cr^{3+} (aq)

8. Consider the following complexes :

(I) K_2PtCl_6 (II) $PtCl_4 \cdot 2NH_3$ (III) $PtCl_4 \cdot 3NH_3$ (IV) $PtCl_4 \cdot 5NH_3$

Their electrical conductances in an aqueous solutions are :

(A) 256, 0, 97, 404 **(B)** 404, 0, 97, 256 **(C)** 256, 97, 0, 404 **(D)** 404, 97, 256, 0

9. If excess of $AgNO_3$ solution is added to 100 mL of a 0.024 M solution of Dichlorobis (ethylene diamine) cobalt (III) chloride, how many mol of AgCl be precipitated :

(A) 0.0012 **(B)** 0.0016 **(C)** 0.0024 **(D)** 0.0048

10. Which has maximum conductance?

(A) $PtCl_4 \cdot 6NH_3$ **(B)** $PtCl_4 \cdot 5NH_3$ **(C)** $PtCl_4 \cdot 4NH_3$ **(D)** equal

11. A compound has the empirical formula $CoCl_3 \cdot 5NH_3$. When an aqueous solution of this compound is mixed with excess silver nitrate, 2 mole of AgCl precipitate is obtained per mol of compound. On reaction with excess HCl, no NH_4^+ is detected. Hence, it is :

(A) $[Co(NH_3)_5Cl_2]Cl$ **(B)** $[Co(NH_3)_5Cl]Cl_2$ **(C)** $[Co(NH_3)_5Cl_3]$ **(D)** $[Co(NH_3)_4Cl_2]Cl \cdot NH_3$

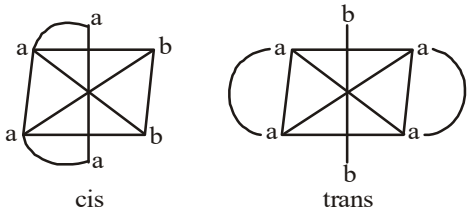
12. 0.001 molal solution of a complex $[M(NH_3)_4Cl_4]$ in water has a freezing point depression of 0.0054°C. If K_f for water is 1.8, the correct formula of the complex is :

(A) $[M(NH_3)_4Cl_3]Cl$ **(B)** $[M(NH_3)_4Cl_2]Cl_2$ **(C)** $[M(NH_3)_4Cl]Cl_3$ **(D)** $[M(NH_3)_4Cl_4]$

13. Statement 1 :$[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$ exhibit ionization isomerism
Statement 2 :Both compounds form chloride ions in solution

(A) If both the statement are true and statement 2 is the correct explanation of statement 1
(B) If both the statement are true but statement 2 is not the correct explanation of statement 1
(C) If statement 1 is true and statement 2 is false
(D) If statement 1 is false and statement 2 is true

14. Which of the following statements is correct regarding the chirality (optical isomerism) of the cis and trans isomers of the type $M(aa)_2b_2$ (M stands for a metal, a and b are achiral ligands and aa means bidentate ligands



(A) The trans form is achiral and optically inactive while the cis form is chiral and exists in two enantiomeric forms
(B) The cis as well as the trans form are achiral and optically inactive
(C) The trans form is chiral and exists in two enantiomeric forms while the cis form is achiral and optically inactive
(D) The cis as well as the trans form are chiral and each of them exists in two enantiomeric forms

15. Of the following statements, which one is correct ?

(A) $[CoF_6]^{3-}$ is a high spin complex and $[Co(NH_3)_6]^{3+}$ is a low spin complex

(B) $[CoF_6]^{3-}$ is a low spin complex and $[Co(NH_3)_6]^{3+}$ is a high spin complex

(C) Both $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are low spin complexes

(D) Both $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are high spin complexes

16. The two compounds $[Cr(NH_3)_5Br]Cl$ and $[Cr(NH_3)_5Cl]Br$ can be distinguished by reagent A and the two compounds exhibit isomerism (B). Then (A) and (B)are :

(A) $AgNO_3$, ionization **(B)** $AgNO_3$, coordination
(C) $BaCl_2$, ionization **(D)** $BaCl_2$, coordination

17. A metal complex having composition $Cr(NH_3)_4Cl_2Br$ has been isolated in two forms A and B. The form A reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia, where as B gives a pale yellow precipitate soluble in concentrated ammonia. The hybridization of Cr in A and magnetic moment in B are respectively

(A) d^2sp^3, 2.8 BM **(B)** sp^3d^2, 3.8 BM **(C)** d^2sp^3, 3.8 BM **(D)** sp^3d^2, 2.8 BM

18. The complex $\left[M(CrO_4)Cl_2(NH_3)_2\right]$ forms two types of coloured crystals viz, red**(A)** and blue**(B)**. A or B reacts with 1 mole of $AgNO_3$ to give $\frac{1}{2}$ mole of a red precipitate. Further, 1 mole of A reacts slowly with 1 mole of $Ag_2C_2O_4$ to form 2 moles of a white precipitate but B does not react with $Ag_2C_2O_4$. Hence, which of the following could be incorrect ?

(A) The central atom is dsp^2hybridised **(B)** Red form is trans isomer and blue form is cis

(C) Blue form is trans isomer and red form is cis **(D)** Oxalate is bidentate ligand

19. The ratio of the value of any colligative property of $K_4[Fe(CN)_6]$ solution to that of $Fe_4[Fe(CN)_6]_3$ (Prussian blue) solution is nearly (assume 100% dissociation of both) :

(A) 0.62 **(B)** 0.71 **(C)** 1.4 **(D)** 1.2

20. Which of the following statements is(are) correct?

I. $[Cu(NH_3)_4]^{2+}$ complex ion has tetrahedral geometry and paramagnetic

II. $[Ni(CN)_4]^{2-}$ complex ion has square planar geometry

III. $[CoF_6]^{3-}$ is an outer orbital complex ion

IV. $[Fe(CN)_6]^{3-}$ is an inner orbital complex ion

The correct option is :

(A) I, II **(B)** I, II, III **(C)** II, III, IV **(D)** I, II, III, IV

21. The following are octahedral and tetrahedral complexes and their characteristics.

I. $\left[Fe(H_2O)_6\right]^{+3}$ **II.** $\left[Cr(NH_3)_6\right]^{+3}$ **III.** $\left[CoCl_4\right]^{-2}$

(i) All high spin d^5 complexes in octahedral system has CFSE = 0

(ii) Complex I is high spin d^5 octahedral complex

(iii) Number of unpaired electrons in II and III are 3 each

(iv) All Cr (III) octahedral complexes are high spin complexes like II

The wrong statements are :

(A) Only (i) **(B)** Only (ii) **(C)** (i), (ii), (iii), (iv) **(D)** None of these

22. A solution containing 0.319 gm of complex $CrCl_3 \cdot 6H_2O$ was passed through cation exchanger and the solution given out was neutralized by 28.5 ml of 0.125 M NaOH. The correct formula of the complex will be [mol. Wt. of complex = 266.5]

(A) $[CrCl(H_2O)_5]Cl_2.H_2O$ **(B)** $[Cr(H_2O)_6]Cl_3$

(C) $[CrCl_2(H_2O)_4]Cl.2H_2O$ **(D)** All are correct

23. The correct order for the CFSE (numerical value) for the following complexes is :

Complex	P	Q	R	S
Formula	$[CoF_6]^{3-}$	$[Co(CN)_6]^{3-}$	$[Co(NH_3)_6]^{3+}$	$[Co(H_2O)_6]^{3+}$

(A) P > Q > R > S **(B)** Q > R > S > P **(C)** S > R > P > Q **(D)** R > Q > P > S

24. Which of the following is true about the complex $[PtCl_2(NH_3)(H_2O)]$; [Atomic no. of Pt = 78]

(i) It will have two geometrical isomeric forms, cis and trans

(ii) The hybridization state of Pt (II) is sp^3

(iii) It is a square planar complex

(iv) It is a diamagnetic complex

(v) It can show hydrate isomerism

(vi) It is a tetrahedral complex

(A) (i), (iii), (iv) **(B)** (ii), (iv), (v) **(C)** (ii), (v), (vi) **(D)** (i), (v), (vi)

25. Amongst the following the most stable complex is :

(A) $[Fe(H_2O)_6]^{3+}$ **(B)** $[Fe(C_2O_4)_3]^{3-}$ **(C)** $[Fe(H_2O)_5NO]^{2+}$ **(D)** $[FeF_6]^{3-}$

26. Which one of the following high-spin complexes has the largest CFSE (Crystal field stabilization energy)?

(A) $[Mn(H_2O)_6]^{2+}$ **(B)** $[Cr(H_2O)_6]^{2+}$ **(C)** $[Mn(H_2O)_6]^{3+}$ **(D)** $[Cr(H_2O)_6]^{3+}$

27. IUPAC name of complex $K_3[Al(C_2O_4)_3]$ is :

(A) Potassium alumino-oxalate **(B)** Potassium trioxalatoaluminate (III)

(C) Potassium aluminium (III) oxalate **(D)** Potassium trioxalatoaluminate (IV)

28. Which one of the following square planar complex will be able to show geometrical isomerism?

(A) MA_3B **(B)** $M(AA)_2$ **(C)** MABCD **(D)** MA_4

29. A complex of platinum, ammonia and chloride produces four ions per molecule in the solution. The structure consistent with the observation is :

(A) $[Pt(NH_3)_4]Cl_4$ **(B)** $[Pt(NH_3)_2Cl_4]$ **(C)** $[Pt(NH_3)_5Cl]Cl_3$ **(D)** $[Pt(NH_3)_4Cl_2]Cl_2$

30. Which complex is likely to show optical activity?

(A) $\text{Trans} - \left[Co(NH_3)_4Cl_2\right]^+$ **(B)** $\left[Cr(H_2O)_6\right]^{3+}$

(C) $\text{Cis} - \left[Co(NH_3)_2(en)_2\right]^{3+}$ **(D)** $\text{Trans} - \left[Co(NH_3)_2(en)_2\right]^{3+}$

31. How many moles of AgCl would be obtained, when 100 ml of 0.1 M $Co(NH_3)_5Cl_3$ is treated with excess of $AgNO_3$?

(A) 0.01 **(B)** 0.02 **(C)** 0.03 **(D)** none of these

32. Which of the following statements is correct?

(A) Geometrical isomerism is not observed in complexes of coordination number 4 having tetrahedral geometry

(B) Square planar complexes generally do not show geometrical isomerism

(C) The square planar complex of general formulae Ma_3b or Mab_3 exhibits cis-trans isomerism

(D) The platinum glycinato complex, $\left[Pt(Gly)_2\right]$ does not show geometrical isomerism

33. How many isomers are possible for the complex ion $\left[Cr(NH_3)(OH)_2Cl_3\right]^{2-}$?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5

34. A complex of certain metal has the magnetic moment of 4.91 BM whereas another complex of the same metal with same oxidation state has zero magnetic moment. The metal ion could be :

(A) Co^{2+} **(B)** Mn^{2+} **(C)** Fe^{2+} **(D)** Fe^{3+}

35. On treatment of $[Ni(NH_3)_4]^{2+}$ with concentrated HCl, two compounds I and II having the same formula, $[Ni(NH_3)_2Cl_2]$ are obtained, I can be converted into II by boiling with dilute HCl. A solution of I reacts with oxalic acid to form $[Ni(NH_3)_2(C_2O_4)]$ whereas II does not react. Point out the correct statement of the following :

(A) I cis, II trans ; both tetrahedral **(B)** I cis, II trans ; both square planar

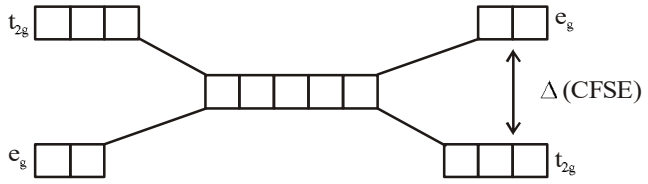
(C) I trans, II cis ; both tetrahedral **(D)** I trans, II cis ; both square planar

36. Which of the following complex shows ionization isomerism :

(A) $\left[Cr(NH_3)_6\right]Cl_3$ **(B)** $\left[Co(en)_3\right]Cl_2$ **(C)** $\left[Cr(en)_3\right]Cl_3$ **(D)** $\left[Co(NH_3)_5Br\right]SO_4$

Paragraph for Questions 37 - 39

When the degenerate orbitals of d sub-shell of an isolated atom / ion come under influence of magnetic field of ligands, the degeneracy is lost. The two sets t_{2g} (d_{xy}, d_{yz}, d_{xz}) and $e_g\left(d_{z^2}, d_{x^2-y^2}\right)$ are either higher or lower energetic depending upon the nature of magnetic field.



Value of CFSE depends upon nature of ligand and spectrochemical series has been made experimentally. For tetrahedral complexes, Δ_t is about 4 / 9 times to Δ_0. This energy lies in visible region and that is why electronic transitions are responsible for colour. Such transitions not possible with d^0 and d^{10} configuration.

37. The values of CFSE (Δ_0) for complexes given below follow the order :

(I) $\left[Co(NH_3)_6\right]^{3+}$ **(II)** $\left[Rh(NH_3)_6\right]^{3+}$ **(III)** $\left[Ir(NH_3)_6\right]^{3+}$

(A) I < II < III **(B)** I > II > III **(C)** I < II > III **(D)** I = II = III

38. The d – orbitals which are lower energetic in an octahedral magnetic field are :

(A) d_{xy} and d_{z^2} **(B)** $d_{x^2-y^2}$ and d_{z^2} **(C)** d_{xy}, d_{xz} and d_{yz} **(D)** d_{z^2} only

39. Ti^{3+} (aq) is purple while Ti^{4+} (aq) is colourlessbecause :

(A) There is no crystal field effect in Ti^{4+}

(B) The energy difference between t_{2g} and e_g of Ti^{4+} is quite high and does not fall in the visible region

(C) Ti^{4+} has d^0 configuration

(D) Ti^{4+} is very small in comparison to Ti^{3+} and hence does not absorb any radiation

Paragraph for Questions 40 - 42

Square planar complexes are formed by d^8 ions with strong field ligands. The crystal field splitting Δ_o is larger for second and third row transition elements and for more highly charged species. All the complexes having $4d^8$ and $5d^8$ configurations are mostly square planar including those with weak field ligands such as halide ions. Square planar complexes can show geometrical isomerism but they do not show optical isomerism due to the presence of plane of symmetry.

40. Which of the following statements is/are true for the complex $[Ni(PPh_3)_2Br_2]$?

(A) Hybridisation is the same as found with strong field ligands like CN^- (with +II oxidation state)

(B) Hybridisation is the same as found with strong field ligands like CO (with zero oxidation state)

(C) Hybridisation is the same as found with weak field ligands like halide ions (with + II oxidation states)

(D) **(B)** and **(C)** both

41. Amongst the following complexes which has square planar geometry?

(A) $[RhCl(CO)(PPh_3)_2]$ **(B)** $K_3[Cu(CN)_4]$

(C) $K_2[Zn(CN)_4]$ **(D)** $[Ni(CO)_4]$

42. Which one of the following square planar complexes will show geometrical isomerism?

(A) $[Pt(en)_2]^{2+}$ **(B)** $[Pt(gly)_2]$

(C) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ **(D)** **(B)** and **(C)** both

Paragraph for Questions 43 - 45

In metal carbonyls, there is synergic bonding interaction between metal and carbon monoxide. This leads to increase in strength of metal-ligand bond and decrease in bond order of CO in carbonyl complex as compared to bond order in carbon monoxide.

Simple carbonyls are invariable spin-paired complexes except for vanadium metal.

43. Which of the following statement is false for Nickel carbonyl $[Ni(CO)_4]$?

(A) It is a colourless compound

(B) The Ni – C – O group is linear

(C) The four carbonyl group are lying at the corners of a regular tetrahedron

(D) The metal – carbon bond length (for σ bond) does not alter

44. Which amongst the following metal carbonyls are inner orbital complexes with diamagnetic property

(I) $Ni(CO)_4$ (II) $Fe(CO)_5$ (III) $V(CO)_6$ (IV) $Cr(CO)_6$

Select the correct answer from the codes gives below :

(A) I and II only **(B)** II, III and IV only **(C)** II and IV only **(D)** I, II and IV only

45. Which of the following statement is correct for metal carbonyls?

(A) In general, the effective atomic number for a stable monomeric carbonyl is equal to the atomic number of the next inert gas except $[V(CO)_6]$

(B) The metal-carbon bond in metal carbonyls possess double bond character

(C) The C – O bond length in $[Cr(CO)_6]$ is greater than that in $\left[Ni(CO)_4\right]$

(D) All of these

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

46. Select correct statement(s) :

(A) $Mn_3(CO)_{12}$ is Dodecacarbonyltrimanganese (0)

(B) EDTA is a polydentet, flexidentate and chelating ligand

(C) $[Co(H_2O)_6]^{+2}$ is more stable than $[Ni(H_2O)_6]^{+2}$

(D) $[Cu(NH_3)_4]^{+2}$ is having dsp^2hybridisation

47. Correct statement(s) in the following is(are) :

(A) Coordination number of a central metal cation in (3d series) is twice its valency

(B) Octahedral complexes of Ma_3b_3 type have only two geometrical isomers

(C) $[Mg(EDTA)]^{-2}$ complex anion contains 5 chelated rings

(D) [M ABCD] type of tetrahedral complexes always possess two stereo isomers

48. In which pairs, both the compounds show geometrical isomerism?

(A) $\left[Pt(NH_3)_2Cl_2\right]$ and $\left[Co(en)_2Cl_2\right]$ **(B)** $\left[Fe(NH_3)_2(CN)_4\right]^{2-}$ and $\left[CoCl_2(OX)_2\right]^{3-}$

(C) $\left[Co(NH_3)_5Cl\right]SO_4$ and $\left[Cr(en)_3\right]^{3+}$ **(D)** $\left[Co(NH_3)_4Cl_2\right]^{+}$ and $\left[Co(NH_3)_3(NO_2)_3\right]$

49. Select the correct statements :

(A) Chelation effect is more important for penta and hexadented ligands for stability of complex

(B) Greater the charge on the central metal cation, greater the value of Δ (CFSE)

(C) In complex ion $[CoF_6]^{3-}$, F^- is a weak field ligand, so that $\Delta_{oct} < P$ (Pairing energy) and it is low spin complex

(D) $[CoCl_2(NH_3)_2(en)]^+$ complex ion will have four different stereoisomer

50. Which of the following ionic species will not impart colour to an aqueous solution?

(A) Ti^{4+} **(B)** Cu^+ **(C)** Zn^{2+} **(D)** Cr^{3+}

51. Which of the following can show coordination isomerism?

(A) $[Cu(NH_3)_4][PtCl_4]$ **(B)** $\left[Fe(NH_3)_6\right]_2\left[Pt(CN)_6\right]_3$

(C) $\left[Co(NH_3)_6\right]\left[Cr(C_2O_4)_3\right]$ **(D)** $\left[Pt(en)_3\right](SO_4)_2$

52. Which statement(s) is/are correct?

(A) $\left[Ag(NH_3)_2\right]^+$ is linear with sp hybridization of Ag^+ ion

(B) $NiCl_4^{2-}$, VO_4^{3-}, MnO_4^- have tetrahedral geometry

(C) $\left[Cu(NH_3)_4\right]^{2+}$, $\left[Pt(NH_3)_4\right]^{2+}$, $\left[Ni(CN)_4\right]^{2-}$ have dsp^2 hybridization of the metal ion

(D) $Fe(CO)_5$ have bipyramidal structure with dsp^3 hybridization of iron

53. Which of the following complexes is / are paramagnetic?

(A) $[Fe(CN)_6]^{4-}$ **(B)** $[Cu(NH_3)_4]^{2+}$ **(C)** $[Ti(H_2O)_6]^{3+}$ **(D)** $[Ni(en)_2]^{2+}$

54. The complex $[Fe(H_2O)_5NO]^{2+}$ is formed in the brown ring test for nitrate when freshly prepared $FeSO_4$ solution is added to aqueous solution of NO_3^- followed by addition of conc. H_2SO_4. Select correct statements about this complex :

(A) colour change is due to charge transfer

(B) it has iron in +1 oxidation state and nitrosyl as NO^+

(C) it has magnetic molent of 3.87 B.M. confirming three unpaired electrons in Fe

(D) It has octahedral geometry

55. In the compound $CoCl_3 \cdot 5NH_3$

(A) all the Cl show primary valency (PV)

(B) two Cl show (PV) and one Cl secondary valency (SV)

(C) two Cl show (PV) and one Cl (PV) as well as (SV)

(D) all the NH_3 show secondary valency

56. Identify the correct statements :

(A) Δ_0 increasing order is $[CrCl_6]^{3-} < [Cr(NH_3)_6]^{+3} < [Cr(CN)_6]^{3-}$

(B) CFSE for $[Ti(H_2O)_6]^{3+}$ is $-0.4\Delta_0$

(C) $[NiCl_4]^{2-}$ as well as $[Ni(CO)_4]$ are paramagnetic

(D) The halide ions are arranged as $I^- < Br^- < Cl^- < F^-$ in the spectro chemical series.

57. Aqueous solution of which of the following complexes impart certain colour?

(A) $[Ti(H_2O)_3Cl_3]Cl$ **(B)** $[Cu(NH_3)_4]Cl$ **(C)** $Na_2[Zn(CN)_4]$ **(D)** $[Cr(H_2O)_5Cl]Cl_2$

58. Which of the following statements is(are)correct ?

(A) $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and $[Co(NO_2)_6]^{3-}$ are diamagnetic, involving d^2sp^3 hybridisation

(B) $[Zn(NH_3)_4]^{2+}$, $[FeCl_4]^-$ and $[Ni(CO)_4]$ are diamagnetic, involving sp^3 hybridisation

(C) The magnetic moment of $[Fe(H_2O)_6]^{3+}$ is 5.92 BM and that of $[Fe(CN)_6]^{3-}$ is 1.73 BM

(D) The magnetic moment of $K_4[MnF_6]$ and $K_3[FeF_6]$ are same

59. Which of the following statement is(are) correct with respect to the crystal field theory?

(A) It considers only the metal ion d-orbitals and gives no consideration at all to other metal orbitals.

(B) It cannot account for the π bonding in complexes.

(C) The ligands are point charges which are either ions or neutral molecules

(D) The magnetic properties can be explained in terms of splitting of d-orbitals in different crystal fields

60. A complex compound of one cobalt (III) ion, two ethylene diamine molecules, two chloride ions and one nitrite ion will show

(A) linkage isomerism **(B)** ionization isomerism

(C) geometrical isomerism **(D)** optical isomerism

61. Consider the following statements

S_1 : Generally square planar complexes show geometrical isomerism but do not exhibit optical isomerism because they do not possess plane of symmetry.

S_2 : $\Delta_t = \frac{4}{9}\Delta_o$

S_3 : In octahedral complexes each electron entering the t_{2g} orbitals stabilizes the complex ion by 0.4 Δ_o and each electron entering the e_g orbital destabilizes the complex by an amount of 0.6 Δ_o.

And select the correct statement from the codes given below :

(A) S_1 and S_3 are correct **(B)** S_2 and S_3 are correct

(C) S_1 is incorrect **(D)** S_2 and S_3 are incorrect

62. Select the correct comparison of complexes on the basis of magnitude of Δ_o :

(A) $\left[Co(CN)_6\right]^{3-} > \left[Co(H_2O)_6\right]^{3+}$ **(B)** $\left[Co(H_2O)_6\right]^{2+} < \left[Co(H_2O)_6\right]^{3+}$

(C) $\left[Co(H_2O)_6\right]^{3+} > \left[Rh(H_2O)_6\right]^{3+}$ **(D)** $\left[Co(NH_3)_6\right]^{3+} < \left[CoF_6\right]^{3-}$

63. In which of the following pairs both the complexes show optical isomerism?

(A) $cis-\left[Cr(en)_2Cl_2\right]$ and $cis-\left[Co(NH_3)_4Cl_2\right]$

(B) $\left[Co(gly)_3\right]$ and $cis-\left[Co(en)_2Cl_2\right]$

(C) $cis\left[Pt(en)_2Cl_2\right]$ and $\left[Ni(NH_3)_3Cl_3\right]$

(D) $\left[Co(NO_3)_3(NH_3)_3\right]$ and $cis-\left[Pt(en)_2Cl_2\right]$

64. Which of the following statement(s) is/are true ?

(A) The order of magnitude of Δ_o in the following complexes is $[Co(H_2O)(NH_3)_5]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

(B) The order of the stability of the complexes in aqueous solution is $[Cu(CN)_4]^{2-} > [Cu(NH_3)_4]^{2+} > [Cu(H_2O)_6]^{2+}$

(C) Irving William's order of stability is $Mn^{2+} < Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} < Zn^{2+}$

(D) The order of magnetic moments of the complex is $[Fe(H_2O)_6]^{3+} > [CoF_6]^{3-} > [Cr(CN)_6]^{3-}$

65. Which statement(s) is/are correct?

(A) $[Ni(PPh_3)_2Cl_2]$ – tetrahedral and paramagnetic

(B) $[Ni(CO)_4]$ – tetrahedral and diamagnetic

(C) $[Ni(CN)_4]^{2-}$ square planar and diamagnetic

(D) $[Ni(CO)_4]$ – square planar and diamagnetic

66. Which of the following statement(s) is / are incorrect?

(A) Both $[Co(Ox)_3]^{3-}$ and $[CoF_6]^{3-}$ are paramagnetic

(B) $CoCl_3 \cdot 3NH_3$ complex is non-conductor of electricity

(C) The number of possible geometrical isomers for complex $[Pt(NO_2)(Py)(OH)(NH_3)]$ is six

(D) The oxidation state of iron in brown ring complex $[Fe(H_2O)_5NO]SO_4$ is + II where NO is NO^+

67. Which of the following complexes can exist as diastereoisomers?

(A) $\left[Cr(NH_3)_2Cl_4\right]^-$ **(B)** $\left[Co(NH_3)_5Br\right]^{2+}$ **(C)** $\left[FeCl_2(NCS)_2\right]^{2-}$ **(D)** $\left[PtCl_2Br_2\right]^{2-}$

68. Select the correct statements from the following

(A) $[Sc(H_2O)_6]^{3+}$ and $[Ti(H_2O)_6]^{3+}$ both are colourless

(B) $Co(NH_3)_4Br_2Cl$ show ionization and geometrical isomerism.

(C) $[Pd(NO_2)_2(NH_3)_2]$ is square planar and shows geometrical as well as linkage isomerism.

(D) $[PtCl_4]^{2-}$ is a square planar complex

69. Which of the following complexes does show stereo isomerism?

(A) $[Co(NH_3)_4Cl_2]^+$ **(B)** $[Co(NH_3)_3(NO_2)_3]$ **(C)** $[Cr(en)_3]^{3+}$ **(D)** $[Pt(gly)_2]$

70. The complex $[Fe(H_2O)_5NO]^{2+}$ is formed in 'brown ring test' for nitrates. Choose the correct statements for the complex

(A) Its magnetic moment is approximately 3.9 BM

(B) The oxidation state of iron is + I

(C) The hybridization of central metal ion is sp^3d^2

(D) The brown colour of the ring is due to d – d transition

71. Select the correct statements :

(A) Potassium ferrocyanide and potassium ferricyanide can be differentiated by measuring the solid state magnetic moment

(B) The complex $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ can be differentiated by adding aqueous solution of barium chloride

(C) The complex $[Co(NH_3)_5Cl]Br$ and $[Co(NH_3)_5Br]Cl$ can be differentiated by adding aqueous solution of silver nitrate.

(D) $\left[Co(NH_3)_6\right]Cl_3$ and $\left[Co(NH_3)_5Cl\right]Cl_2$ can be differentiated by electrical conductivity of respective aqueous solutions.

72. $[Fe(en)_2(H_2O)_2]^{2+} + en \rightarrow$ complex (X). The correct statements about the complex (X) is :

(A) It is low spin complex **(B)** It is diamagnetic

(C) It shows geometrical isomerism **(D)** It shows optical isomerism

73. Which of the following are bidentate monoanion ligands?

(A) Acetyl acetonato **(B)** Oxalato ion

(C) Dimethyl glyximato **(D)** None of these

74. Which amongst the following are organometallic compounds?

(A) $Al_2(CH_3)_6$ **(B)** $K[PtCl_3C_2H_2]$ **(C)** $N(CH_3)_3$ **(D)** $B(CH_3)_3$

75. Complexes $[Co(NH_3)_5SO_4]Br$ and $\left[Co(NH_3)_5Br\right]SO_4$ can be distinguished by :

(A) conductance measurement **(B)** using $BaCl_2$

(C) using $AgNO_3$ **(D)** dipole moment measurement

76. Which of the following statements are true?

(A) $MnCl_4^{2-}$ ion has tetrahedral geometry and is paramagnetic

(B) $[Mn(CN)_6]^{2-}$ ion has octahedral geometry and is diamagnetic

(C) $[Cu(CN)_4]^{3-}$ has square planar geometry and is diamagnetic

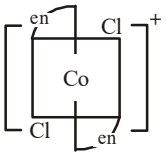
(D) $[Ni(Ph_3P)_2Br_3]$ has trigonal bipyramidal geometry and is paramagnetic

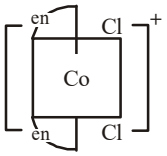
77. Other than the X-ray diffractions, how could be the following pairs of isomers be distinguished from the another by $\left[Cr(NH_3)_6\right]\left[Cr(NO_2)_6\right]$ and $\left[Cr(NH_3)_4(NO_2)_2\right]\left[Cr(NH_3)_2(NO_2)_4\right]$

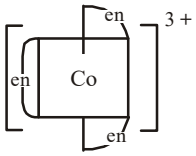
(A) dipole moment measurement **(B)** measurement of molar conductance

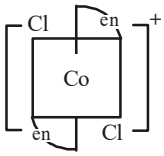
(C) measuring magnetic moments **(D)** observing their colours

78. Which of the following ions are optically active?

(A) 

(B) 

(C) 

(D) 

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Set 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Set 2 can be matched with Set 1.

79. MATCH THE FOLLOWING :

Set – I (Complex Compound)		**Set – II (Type of Isomerism Shown)**
(1)	$[Co(H_2O)_3F_3]$	**(P)** Geometrical isomerism
(2)	$[Co(en)_3]Cl_3$	**(Q)** Optical isomerism
(3)	$[Co(en)_2(NO_2)_2]Cl$	**(R)** Linkage isomerism
(4)	$K_3[Cr(CN)_6]$	**(S)** Ionisation isomerism

(A) 1 – P, 2 – Q, 3 – R, 4 – S **(B)** 1 – Q, 2 – P, 3 – S, 4 – R

(C) 1 – P, 2 – Q, 3 – P,Q,R,S 4 – R **(D)** 1 – R, 2 – Q, 3 – S, 4 – P

80. MATCH THE FOLLOWING :

Set – I (Complex compound)		**Set – II (Related property)**
(1)	$\left[Co(NH_3)_4(H_2O)_2\right]Cl_2$	**(P)** Give precipitate by the action of $AgNO_3$(aq)
(2)	$\left[Pt(NH_3)_2Cl_2\right]$	**(Q)** Paramagnetic in nature
(3)	$\left[Co(H_2O)_5Cl\right]Cl$	**(R)** Exhibit geometrical isomerism
(4)	$\left[Ni(H_2O)_6\right]Cl_2$	**(S)** Does not conduct electricity in its aqueousstate

(A) 1 – P, 2 – S, 3 – R, 4 – Q **(B)** 1 – P,Q,R 2 –R,S 3 – P,Q 4 –P,Q

(C) 1 – S, 2 – R, 3 – Q, 4 – P **(D)** 1 – R, 2 – P, 3 – S, 4 – Q

81. MATCH THE FOLLOWING :

Set – I		Set – II	
(1)	$[MnCl_6]^{2-}$	**(P)**	contain one unpaired electron
(2)	$[Fe(CN)_6]^{3-}$	**(Q)**	d^2sp^3
(3)	$[Co(NH_3)_6]^{3+}$	**(R)**	outer orbital complex
(4)	$[Fe(H_2O)_6]^{2+}$	**(S)**	involve electron rearrangement

(A) 1 – Q, 2 – P, 3 – R, 4 – S **(B)** 1 – P, 2 – Q, 3 – S, 4 – R
(C) 1 – Q, 2 – S, 3 – P, 4 – R **(D)** 1 – Q 2 – P,Q,S 3 –Q,S 4 – R

82. MATCH THE FOLLOWING :

Set – I (Ligand)		Set – II (Related Character)	
(1)	Triphenyl phosphine	**(P)**	Ambidentate
(2)	Ethylene diamine	**(Q)**	Monodentate
(3)	SCN^-	**(R)**	Chelating ligand
(4)	Dimethyl glyoximate	**(S)**	Bidentate

(A) 1 – Q, 2 – P, 3 – S, 4 – R **(B)** 1 – Q, 2 – R,S 3 – P,Q 4 – R,S
(C) 1 – P, 2 – S, 3 – Q, 4 – R **(D)** 1 – Q, 2 – R, 3 – S, 4 – P

83. MATCH THE FOLLOWING :

Set – I		Set – II	
(1)	$[Fe(H_2O)_5\ NO]SO_4$	**(P)**	$\sqrt{3}$ BM, d^2sp^3
(2)	$[Mn(CN)_6]^{-4}$	**(Q)**	zero BM, dsp^2
(3)	$[Fe(CO)_5]$	**(R)**	$\sqrt{15}$ BM, sp^3d^2
(4)	$[Ni(CN)_4]^{2-}$	**(S)**	zero BM, dsp^3

(A) 1 – P, 2 – R, 3 – S, 4 – Q **(B)** 1 – R, 2 – S, 3 – P, 4 – Q
(C) 1 – R, 2 – P, 3 – Q, 4 – S **(D)** 1 – R, 2 – P, 3 – S, 4 – Q

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

84. Find out the numbers of isomers (structural and stereo) produced by the complex $[Pt(NH_3)_2(NO_2)Cl_3]$

85. What is the number of stereoisomers possible for the octahedral complex ion $[Co(CH_3NH_2)_2(Py)_2(C_2O_4)]^{+1}$

86. During of 'Fixing of image' in the photography process the following reaction takes place $AgBr + xNa_2S_2O_3 \rightarrow Na_y[Ag(S_2O_3)_x]$ (water soluble). The value of (x + y) is

87. The molecular formula of an octahedral complex is $Cr(Cl)(Br)(I).4H_2O$. How many ionization isomer(s) is/are possible for the complex?

88. In the reaction $\underset{(CiS)}{[CoCl_2(NH_3)_4]^+} + Cl^- \rightarrow [CoCl_3(NH_3)_3] + NH_3$. How many isomers of the products (co-complex) is obtained.

89. Effective atomic number of complex of $_{42}Mo$ is 54. The formula of its carbonyl complex is $Mo(CO)_x$. The value of 'x' is …….

90. Number of isomers possible for the complex compound $\left[Co(en)_2 Cl(NO_2)\right]Cl$ are _____.

91. How many of the following complexes can exist as 'd' and '*l*' isomers

$\left[Co(NH_3)_4 Cl_2\right]^+$, $\left[Co(NH_3)_3 Cl_3\right]$, trans $\left[Co(en)_2 Cl_2\right]^+$,

Cis$\left[Co(en)_2 Cl_2\right]^+$, $\left[Cr(Ox)_3\right]^{3-}$, $\left[Cr(en)_3\right]^{3+}$, $\left[Pt(en)_2 Cl_2\right]$

92. Find the number of paramagnetic compound(s) with octahedral anion.

$K_2[CoF_6]$:	$O_2[AsF_6]$:	$K_2[CoCl_4]$:	$K_3[Co(CN)_6]$:
$K_3[CoF_6]$:	$[Ni(NH_3)_6]SO_4$:	$[Pt(NH_3)_6][Fe(CN)_6]$:	$Na_2[Fe(CN)_5NO]$

Advanced Problem Package	Metallurgy

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Froth floatation process is used for the concentration of :
(A) Oxide ores **(B)** Sulphide ores **(C)** Chloride ores **(D)** Amalgams

2. In metallurgical processes the flux used for removing acidic impurities is :
(A) Silica **(B)** Sodium chloride **(C)** Lime stone **(D)** Sodium carbonate

3. The main function of roasting is :
(A) to remove the volatile matter **(B)** oxidation of ore
(C) Both A and B **(D)** to make slag

4. Which of the following metals is obtained by leaching its ore with dilute cyanide solution?
(A) Silver **(B)** Titanium **(C)** Vanadium **(D)** Zinc

5. Electrolytic reduction method is used in the extraction of :
(A) Highly electronegative elements **(B)** High electropositive elements
(C) Transition metals **(D)** Noble metals

6. In electro refining of metal the pure metal is made the anode and a strip of pure metal as cathode during the electrolysis of an aqueous solution of a complex metal salt. This method cannot be used for refining of :
(A) Silver **(B)** Copper **(C)** Aluminium **(D)** Gold

7. Zone refining process is used for the :
(A) Concentration of an ore **(B)** Reduction of a metal oxide
(C) Purification of metal **(D)** Purification of an ore

8. The ignition mixture in alumino thermite process contains a mixture of :
(A) Magnesium powder and BaO_2 **(B)** Magnesium powder, aluminium and BaO_2
(C) Magnesium and aluminium powders **(D)** Magnesium and aluminium oxide

9. Which of the following is not employed for refining of metal?
(A) Poling **(B)** Leaching **(C)** Electrolysis **(D)** Liquation

10. The purpose of smelting an ore is :
(A) to oxidise it **(B)** to reduce it
(C) to separate volatile impurities **(D)** to obtain an alloy

11. Roasting is done generally in case of the :
(A) oxide ores **(B)** silicate ores **(C)** sulphide ores **(D)** carbonate ores

12. Cupellation process is used in the metallurgy of :
(A) Cu **(B)** Ag **(C)** Zn **(D)** Al

13. The slag obtained during the extraction of copper pyrites is composed mainly of :
(A) Au_2S **(B)** $FeSiO_3$ **(C)** $CuSiO_3$ **(D)** SiO_2

14. Which one of the following benefication processes is used for the minerals $Al_2O_3.2H_2O$?

(A) Froth floatation **(B)** Leaching **(C)** Liquation **(D)** Magnetic separation

15. Among the following statements, the incorrect one is :

(A) Calamine and siderite are carbonates **(B)** Argentite and cuprite are oxides

(C) Zinc blende and iron pyrites are sulphides **(D)** Malachite and azurite are basic carbonates

16. The metal extracted by cyanide process is :

(A) Silver **(B)** Copper **(C)** Iron **(D)** Sodium

17. Malachite is an ore of :

(A) Iron **(B)** Zinc **(C)** Copper **(D)** Mercury

18. Heating an ore in the absence of air below its melting point is called :

(A) Leaching **(B)** Roasting **(C)** Smelting **(D)** Calcination

19. In the commercial electrochemical process for aluminium extraction the electrolyte used is :

(A) $Al(OH)_3$ in NaOH solution

(B) an aqueous solution of $Al_2(SO_4)_3$

(C) a molten mixture of Al_2O_3 and Na_3AlF_6

(D) a molten mixture of Al_2O_3 and $Al(OH)_3$

20. The most electropositive metals are isolated from their ores by :

(A) high temperature reduction with C

(B) self reduction

(C) thermal decomposition

(D) electrolysis of fused ionic salts

21. In order to refine blister copper it is melted in a furnace and is stirred with green logs of wood. The purpose is :

(A) to expel the dissolved gases in blister copper

(B) to bring the impurities to surface and oxidise them

(C) to increase carbon content of copper

(D) to reduce the metallic oxide impurities with hydrocarbon gases liberated from the wood

22. ΔG° v/s T plot in Ellingham diagram slopes downward for the reaction:

(A) $Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)}$ **(B)** $2Ag_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow Ag_2O_{(s)}$

(C) $C_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$ **(D)** $CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)}$

23. Which of the following is an important ore of uranium?

(A) Zinc blende **(B)** Pitch blende **(C)** Galena **(D)** Malachite

24. By which process Cu and Ag are extracted respectively:

(A) Carbon reduction; Self-reduction

(B) Self-reduction; Carbon reduction

(C) Electrolytic reduction; cyanide process

(D) Self-reduction; Cyanide process

Paragraph for Questions 25 - 27

Copper is the most noble of the first row transition metals and occurs in small deposits in several countries. The main ores of copper include cuprite (Cu_2O), copper glance (Cu_2S) malachite ($Cu_2(OH)_2CO_3$) and chalcopyrite ($CuFeS_2$). However 80% of the world copper production comes from the ore chalcopyrite. The extraction of copper from chalcopyrite involves partial roasting, removal of iron, self-reduction, poling and electrolytic refining.

25. Partial roasting of chalcopyrite produces :
(A) Cu_2S and FeO **(B)** Cu_2O and FeO **(C)** CuS and Fe_2O_3 **(D)** Cu_2O and Fe_2O_3

26. Iron is removed from chalcopyrite as :
(A) FeO **(B)** FeS **(C)** Fe_2O_3 **(D)** $FeSiO_3$

27. In self-reduction the reducing species is :
(A) S **(B)** O^{2-} **(C)** S^{2-} **(D)** SO_2

28. Poling process is used :
(A) for the removal of Cu_2O from Cu **(B)** for removal of S from Cu_2S
(C) for the removal of FeO from Cu **(D)** None of these

29. In electro refining process impure copper acts as :
(A) Anode **(B)** Cathode **(C)** Both **(D)** None of these

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

30. Which of the following is(are) a carbonate mineral:
(A) Trona **(B)** Dolomite **(C)** Malachite **(D)** Siderite

31. Which of the following ore(s) is(are) concentrated by forth floatation process?
(A) Galena (PbS) **(B)** Copper pyrite ($CuFeS_2$)
(C) Cinnabar (HgS) **(D)** Argentite (Ag_2S)

32. Which of the following reactions occurs during calcination?
(A) $CaCO_3 \cdot MgCO_3 \rightarrow CaO + MgO + CO_2$ **(B)** $FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$
(C) $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$ **(D)** $Cu_2S + 2CuO \rightarrow 4Cu + SO_2$

33. Self-reduction process is used for the extraction of :
(A) Cu **(B)** Hg **(C)** Pb **(D)** Zn

34. Which of the following ores contains more than one metals?
(A) Copper pyrite **(B)** Dolomite **(C)** Carnalite **(D)** Cryolite

35. Consider the following statements related to roasting and identify **correct** statement(s).
(A) Roasting is carried out to convert sulphide into oxide.
(B) Roasting is carried out to melt the ore.
(C) Roasting is carried out to remove moisture, water of crystallization and to expel organic matter.
(D) Roasting is carried out to remove volatile impurities.

36. Magnesium oxide is used for the lining in steel making because it remove impurities of which of the following through slag formation?

(A) S **(B)** Si **(C)** P **(D)** None of these

37. Which of the following ores of copper is roasted not calcined during recovery of copper?

(A) Copper pyrite **(B)** Chalcocite **(C)** Malachite **(D)** Cuprite

38. Metals are usually extracted by reduction. The concentrated ores is converted to oxides for reduction to metal. In which of the following case concentrated ore is directly used for reduction?

(A) Rutile **(B)** Bauxite **(C)** Haematite **(D)** Cassiterite

39. Which of the following minerals of aluminium is an ore of aluminium?

(A) Cryolite; Na_3AlF_6 **(B)** Feldspar; $KAlSi_3O_8$

(C) Bauxite; $Al_2O_3 \cdot 2H_2O$ **(D)** China clay; $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$

40. Identify correctly matched ores and method of their concentration.

(A) Galena; Froth floatation process **(B)** Bauxite; Leaching

(C) Cassiterite; Gravity separation **(D)** Magnetite; Electromagnetic separation

41. In the equation $4M + 8CN^- + 2H_2O + O_2 \rightarrow 4[M(CN)_2]^- + 4OH^-$. The metal M is :

(A) Al **(B)** Ag **(C)** Au **(D)** Fe

42. Which of the following is correctly matched?

(A) Mond's process; Refining of Nickel

(B) Van Arkel's process; Ultrapure metal

(C) Cyanide process; Extraction of silver

(D) Froth-Floatation process; Concentration of sulphide ores.

43. In the cyanide extraction process of silver from argentite (Ag_2S) ore :

(A) O_2 acts as oxidizing agent

(B) $Na[Ag(CN)_2]$ is formed as soluble complex

(C) Zn acts as reducing agent

(D) Ore is concentrated by froth floatation process

44. Leaching is often used for concentration of ore if the ore is soluble in some suitable solvent. Identify ore and solvent used for leaching of the ore?

(A) Bauxite; NaOH **(B)** Silver; NaCN

(C) Gold; KCN **(D)** Pitch blende; H_2SO_4

45. Which of the following is correctly matched?

(A) Lead; self-reduction

(B) Boron; Decomposition of iodide

(C) Nickel; Decomposition of carbonyl complex

(D) Silver; Complex formation and displacement by metal

46. Thermal decomposition is used for purification of

(A) Ni **(B)** B **(C)** Ti **(D)** Pb

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

47. MATCH THE FOLLOWING :

Column 1 (metallurgical process)		Column 2 (ore)	
(A)	Smelting	**(p)**	Copper glance
(B)	Self reduction	**(q)**	Silver glance
(C)	Electrolytic reduction	**(r)**	Haematite
(D)	Hydrometallurgy	**(s)**	Bauxite

48. MATCH THE FOLLOWING :

Column 1		Column 2	
(A)	Au	**(p)**	Self reduction
(B)	Al	**(q)**	Liquation
(C)	Pb	**(r)**	Electrolysis
(D)	Sn	**(s)**	Baeyer's process

49. MATCH THE FOLLOWING :

Column 1		Column 2	
(A)	Mond's process	**(p)**	Purification of silver
(B)	Van Arkel method	**(q)**	Purification of zinc
(C)	Cupellation	**(r)**	Purification of nickel
(D)	Distillation	**(s)**	Purification of titanium
		(t)	Ultra pure metals

50. MATCH THE FOLLOWING :

Column 1		Column 2 (Method of reduction)	
(A)	Iron & Tin	**(p)**	Carbon reduction method
(B)	Copper & Lead	**(q)**	Self-reduction method
(C)	Magnesium & Aluminium	**(r)**	Electrolytic reduction method
(D)	Silver & Gold	**(s)**	Cyanide process

51. MATCH THE FOLLOWING :

Column 1		Column 2	
(A)	Electrolytic reduction	**(p)**	Aluminium
(B)	Electrolytic oxidation	**(q)**	Chlorine
(C)	Chemical reduction	**(r)**	Iron
(D)	Chemical oxidation	**(s)**	Silver
		(t)	Sulphur

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

52. The number of valence electrons in the most abundant element in earth's crust is _____?

53. How many of the following are sulphide ores?
Copper pyrites, Argentite, Zinc blende, cinnabar, galena, Iron pyrite, Haematite, Malachite, Dolomite.

54. How many of the following are oxide ores?
Bauxite, Cuprite, Cassiterite, Haematite, Magnetite, Chromite, Cryolite, galena, Limestone, Rutile, Pyrolusite.

55. What is the number of valence shell electrons in the most abundant metal?

56. What is the numerical value of oxidation state of sulphur in an ore of iron known as Fool's gold?

57. How many of the following metals are extracted by the electrolysis of their fused salts : Na, K, Mg, Ca, Al, Ag, Cu, Fe

58. What is the numerical value of oxidation state of the metal in the minerals cassiterite?

59. How many of the following metals and method of their reduction are correctly matched?

1. Al; Electrolytic reduction
2. Pb; Self reduction
3. Sn; Carbon reduction
4. Mg; Electrolytic reduction
5. Hg; Self reduction
6. Cu; Self reduction
7. Ag; Chemical reduction
8. Fe; Carbon reduction
9. Zn; Carbon reduction

60. Extraction of iron from magnetite ore involves how many of the following step(s) process(es) among given ?

(i) Gravity separation (ii) Roasting (iii) Smelting (iv) Reduction by CO
(v) Removal of impurity in form of slag
(vi) Collection of molten pig iron at bottom of blast furnace
(vii) Oxidation of carbon (viii) Reduction of MnO (ix) Reduction of SiO_2

61. How many of the following ores are carbonate ores :

(i) Siderite (ii) Limonite (iii) Zincite (iv) Dolomite
(v) Calamine (vi) Malachite

Advanced Problem Package	Hydrogen & s-Block Elements

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In context with the industrial preparation of hydrogen from water gas ($CO + H_2$) which of the following is the correct statement.

(A) CO and H_2 are fractionally separated using differences in their densities

(B) CO is removed by absorption in aqueous Cu_2Cl_2 solution

(C) H_2 is removed through occlusion with Pd

(D) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali

2. The normality of 30 volume H_2O_2 is :

(A) 2.68 N **(B)** 5.36 N **(C)** 8.04 N **(D)** 6.65 N

3. When hydrogen peroxide is added to ice cold acidified potassium dichromate, a blue colour is produced due to formation of :

(A) CrO_3 **(B)** Cr_2O_3 **(C)** CrO_5 **(D)** CrO_4^{2-}

4. Moist hydrogen peroxide cannot be dried over conc. H_2SO_4 because :

(A) it can catch fire **(B)** it is reduced by H_2SO_4

(C) it is oxidized by H_2SO_4 **(D)** it is decomposed by H_2SO_4

5. The correct order of solubility of the sulphates of alkaline earth 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

6. On strong heating $MgCl_2 \cdot 6H_2O$, the product obtained is :

(A) $MgCl_2$ **(B)** MgO **(C)** $MgCl_2 \cdot 2H_2O$ **(D)** $MgCl_2 \cdot 4H_2O$

7. Which one of the following reactions represents the oxidizing property of H_2O_2 ?

(A) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

(B) $2K_3[Fe(CN)_6] + 2KOH + H_2O_2 \longrightarrow 2K_4[Fe(CN)_6] + 2H_2O + O_2$

(C) $PbO_2 + H_2O_2 \longrightarrow PbO + H_2O + O_2$

(D) $2KI + H_2SO_4 + H_2O_2 \longrightarrow K_2SO_4 + I_2 + 2H_2O$

8. The critical temperature of water is much higher than that of CO_2 because water molecule has :

(A) Less number of o-atoms **(B)** No double bond

(C) High dipole moment **(D)** None of these

9. Which of the following statements is correct? Dielectric constant of H_2O_2

(A) Increases with dilution **(B)** Decreases with dilution

(C) In unaffected on dilution **(D)** None of the above

10. A metal M forms water soluble MSO_4 and inert MO. MO in aqueous solution forms insoluble $M(OH)_2$ soluble in NaOH. Metal M is :

(A) Be **(B)** Mg **(C)** Ca **(D)** Si

11. The product obtained on fusion of $BaSO_4$ and Na_2CO_3 is :

(A) $BaCO_3$ **(B)** BaO **(C)** $Ba(OH)_2$ **(D)** $BaHSO_4$

12. Which of the following carbonates decomposes at lowest temperature?

(A) $MgCO_3$ **(B)** $CaCO_3$ **(C)** $SrCO_3$ **(D)** $BaCO_3$

13. Decomposition of H_2O_2 is prevented by :

(A) KOH **(B)** MnO_2 **(C)** acetanilide **(D)** oxalic acid

14. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in :

(A) Exhibiting maximum covalency in compounds
(B) Forming polymeric hydrides
(C) Forming covalent halides
(D) Exhibiting amphoteric nature in their oxides

15. Which one of the following processes is used for the manufacture of calcium ?

(A) Reduction of CaO with carbon
(B) Reduction of CaO with hydrogen
(C) Electrolysis of a mixture of anhydrous $CaCl_2$ and KCl
(D) Electrolysis of molten $Ca(OH)_2$

16. Calgon used as water softner 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)** None of these

17. Electrolysis of X gives Y at anode. Vacuum distillation of Y gives H_2O_2. The number of peroxy (O–O) bonds present in X and Y respectively are :

(A) 1, 1 **(B)** 1, 2 **(C)** Zero, 1 **(D)** Zero, zero

18. The pH of a solution of H_2O_2 is 6.0. Some chlorine gas is bubbled into this solution. Which of the following is correct?

(A) The pH of resultant solution becomes 8.0
(B) Hydrogen gas is liberated from resultant solution
(C) The pH of resultant solution becomes less than 6.0 and oxygen gas is liberated
(D) Cl_2O is formed in the resultant solution

19. Water is oxidized to oxygen by

(A) ClO_2 **(B)** $KMnO_4$ **(C)** H_2O_2 **(D)** F_2

20. NaOCl is used as a bleaching agent and sterilizing agent. It can be synthesized by the action of

(A) NaCl with H_2O **(B)** NH_4Cl with NaOH
(C) Cl_2 with cold and dilute NaOH **(D)** Cl_2 with hot and concentrated NaOH

21. A fire of lithium, sodium and potassium can be extinguished by

(A) H_2O **(B)** nitrogen **(C)** CO_2 **(D)** asbestose blanket

22. The hydride ion H^- is stronger base than hydroxide ion OH^-. Which of the following reactions will occur if sodium hydride (NaH) is dissolved in water?

(A) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow H_3O^-_{(aq)}$ **(B)** $H^-_{(aq)} + H_2O_{(l)} \longrightarrow OH^-_{(aq)} + H_{2(g)}$

(C) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow$ no reaction **(D)** None of these

23. Compared with the alkaline earth metals, the alkali metals exhibit

(A) Smaller ionic radii **(B)** Higher boiling points

(C) Greater hardness **(D)** Lower ionization energy

24. Which will show highest lattice energy?

(A) RbF **(B)** CsF **(C)** NaF **(D)** KF

25. Which of the following has minimum value of cation/anion radius ratio?

(A) NaCl **(B)** KCl **(C)** $MgCl_2$ **(D)** CaF_2

26. Sodium chloride imparts golden yellow colour to the Bunsen flame. This can be interpreted due to :

(A) low ionization potential of sodium **(B)** Photosensitivity of sodium

(C) Sublimation of metallic sodium to give yellow vapour

(D) Emission of energy absorbed as a radiation in the ultraviolet region

27. Which of the following imparts violet colouration to the Bunsen burner nonluminous flame?

(A) NaCl **(B)** $BaCl_2$ **(C)** $CaCl_2$ **(D)** KCl

28. The molecular formula of potash alum is :

(A) $KAl_2S_4H_{48}O_{40}$ **(B)** $K_2Al_2S_4H_{48}O_{39}$ **(C)** $K_2Al_2S_4H_{48}O_{40}$ **(D)** $KAl_2S_4H_{48}O_{40}$

29. Microcosmic salt is :

(A) $Na(NH_4)HPO_4.4H_2O$ **(B)** $Na(NH_4)_2PO_4 \cdot H_2O$

(C) $Na(NH_3)HPO_4.4H_2O$ **(D)** $K(NH_4)HPO_3.2H_2O$

30. Which of the following compounds on reaction with NaOH and H_2O_2 gives yellow colour?

(A) $Cr(OH)_3$ **(B)** $Zn(OH)_2$ **(C)** $Al(OH)_3$ **(D)** none of these

31. The metal extracted by electrolysis of its fused salt is :

(A) iron **(B)** sodium **(C)** copper **(D)** lead

32. The stability of the following alkali metal chlorides follows the order?

(A) LiCl > KCl > NaCl > CsCl **(B)** CsCl > KCl > NaCl > LiCl

(C) NaCl > KCl > LiCl > CsCl **(D)** KCl > CsCl > NaCl > LiCl

33. Identify the incorrect statement :

(A) Elemental sodium can be prepared and isolated by electrolyzing an aqueous solution of sodium chloride

(B) Elemental sodium is a strong oxidizing agent

(C) Elemental sodium is soluble in liquid ammonia

(D) Elemental sodium is easily oxidized

34. Chemical (A) is used for water softening to remove temporary hardness. (A) reacts with sodium carbonate to give caustic soda and when CO_2 is bubbled through (A), it turns cloudy. What is the chemical formula of (A)?

(A) $CaCO_3$ **(B)** CaO **(C)** $Ca(OH)_2$ **(D)** $Ca(HCO_3)_2$

35. Which of the following has correct increasing basic strength?

(A) MgO < BeO < CaO < BaO **(B)** BeO < MgO < CaO < BaO

(C) BaO < CaO < MgO < BeO **(D)** CaO < BaO < BeO < MgO

36. Amongst the following hydroxide NaOH, KOH, $Ca(OH)_2$ and $Zn(OH)_2$, the weakest base is

(A) NaOH **(B)** KOH **(C)** $Ca(OH)_2$ **(D)** $Zn(OH)_2$

37. Electrolysis of $KCl.MgCl_2.6H_2O$ gives :

(A) Potassium only **(B)** Magnesium only

(C) Magnesium and chlorine **(D)** Potassium and magnesium

38. An important ore of magnesium is :

(A) Malachite **(B)** Cassiterite **(C)** Carnallite **(D)** Galena

39. Beryllium is placed above magnesium in the second group. Beryllium dust, therefore, when added to $MgCl_2$ solution will :

(A) Have no effect **(B)** Will form polymeric beryllium chloride

(C) Precipitate Mg **(D)** Leads to the dissolution of beryllium metal

40. Amongst the metals Be, Mg, Ca and Sr of group II of the periodic table, the least ionic chloride would be formed by :

(A) Mg **(B)** Be **(C)** Ca **(D)** Sr

41. Magnesium burns in air to give :

(A) MgO **(B)** Mg_3N_2 **(C)** $MgCO_3$ **(D)** MgO and Mg_3N_2

42. Which of the following is super phosphate of lime ?

(A) $Ca_3(PO_4)_2$ **(B)** $CaHPO_4$

(C) $Ca(HPO_3)$ **(D)** $Ca(H_2PO_4)_2 \cdot 2CaSO_4 \cdot 2H_2O$

43. Halides of alkaline earth metals forms hydrates such as $MgCl_2.6H_2O, CaCl_2.6H_2O, BaCl_2.2H_2O$ and $SrCl_2.2H_2O$. This shows that halides of group 2 elements :

(A) are hygroscopic in nature **(B)** act as dehydrating agent

(C) can absorb moisture from air **(D)** all the above

44. Calcium is obtained by :

(A) Roasting of lime stone

(B) Electrolysis of solution of calcium chloride in water

(C) Reduction of calcium chloride with carbon

(D) Electrolysis of molten anhydrous fused calcium chloride

45. The metallic luster exhibited by sodium is explained by

(A) Diffusion of sodium ions **(B)** Oscillation of mobile valence electrons

(C) Excitation of free protons **(D)** Existence of body centered cubic lattice

46. A solution of sodium metal in liquid ammonia is strongly reducing due to the presence of :

(A) Sodium atoms **(B)** Sodium hydride

(C) Sodium amide **(D)** Solvated electrons

47. Which halide has highest melting point?

(A) NaCl **(B)** NaBr **(C)** NaF **(D)** NaI

48. When CO is passed over solid NaOH heated to 200°C, it forms :

(A) Na_2CO_3 **(B)** $NaHCO_3$ **(C)** HCOONa **(D)** All

49. The pair of compounds which cannot exist together is :

(A) $NaHCO_3$ and NaOH **(B)** Na_2CO_3 and $NaHCO_3$

(C) Na_2CO_3 and NaOH **(D)** $NaHCO_3$ and NaCl

50. Sodium carbonate reacts with SO_2 in aqueous medium to give :

(A) $NaHSO_3$ **(B)** $Na_2S_2O_3$ **(C)** $NaHSO_4$ **(D)** Na_2SO_4

51. When CO_2 is bubbled into an aqueous solution of Na_2CO_3 the following is formed :

(A) NaOH **(B)** $NaHCO_3$ **(C)** H_2O **(D)** OH^-

52. A deliquescent white crystalline hydroxide X reacts with a nitrate Y to form another hydroxide which decomposes to give a insoluble brown layer of its oxide. X is a powerful cautery and breaks down the proteins of skin flesh to a pasty mass. X and Y are

(A) NaOH, $AgNO_3$ **(B)** NaOH, $Zn(NO_3)_2$

(C) NaOH, $Al(NO_3)_3$ **(D)** $Ca(OH)_2$, $HgNO_3$

53. Bleaching action of bleaching powder is due to the liberation of :

(A) O_2 **(B)** OCl^- **(C)** Cl_2 **(D)** Cl^-

54. Sodium is heated in air at 300°C to form X.X absorbs CO_2 and forms Na_2CO_3 and Y? Which of the following is Y?

(A) H_2 **(B)** O_2 **(C)** H_2O_2 **(D)** O_3

55. Calcium cyanamide on treatment with steam under pressure gives NH_3 and

(A) Calcium carbonate **(B)** Calcium hydroxide

(C) Calcium oxide **(D)** Calcium bicarbonate

56. When standard solution of NaOH is left in air for few hours :

(A) A precipitate will be formed **(B)** The strength of the solution will increase

(C) The strength of the solution will decrease **(D)** The concentration of sodium ions will remain constant

57. Consider the following abbreviations for hydrated alkali ions.

$X = [Li(H_2O)_n]^+$ $Y = [K(H_2O)_n]^+$ $Z = [Cs(H_2O)_n]^+$

What is the correct order of size of these hydrated alkali ions ?

(A) X > Y > Z **(B)** Z > Y > X **(C)** X = Y = Z **(D)** Z > X > Y

58. Based on lattice energy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point ?

(A) RbCl **(B)** KCl **(C)** NaCl **(D)** LiCl

59. When a substance (A) reacts with water it produces a combustible gas (B) and a solution of a substance (C) in water. When another substance (D) reacts with this solution of (C), it also produces the same gas (B). (A) imparts a deep golden yellow colour to a smokeless flame of Bunsen burner. A, B, C, and D respectively are :

(A) $Na, H_2, NaOH$ and Zn **(B)** K, H_2, KOH and Al

(C) $Ca, H_2, Ca(OH)_2$ and Sn **(D)** $CaC_2, C_2H_2, Ca(OH)_2$ and Fe

60. In the following reaction : $NaOH + S \longrightarrow A + Na_2S + H_2O; A$ is :

(A) Na_2SO_4 **(B)** Na_2SO_3 **(C)** Na_2S **(D)** $Na_2S_2O_3$

61. Which property of $Na_2S_2O_3$ makes it useful in photography ?

(A) Photochemical property **(B)** Complex formation property
(C) Oxidizing agent **(D)** Reducing agent

62. Which sequence of reactions shows correct chemical relation between sodium and its compounds?

(A) $Na + O_2 \longrightarrow Na_2O \xrightarrow{HCl_{(aq)}} NaCl \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(B) $Na \xrightarrow{O_2} Na_2O \xrightarrow{H_2O} NaOH \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(C) $Na + H_2O \longrightarrow NaOH \xrightarrow{HCl} NaCl \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(D) $Na + H_2O \longrightarrow NaOH \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{HCl} \underset{(molten)}{NaCl} \xrightarrow{Electrolysis} Na + Cl_2$

63. Aqueous solution of $Na_2S_2O_3$ on reaction with Cl_2 gives :

(A) $Na_2S_4O_6$ **(B)** $NaHSO_4$ **(C)** NaCl **(D)** NaOH

64. One of the elements present in carnallite shows flame colouration. The colour of the flame is :

(A) orange **(B)** green **(C)** yellow **(D)** lilac

65. What are the products formed when an aqueous solution of magnesium bicarbonate is boiled ?

(A) MgO, H_2O, CO_2 **(B)** $Mg(HCO_3)_2, H_2O$
(C) $Mg(OH)_2, H_2O$ **(D)** Mg, CO_2, H_2O

66. When KI is added to acidified solution of sodium nitrite then :

(A) NO gas is liberated and I_2 is set free **(B)** N_2 gas is liberated and HI is produced
(C) N_2O gas is liberated and I_2 is set free **(D)** N_2 gas is liberated and HOI is produced

67. The ionic conductance is least for :

(A) Cs^+ **(B)** Rb^+ **(C)** K^+ **(D)** Na^+

Paragraph for Questions 68 - 70

All alkali metals dissolve in anhydrous liquid ammonia to give blue colour solution. It is the ammoniated electron which is responsible for the blue colour of the solution, and the electrical conductivity is due to the ammoniated cation, $[M(NH_3)_x]^+$ as well as the ammoniated electron, $[e(NH_3)_y]^-$, values of x and y depend on the extent of solvation by NH_3. Dilute solutions are paramagnetic due to free ammoniated electrons.

68. What happens if alkali metal is allowed to react with concentrated liquid ammonia?

(A) Paramagnetic character of solvated electrons is retained
(B) Solvated electrons associated to form electron-pairs and paramagnetic character decreases
(C) Reducing character is increased
(D) Reducing character is not affected

69. Which of the following statement about solution of alkali metals in liquid ammonia is correct ?

(A) The solution have strong oxidizing properties

(B) Both the dilute solution as well as conc. solution are equally paramagnetic in nature

(C) Charge transfer is responsible for the colour of the solution

(D) None of these

70. Ammoniated solutions of alkali metals are reducing agents due to the presence of free ammoniated or solvated electrons that can reduce

I. O_2 to O_2^{2-} **II.** $K_2[Ni(CN_4)]$ to $K_4[Ni(CN)_4]$

III. Aromatic ring **IV.** Non-terminal alkyne

Choose the correct code :

(A) III and IV **(B)** II and III **(C)** I, II, III and IV **(D)** I, III and IV

Paragraph for Questions 71 - 75

The thermal stability of the salts of the s-block elements is dependent upon three main factors. Firstly, the greater the charge of the ions involved, the stronger the interionic attraction and the more stable the salt. Also, the smaller the ions become in terms of their ionic radii the close they approach each other in the crystal lattice of their salts and the more stable the salt. Thirdly, if the ions in the lattice are of comparable size, the crystal lattice is arranged in a more uniform fashion and thus possesses greater thermal stability.

There is other factor that affects thermal stability. The larger the anions in the crystal become, for example CO_3^{2-}, unless the cation is of comparable size, the anions decompose on heating to give smaller anions such as O^{2-}. This point is especially important when considering the thermal stability of the carbonates, nitrates and hydroxides of the s-block elements.

71. Which groups of the periodic table comprise the s-block elements?

(A) Groups I, II and III **(B)** Groups I and III

(C) Groups, II and III **(D)** Groups I and II

72. Given that the CO_3^{2-} anion is approximately the same size as the early Group I cations, what would occur if Na_2CO_3 were heated?

(A) It would decompose to yield Na_2O.

(B) It would decompose to yield Na_2O and CO_2.

(C) It would decompose to yield $NaHCO_3$ and CO_2.

(D) No decomposition would occur

73. Comparing calcium oxide and magnesium oxide, which of the two would be more stable?

(A) Magnesium oxide would be more stable because the magnesium cation is smaller.

(B) Magnesium oxide would be more stable because magnesium has a lower atomic mass than calcium.

(C) Calcium oxide would be more stable because the calcium anion is smaller than the magnesium cation.

(D) Calcium oxide would be more stable because calcium has a greater atomic mass than magnesium.

74. The nitrates of the Group I elements decompose to give nitrite (NO_2^-) and not oxide although O^{2-} is smaller than NO_2^-. Why?

(A) Because only doubly charged anions like CO_3^{2-} decompose to the oxide.

(B) Because the double charge on the oxygen would make the salt less stable than a singly charged nitrite anion.

(C) Because the nitrite anion contains two oxygen atoms while the oxide anion contains only one.

(D) Because the nitrite anion is probably about the same size as the Group I cations

75. Li_2O is often considered to be covalent in nature because of the unusually high electronegativity of lithium. Which of the following would be a plausible Lewis dot structure for the compound?

(A) $Li-Li-\ddot{\underset{\cdot\cdot}{O}}$ **(B)** $Li-\ddot{\underset{\cdot\cdot}{O}}-Li$ **(C)** $Li=O=Li$ **(D)** $Li-\ddot{O}\rightarrow Li$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

76. Which one of the following reaction form gaseous product?

(A) $PbO_2 + H_2O_2 \longrightarrow$ **(B)** Acidified $KMnO_4 + H_2O_2 \longrightarrow$

(C) $PbS + H_2O_2 \longrightarrow$ **(D)** $Cl_2 + H_2O_2 \longrightarrow$

77. Which of the following statements is(are) **true** regarding saline hydrides?

(A) In the molten state they conduct electricity

(B) They dissolve in water giving off hydrogen

(C) They are used as reducing agents

(D) They are covalent in nature

78. Sodium sulphate is soluble in water but barium sulphate is insoluble because

(A) The hydration energy of Na_2SO_4 is more than its lattice energy

(B) The lattice energy of $BaSO_4$ is more than its hydration energy

(C) The lattice energy has no role to play in solubility

(D) The lattice energy of Na_2SO_4 is more than its hydration energy

79. When zeolite, which is hydrated sodium aluminium silicate, is treated with hard water, the sodium ions are exchanged with :

(A) H^+ ions **(B)** Ca^{2+} ions **(C)** SO_4^{2-} ions **(D)** Mg^{2+} ions

80. Which of the following is(are) **correct**?

(A) Mg burn in air releasing dazzling light rich in UV rays

(B) $CaCl_2.6H_2O$ when mixed with ice gives freezing mixture

(C) Mg cannot forms complexes

(D) Be can forms complexes due to its very small size

81 Which one of the following salts does impart a colour to the flame or the flame test is/are shown by :

(A) LiCl **(B)** KI **(C)** $MgCl_2$ **(D)** $CaCl_2$

82. Which one of the following is(are) false?

(A) NaOH is used in the concentration of bauxite ore

(B) NaOH is a primary standard in volumetric analysis

(C) Manganous hydroxide is soluble in excess of NaOH solution

(D) NaOH solution does not react with Cl_2

83. Which of the following illustrate the anamolous properties of Li?

(A) The melting and boiling points of Li are comparatively high

(B) Li is much softer than the other Group I metals

(C) Li forms nitride Li_3N unlike Group I metals

(D) The ion of Li and its compounds are more heavily hydrated than those of the rest of the group

84. Which of the following is/are **correct** ?

(A) In the Castner's process of sodium extraction, NaCl is used as an electrolyte.

(B) Sodium reduces CO_2 to carbon.

(C) Mg reacts with cold water and liberate hydrogen gas.

(D) Magnalium is an alloy of Mg and Al.

85. Which of the following statements is/are **correct** for alkali metal compounds ?

(A) Superoxides are paramagnetic in nature.

(B) The basic strength of hydroxides increases down the group.

(C) The conductivity of chlorides in their aqueous solutions increases down the group.

(D) The basic nature of carbonates in aqueous solutions is due to cationic hydrolysis.

86. Which of the following reactions liberate gaseous product?

(A) $AlCl_3 + NaOH \longrightarrow$ **(B)** $NaOH + P(white) + H_2O \longrightarrow$

(C) $Al + NaOH \xrightarrow{\Delta}$ **(D)** $Zn + NaOH \xrightarrow{\Delta}$

87. Which one of the following statements is not true for all the alkali metals?

(A) Their nitrates decompose on heating to give NO_2 and O_2.

(B) Their carbonates decompose on heating to give CO_2 and the metal oxide.

(C) They react with oxygen to give mainly the oxide M_2O.

(D) They react with nitrogen to give nitrides.

88. In which of the following reactions, MgO is formed?

(A) $Mg + CO_2 \longrightarrow$ **(B)** $Mg + dil.HNO_3 \longrightarrow$

(C) $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta}$ **(D)** $Mg + B_2O_3 \longrightarrow$

89. Which is(are) true in respect of beryllium chemistry?

(A) Beryllium is amphoteric **(B)** It forms unusual carbide Be_2C

(C) $Be(OH)_2$ is basic **(D)** Beryllium halides are electron deficient

90. In which of the following reactions, H_2O_2 is acting as an oxidizing agent?

(A) $SO_2 + H_2O_2 \longrightarrow H_2SO_4$ **(B)** $2KI + H_2O_2 \longrightarrow 2KOH + I_2$

(C) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$ **(D)** $Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$

91. Which of the following is/are correct regarding the electrolytic preparation of H_2O_2?

(A) Peroxodisulphuric acid is formed at anode. **(B)** 50% H_2SO_4 is used

(C) Hydrogen is liberated at anode **(D)** Sulphuric acid undergoes oxidation

92. Which of the following can exist in different conformeric form?

(A) C_2H_6 **(B)** H_2O_2 **(C)** N_2H_4 **(D)** B_2H_6

93. Which is/are true about H_2O_2?

(A) Acts as redox substance **(B)** Two O—H bonds lie in different plane

(C) Pale blue liquid **(D)** Can be oxidized by O_3

94. Which can be oxidized by H_2O_2 ?

(A) Na_2SO_3 **(B)** PbS **(C)** KI **(D)** O_3

95. Which one of the following processes will produce hard water?

(A) Saturation of water with $Ca(HCO_3)_2$ solution **(B)** Saturation of water with $MgCO_3$

(C) Saturation of water with $CaSO_4$ **(D)** Addition of Na_2SO_4 to water

96. Hydrogen can reduce :

(A) heated cupric acid **(B)** heated ferric oxide

(C) heated stannic oxide **(D)** heated aluminium oxide

97. Phosphine, acetylene and ammonia can be formed by treating water with

(A) Ca_3P_2, Al_4C_3, Li_3N **(B)** Ca_3P_2, CaC_2, Mg_3N_2

(C) $Ca_3P_2, CaC_2, CaCN_2$ **(D)** Ca_3P_2, Mg_2C, NH_4NO_3

98. Which of the following pairs of substances would give same gaseous product on reaction with water?

(A) Na and Na_2O_2 **(B)** Ca and CaH_2 **(C)** Ca and CaO **(D)** Mg_3N_2 and $NaNH_2$

99. Which of the following exists in polymeric form?

(A) $AlCl_3$ **(B)** $BeCl_2$ **(C)** BeH_2 **(D)** LiH

100. The property of hydrogen which resembles with alkali metals is(are) :

(A) Its electropositive character **(B)** Its affinity for non metal

(C) Its reducing character **(D)** Electronic configuration

101 The alkali metals :

(A) Form salt like hydrides. **(B)** Form salts which are predominantly ionic.

(C) Show increased chemical reactivity with dry oxygen in going from Li to Cs.

(D) Show increasing metallic nature from Li to Cs.

102. The compound(s) soluble in acetic acid is(are) :

(A) Calcium oxide **(B)** Calcium carbonate **(C)** Calcium oxalate **(D)** Calcium hydroxide

103. A combustible gas is liberated when caustic soda solution is heated with :

(A) S **(B)** NH_4Cl **(C)** Al **(D)** Zn

104. A metal is burnt in air and the ash on moistening smells of ammonia. The metal is(are) :

(A) Na **(B)** Li **(C)** Mg **(D)** Al

105. In Down's method for the extraction of sodium, the melting point of the electrolyte is lowered by adding

(A) potassium chloride **(B)** calcium chloride

(C) potassium fluoride **(D)** potassium fluoride and sodium carbonate

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

106. MATCH THE FOLLOWING :

Column 1 (Prop. of metals)		**Column 2** (Metals)	
(A)	Imparts colouration to flame	**(p)**	Ca
(B)	Most reactive (in aqueous solution)	**(q)**	Mg
(C)	Gives carbide when heated with 'C'	**(r)**	Na
(D)	Metal nitrate $\xrightarrow{\Delta}$ metal oxide $+NO_2 + O_2$	**(s)**	Li

107. MATCH THE FOLLOWING :

Column 1 (Chemical Prop.)		**Column 2** (Metals)	
(A)	Metal sulphate $\xrightarrow{\Delta}$ metal oxide $+SO_2 + O_2$	**(p)**	Ba
(B)	Metal cation $+K_2CrO_4 \longrightarrow$ yellow ppt.	**(q)**	Sr
(C)	Metal $+NH_{3(l)} \longrightarrow$ blue solution	**(r)**	Na
(D)	MCl_2 + conc. $H_2SO_4 \longrightarrow$ white ppt.	**(s)**	Mg

108. MATCH THE FOLLOWING :

Column 1 (Chemical eq. related to compounds)		**Column 2** (Compound in excess amount)	
(A)	$S \longrightarrow S_2O_3^{2-} + S^{2-}$	**(p)**	$Na_2S_2O_3$
(B)	Ag^+ salt $\longrightarrow$ soluble compound	**(q)**	NaOH
(C)	$Fe^{3+} \longrightarrow$ precipitate	**(r)**	Na_2S
(D)	$FeCl_3 \longrightarrow FeCl_2$	**(s)**	Na_2SO_3

109. MATCH THE FOLLOWING : .

Column 1		**Column 2**	
(A)	Complex formation	**(p)**	Be
(B)	Formation of covalent compounds	**(q)**	Mg
(C)	High solubility of salts	**(r)**	Ca
(D)	Explosive reaction with acids	**(s)**	Sr

110. MATCH THE FOLLOWING :

Column 1 (Hydride)		Column 2 (Type of hydride)	
(A)	BeH_2	**(p)**	Complex
(B)	AsH_3	**(q)**	Lewis acid
(C)	B_2H_6	**(r)**	Covalent
(D)	$LiAlH_4$	**(s)**	Polymeric
		(t)	Ionic

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

111. 0.789 g of crystalline barium hydroxide is dissolved in water. For the neutralization of this solution, 20 ml of $\frac{N}{4}HNO_3$ is required. How many molecules of water are present in one g mole of this base.

112. How many mole of H_2O molecules are formed on heating one mole of $MgCl_2 \cdot 6H_2O$ to make it anhydrous?

113. Trona, a natural hydrated mixed carbonate and bicarbonate of sodium is found in nature. In one molecule, how many sodium bicarbonate molecules are present?

114. Alkali metals are paramagnetic but their ions are diamagnetic. Decide how many of the following are paramagnetic due to the presence of unpaired electrons in anion?

$Na_2O_2, KO_2, K_2Cr_2O_7, K_2MnO_4, KMnO_4, NaNO_2, NaHCO_3$

115. How many of the following compounds of s-block elements are used as bleaching agent?

$NaOH, Na_2O_2, NaOCl, CaOCl_2, KNO_2, Na_2S_2O_3, NaCN, Na_2SO_4, KO_2$

116. How many of the following can show flame test?

Caustic potash, Glauber's salt, Alum, Microcosmic salt, Hypo, Rock salt, Washing soda, Epsom salt, Carnallite, Lime stome.

117. How many of the following on heating evolve an acidic gaseous substance?

$LiNO_3, NaNO_3, Mg(NO_3)_2, CaCO_3, NaHCO_3, MgCl_2 \cdot 6H_2O, Na_2CO_3, Li_2CO_3.$

118. Consider the following sequential process.

$$Na_2CO_3 \xrightarrow{SO_2} (A) \xrightarrow{Na_2CO_3} (B) \xrightarrow[S]{\text{Elemental}} (C) \xrightarrow{Cl_2} (D).$$

What is numerical value of oxidation state of sulphur in (D)?

119. How many of the following chemical reagents imparts brick red colouration to the flame during flame test?

Lime stone, Dolomite, Carnallite, Bleaching powder, Alum, Gypsum, Rock salt, Hydrolith, Nitrolim.

120. How many of the following are double salts containing s-block element(s)?

Dolomite, Carnallite, Bleaching powder, Alum, Gypsum, Microcosmic salt.

121. Lime stone(X) $\xrightarrow{\Delta}$ Solid (A) + gas (B)

Other Binary Compound of Calcium(Y) $\xrightarrow{H_2O}$ Solution (C) + Gas (D)

Gas (B) turns solution (C) milky but does not react with $KMnO_4 / H^+$

Gas (D) produce white ppt. in Tollen's reagent and it also produce benzene when passed through red hot iron tube

The difference of oxidation state of same central atom in (B) & (D) is :

122. Number of non-radioactive alkali metals forming superoxide as major product on heating with excess $O_2 = x$

Number of II-A metals of periodic table whose hydrated halides suffer hydrolysis on heating = y

Number of non radio active alkali metals which dissolve in liquid ammonia and produce blue colour solution = u

The value of (x + y – u) would be ……

Advanced Problem Package	p-Block Elements-I

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. $AlCl_3$ fumes in moist air because :

(A) It is very volatile **(B)** It is covalent

(C) HCl is formed in moist air **(D)** It is highly hygroscopic

2. $AlCl_3$ exist as dimer because :

(A) Al has greater ionization potential **(B)** Al has larger radius

(C) High nuclear charge **(D)** Incomplete octet

3. Reactivity of Borazole is greater than of Benzene because :

(A) Borazole is nonpolar compound **(B)** Borazole is polar compound

(C) Borazole is electron deficient compound **(D)** Of localized electrons in borazole

4. Which of the following statements is **correct**?

(A) BCl_3 and $AlCl_3$ are both Lewis acids and BCl_3 is stronger than $AlCl_3$

(B) BCl_3 and $AlCl_3$ are both Lewis acids and $AlCl_3$ is stronger than BCl_3

(C) BCl_3 and $AlCl_3$ are both equally strong Lewis acids

(D) Both BCl_3 and $AlCl_3$ are not Lewis acids.

5. Which of the following is a **correct** statement?

(A) The hydroxide of aluminium is more acidic than that of boron.

(B) The hydroxide of boron is basic, while that of aluminium is amphoteric.

(C) The hydroxide of boron is acidic, while that of aluminium is amphoteric.

(D) The hydroxide of aluminium and boron are amphoteric.

6. In diborane B_2H_6 :

(A) 4 bridge hydrogens and two terminal hydrogens are present

(B) 2 bridged hydrogens and four terminal hydrogens are present

(C) 3 bridged and three terminal hydrogen are present

(D) None of these

7. The type of hybridization of boron in diborane is :

(A) sp-hybridization **(B)** sp^2 - hybridization

(C) sp^3 - hybridization **(D)** sp^3d^2 - hybridization

8. In graphite electrons are :

(A) Localized on every third carbon atom **(B)** Present in antibonding orbitals

(C) Localized on each carbon atom **(D)** Spread out between the structure

9. Which of the following combines with haemoglobin of the blood to form carboxyhaemoglobin?

(A) CO **(B)** CO_2 **(C)** $COCl_2$ **(D)** PbO

10. The ability of a substance to assume two or more crystalline structures is called :

(A) Isomerism **(B)** Polymorphism **(C)** Isomorphism **(D)** Amorphism

11. Which of the following is a tetrabasic acid?

(A) Orthophosphoric acid **(B)** Hypophosporic acid

(C) Metaphosphoric acid **(D)** Pyrophosphoric acid

12. In P_4O_6 the number of oxygen atoms bonded to each phosphorus atom is :

(A) 1.5 **(B)** 2 **(C)** 3 **(D)** 4

13. Nitric acid on standing becomes brownish in colour which may be attributed to the presence of :

(A) NO_2^+ ion **(B)** NO_3^- ion **(C)** NO_2 **(D)** HNO_2

14. Group 15 of the periodic table consists of the elements N, P, As, Sb and Bi. On passing from N to Bi the oxides of the elements of general formula M_2O_3 become :

(A) Stronger reducing agents **(B)** More ionic

(C) More basic **(D)** More volatile

15. The basic character of hydrides of the V(15) group elements decreases in the order:

(A) $SbH_3 > PH_3 > AsH_3 > NH_3$ **(B)** $NH_3 > SbH_3 > PH_3 > AsH_3$

(C) $NH_3 > PH_3 > AsH_3 > SbH_3$ **(D)** $SbH_3 > AsH_3 > PH_3 > NH_3$

16. Which of the following species has the highest dipole moment?

(A) NH_3 **(B)** PH_3 **(C)** AsH_3 **(D)** SbH_3

17. Which of the following is isoelectronic as well as has same structure as that of N_2O?

(A) N_3H **(B)** H_2O **(C)** NO_2 **(D)** CO_2

18. The compound having lowest boiling point is

(A) NH_3 **(B)** PH_3 **(C)** AsH_3 **(D)** SbH_3

19. Which of the following bonds will be the most polar?

(A) N–Cl **(B)** O–F **(C)** N–F **(D)** N–N

20. Which of the following is in the increasing order of the ionic character?

(A) $PbCl_4 < PbCl_2 < CaCl_2 < NaCl$ **(B)** $PbCl_2 < PbCl_4 < CaCl_2 < NaCl$

(C) $PbCl_2 < PbCl_4 < NaCl < CaCl_2$ **(D)** $PbCl_4 < PbCl_2 < NaCl < CaCl_2$

21. Pure nitrogen gas is obtained from :

(A) $NH_3 + NaNO_2$ **(B)** $NH_4Cl + NaNO_2$

(C) $N_2O + Cu$ **(D)** $(NH_4)_2Cr_2O_7$

22. Which of the following evolve hydrogen on reacting with cold dilute nitric acid?

(A) Mg **(B)** Al **(C)** Fe **(D)** Cu

23. Which of the following is manufactured from the molecular nitrogen by bacteria?

(A) Nitrates **(B)** Nitrites **(C)** Amino acids **(D)** Ammonia

24. The correct order of the decreasing oxidizing powers of ClO_4^-, BrO_4^-, IO_4^- is :

(A) $ClO_4^- > BrO_4^- > IO_4^-$ **(B)** $BrO_4^- > ClO_4^- > IO_4^-$

(C) $IO_4^- > BrO_4^- > ClO_4^-$ **(D)** $IO_4^- > ClO_4^- > BrO_4^-$

25. When air is passed over red-hot coke, the outgoing gas contains:
(A) Producer gas **(B)** Water gas **(C)** Coal gas **(D)** Oil gas

26. P_4O_{10} is treated with water to give :
(A) Hypophophorus acid **(B)** Ortho phosphorus acid
(C) Hypophophoric acid **(D)** Ortho phosphoric acid

27. $PH_4I + NaOH$ on reaction forms :
(A) PH_3 **(B)** NH_3 **(C)** P_4O_6 **(D)** P_4O_{10}

28. The most stable allotropic form of phosphorus is :
(A) Yellow P **(B)** Red P **(C)** White P **(D)** Black P

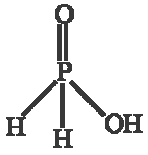
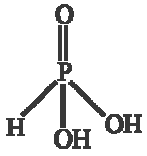
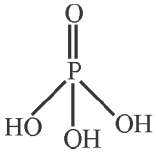
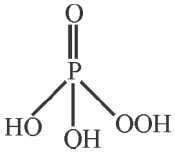
29. Orthoboric acid on strong heating to red hot gives :
(A) Metaboric acid **(B)** Borax **(C)** Boron trioxide **(D)** Tetraboric acid

30. In Borax bead test for quantitative analysis which component of the bead reacts with basic radical to form metaborate?
(A) $NaBO_3$ **(B)** B_2O_3 **(C)** $Na_2B_4O_7$ **(D)** $Na_2B_4O_7.10H_2O$

31. Ultrapure silicon is prepared by :
(A) Fractional distillation **(B)** Zone-refining
(C) Crystallization **(D)** None of the above

32. White phosphorus reacts with caustic soda. The products are PH_3 and NaH_2PO_2. This reaction is an example of :
(A) Oxidation **(B)** Reduction
(C) Reduction and oxidation **(D)** Neutralization

33. Sodium tripolyphosphate used in industrial detergent and softening of water is obtained by the hydrolysis of :
(A) Sodium dihydrogen phosphate **(B)** Triphosphate
(C) Orthophosphate **(D)** None of the above

34. The structural formula of Hypophosphorus acid is :
(A)  **(B)**  **(C)**  **(D)** 

35. Which of the following reaction does **NOT** give H_3PO_4 ?
(A) $Ca_3(PO_4)_2 + H_2SO_4 \longrightarrow$ **(B)** $P_4O_6 + H_2O \longrightarrow$
(C) $PCl_5 + H_2O \longrightarrow$ **(D)** $P_4S_{10} + H_2O \longrightarrow$

36. In the thermite process, iron oxide is reduced to molten iron by aluminium powder because :
(A) The melting point of iron is low **(B)** The reaction is highly endothermic
(C) Large amount of heat is liberated in the formation of Al_2O_3
(D) Aluminium is an amphoteric element

37. Egyptian blue $CaCuSi_4O_{10}$ is an example of :
(A) Sheet silicate **(B)** cylic silicate **(C)** Pyrosilicate **(D)** Chain silicate

38. Calgon used for water softening is $Na_2[Na_4(PO_3)_6]$ and it is prepared by heating microcosmic salt. The microcosmic salt is :

(A) Na_2HPO_3 **(B)** NaH_2PO_4 **(C)** $Na_2HPO_4.4H_2O$ **(D)** $Na(NH_4)HPO_4.4H_2O$

39. Which one of the following is an electron-deficient molecule according to the octet rule?

(A) CH_4 **(B)** $H_3N:BH_3$ **(C)** AlH_3 **(D)** GeH_4

40. In the structure of $B_4O_5(OH)_4^{2-}$:

(A) All four B atoms are trigonal planar

(B) One B atom is tetrahedral and the other three are trigonal planar

(C) Three B atoms are tetrahedral and one is trigonal planar

(D) Two B atoms are tetrahedral and the other two are trigonal planar

41. Hydrolysis of $(CH_3)_2SiCl_2$ and CH_3SiCl_3 leads to :

(A) Linear chain and cross-linked silicones, respectively

(B) Cross-linked and linear chain silicones, respectively

(C) Linear chain silicones only

(D) Cross-linked silicones only

42. Fluorine is more electronegative than either boron or phosphorus. What conclusion can be drawn from the fact that BF_3 has no dipole moment but PF_3 does?

(A) BF_3 is not spherically symmetrical, PF_3 is spherically symmetrical.

(B) BF_3 molecule must be linear.

(C) The atomic radius of P is larger than the atomic radius of B.

(D) The BF_3 molecule must be planar triangular.

43. The bonds present in borazole are :

(A) $12\sigma, 3\pi$ **(B)** $9\sigma, 6\pi$ **(C)** $6\sigma, 6\pi$ **(D)** $9\sigma, 9\pi$

44. From B_2H_6 all the following can be prepared except :

(A) B_2O_3 **(B)** H_3BO_3 **(C)** $B_2(CH_3)_6$ **(D)** $NaBH_4$

45. Which compound has more Lewis acid character?

(A) Al_2Cl_6 **(B)** Al_2Me_6 **(C)** $AlCl_3 \cdot 6H_2O$ **(D)** None of these

For Questions 46 - 48

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 is a not a correct explanation for Statement-1

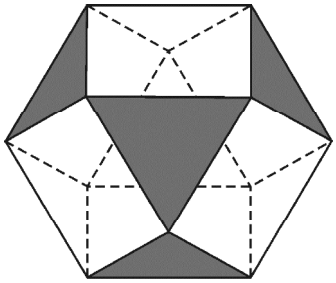
(C) Statement-1 is True, Statement-2 is False **(D)** Statement-1 is False, Statement-2 is True

46. **Statement-1 :** Boric acid acts as a strong acid in the presence of a cis-diol.
Statement-2 : A cis-diol forms hydrogen bonding with oxygen of boric acid.

47. **Statement-1 :** White phosphorus is a reactive allotrope of phosphorus.
Statement-2 : White phosphorus exists as monatomic solid.

48. **Statement-1 :** Pyrophosphoric acid $(H_4P_2O_7)$ is a reducing tetrabasic acid.
Statement-2 : The reducing property of acids of phosphorus is due to hydrogen atom attached to phosphorus atom.

Paragraph for Questions 49 - 51


Cuboctahedron

Phosphorus exists as a number of allotropes, the most reactive being white phosphorus. This was first prepared from the reduction of the phosphate present in urine.

Solid white phosphorus contain P_4 molecules, with each P atom at the vertex of a regular tetrahedron. White phosphorus spontaneously ignites in air to form a mixture of phosphorus (III) oxide and phosphorus (V) oxide.

The structure of each oxide is also based on a regular tetrahedron. The phosphorus atoms remain at the vertices but are no longer bounded to each other. Instead the P atoms are joined by bridging oxygens.

Phosphorus (V) oxide has a further oxygen atom bounded to each phosphorus atom at the vertex of the tetrahedron.

Each oxide reacts with water to form an acid. Phosphorus (V) oxides forms phosphorus (V) acid, H_3PO_4.

A quantitative method for determining phosphate levels in aqueous solution involves adding ammonium molybdate, $(NH_4)_2MoO_4$, to form a precipitate of ammonium molybdophosphate. The structure of this solid is based on a cuboctahedron (shown in figure). A molybdenum atom lies at each vertex of the cuboctahedron and these are joined by oxygen atoms with every edge of the cuboctahedron being bridged by an oxygen atom. A further oxygen atom is joined to every vertex. A single phosphate unit lies at the centre of the structure with each of its four oxygen atoms coordinating to three molybdenum atoms.

49. The **incorrect** statement about structure of white phosphorus is :

(A) It has six P—P single bonds. **(B)** It has four P—P single bonds.

(C) It has four lone pairs of electrons. **(D)** It has PPP angle of 60°

50. Which statement is **wrong** about structure of phosphorus (V) oxide?

(A) It has 6 P—O—P bonds. **(B)** Each 'P' atom is sp^3 hybridised.

(C) It has two types of P—O bond lengths **(D)** It has POP angle of 180°

51. The number of molybdenum atoms and oxygen atoms in the molybdophosphate ion respectively, are :

(A) 9, 15 **(B)** 12, 40 **(C)** 12, 36 **(D)** 12, 24

Paragraph for Questions 52 - 54

Nitric acid acts as an oxidizing agent especially in concentrated solution. In solution more dilute then 2M the oxidizing power of nitrate group is greatly diminished and only the protons of dissociated acid reacts with the active metals. This behaviors should not be too surprising since the power of NO_3^- ion as an oxidant is very sensitive to the concentration of acid. During oxidation HNO_3 is reduced successively as $HNO_3 \rightarrow NO_2 \rightarrow HNO_2 \rightarrow NO \rightarrow N_2O \rightarrow N_2 \rightarrow NH_2OH \rightarrow NH_3$.

52. When FeS is dissolved in conc. HNO_3 than the oxidation product obtained is/are :

(A) H_2S and $Fe(NO_3)_3$ **(B)** $FeSO_4$

(C) $Fe_2(SO_4)_3$ **(D)** only H_2S

53. When Sn metal is treated with dilute nitric acid then the products obtained are :

(A) $Sn(NO_3)_4$ and NO_2 **(B)** $Sn(NO_3)_2$ and NO_2

(C) $Sn(NO_3)_2$ and NH_4NO_3 **(D)** $Sn(NO_3)_2$ and NO

54. Which of the following metal becomes passive on treatment with nitric acid?

(A) Cr **(B)** Mg **(C)** Mn **(D)** Pb

Paragraph for Questions 55 - 58

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of NH_3 and PH_3. Phosphine is a flammable gas and is prepared from white phosphorus.

55. Among the following, the correct statements is :

(A) Phosphates have no biological significance in humans

(B) Between nitrates and phosphates, phosphates are less abundant in earth's crust

(C) Between nitrate and phosphates, nitrates are less abundant in earth's crust

(D) Oxidation of nitrates is possible in soil

56. Among the following, the correct statement is :

(A) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional

(B) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional

(C) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional

(D) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electron occupies spherical 's' orbital and is less directional

57. White phosphorus on reaction with NaOH give PH_3 as one of the products. This is a :

(A) Dimerization reaction **(B)** Disproportionation reaction

(C) Condensation reaction **(D)** Precipitation reaction

58. Which of the following is **correct**?

(A) Bond angle in NH_3 is 109.5º **(B)** Bond angle in NH_3 is 107º

(C) Bond angle in NH_3 is 120º **(D)** None of these

Paragraph for Questions 59 - 61

It is well known that there are two major forms of carbon, that is, carbon has two main allotropes: graphite and diamond. These differ greatly from each other with respect to the physical properties as shown in table. The physical properties of silicon are also shown in Table 1 for comparison as carbon and silicon belong to the same group in the periodic table.

Physical properties	Graphite	Diamond	Silicon
Density (g cm^{-3})	2.26	3.51	2.33
Enthalpy of combustion to yield CO_2 (kJ/mol)	–393.3	–395.3	–910
Melting point (ºC)	2820	3730	1410
Boiling point (ºC)		4830	2680
Conductivity (electrical)	Fairly good	Non-conductor	Good
Conductivity (thermal)	Good	Fairly good	Good

Graphite possesses what is commonly known as a layer structure: carbon atoms from three covalent bonds with each other. These layers are held together via weak Van der Waals' forces which permit some movement of the layers relative to one another.

The most common compound of carbon is carbon dioxide which makes up 0.03% of the atmosphere. The triple point of carbon dioxide occurs at 217 K and 515 kP_a. One of the unique properties of carbon is that it can form multiple bonds between itself and other atoms, including other atoms. Thus, large polymers involving carbon atoms are possible.

59. It is possible to convert graphite into diamond via various chemical processes. Based on the information in the passage, which of the following would facilitate increased amounts of diamond assuming that the system is in equilibrium?

(A) High pressures **(B)** High temperatures
(C) A catalyst **(D)** Through set of chemical reactions

60. The properties of the layer-like structure of solid graphite stated in the passage would lend it to which of the following industrial uses?

(A) Insulator **(B)** Structural **(C)** Corrosive **(D)** Lubricant

61. Using the information in the table, calculate the enthalpy change for the following process : $C_{graphite} \longrightarrow C_{diamond}$

(A) +1.8 kJ mol^{-1} **(B)** –1.8 kJ mol^{-1} **(C)** +1.0 kJ mol^{-1} **(D)** –1.0 kJ mol^{-1}

Paragraph for Questions 62 - 64

Borates and silicates are having similarity in their various forms where they exist as ortho, pyro, chain & sheet types. Orthobrates (BO_3^{3-}) have trigonal planar shape while orthosilicates (SiO_4^{4-}) have a tetrahedral shape.

62. Borax ($Na_2B_4O_7.10H_2O$) has :

(A) 2 triangular units **(B)** 2 tetrahedral units **(C)** four –OH units **(D)** All of these

63. Pyroborates have :

(A) No corner shared **(B)** One corner shared
(C) Two corners shared **(D)** A linear chain structure

64. The chain silicates have the general formula :

(A) $(SiO_3)_n^{2n-}$ **(B)** $Si_2O_7^{6-}$ **(C)** $(Si_2O_5)_n^{2n-}$ **(D)** $(Si_4O_{11})_n^{6n-}$

Paragraph for Questions 65 - 67

In addition to the two most common oxides carbon monoxide and carbon dioxide a few other compounds may be formed containing carbon and oxygen only. Each oxide may be prepared by the dehydration of the appropriate acid.

Carbon dioxide may be prepared by simply protonating the carbonate salt to yield unstable carbonic acid, which readily loses water to form carbon dioxide.

Carbon monoxide may be prepared by dehydrating methanoic acid with concentrated sulfuric acid at about 140°C.

Diiodine pentoxide I_2O_5, is a white crystalline powder that has the useful property of reacting quantitatively with carbon monoxide to yield iodine and one other product. 'Carbon suboxide' is a foul–smelling gas obtained by fully dehydrating propane–1, 3–dioic acid.

A fourth oxide of carbon has the formula $C_{12}O_9$ and may be obtained by fully dehydrating mellitic acid [benzene hexacarboxylic acid $-C_6(COOH)_6$].

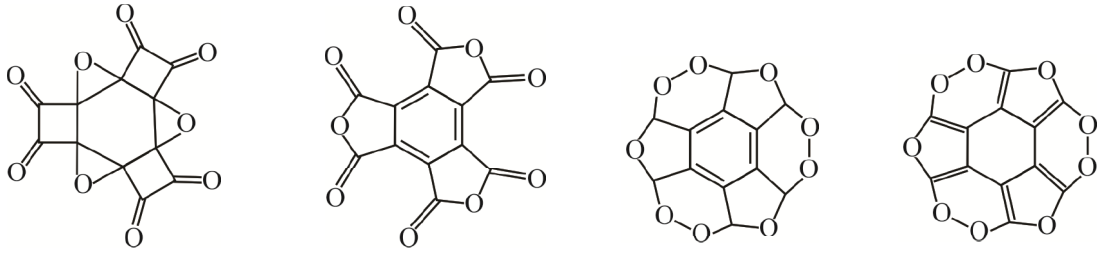
65. A 150 cm^3 sample of gas (at room temperature and pressure, r.t.p.) that was known to contain carbon monoxide was heated over excess I_2O_5 at 170°C. The iodine generated required exactly 8.00 cm^3 of 0.100 mol dm^{-3} sodium thiosulfate solution to react with it. The percentage by volume of carbon monoxide present in the sample of gas is (assume 1 mole of any gas occupies 24.0 dm^3 at r.t.p.) :

(A) 42% **(B)** 32% **(C)** 24% **(D)** 64%

66. Which of the following formulation represents the correct ground state Lewis structure for carbon suboxide?

(A) $:\ddot{O}:C:C:C::\ddot{O}:$ **(B)** $:\ddot{O}::C:C:C::\ddot{O}:$ **(C)** $:\ddot{O}::C::C:\,:C::\ddot{O}:$ **(D)** $:\ddot{O}:C:C{:}C:\ddot{O}:$

67. The structural formula of $C_{12}O_9$ is :



(A) **(B)** **(C)** **(D)**

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

68. Among the following the correct statement(s) is/are

(A) Diamond and graphite are two allotropes of carbon.

(B) Graphite shows high electrical conductivity in one direction only.

(C) Density of diamond is more than the density of graphite.

(D) Graphite has higher C–C bond order than diamond.

69. Which of the following reaction will give anhydrous $AlCl_3$?

(A) By heating $AlCl_3.6H_2O$

(B) By passing dry HCl on heated aluminium powder

(C) By passing dry chlorine on heated aluminium powder

(D) By passing dry chlorine over heated mixture of aluminium and coke

70. A gas which cannot be collected over water is :

(A) N_2 **(B)** O_2 **(C)** SO_3 **(D)** PH_3

71. Which one of the following statement is/are correct :

(A) Ammonia is more poisonous than phosphine **(B)** Ammonia is more basic than phosphine

(C) Ammonia is more stable than phosphine **(D)** Ammonia is more soluble in water than phosphine

72. Which of the following is/are correctly matched?

(A) Trona : $Na_3(CO_3)(HCO_3).2H_2O$ **(B)** Borax : $Na_2[B_4O_5(OH)_4].8H_2O$

(C) Graham's salt : $Na_2[Na_4(PO_3)_6]$ **(D)** Alum : $[K(H_2O)_6]_2SO_4.[Al(H_2O)_6]_2(SO_4)_3$

73. In which of the following reaction HNO_3 behave as a base?

(A) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$ **(B)** $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$

(C) $HNO_3 + H_2SO_4 \longrightarrow NO_2^+ + HSO_4^- + H_2O$ **(D)** None of these

74. Which of the following ionic compounds when dissolves in water, it reacts to make two moles of H_3O^+ per mole of compound?

(A) $NO_2^+BF_4^-$ **(B)** $NO_2^+NO_3^-$ **(C)** $NO_2^+ClO_4^-$ **(D)** $NH_4^+NO_3^-$

75. Which of the following compound reacts with nitrobenzene to give m-dinitrobenzene?

(A) $NO_2BF_{4(s)}$ **(B)** $NO_2ClO_{4(s)}$ **(C)** $N_2O_{5(s)}$ **(D)** $HNO_3 \& H_2SO_4$

76. A colourless, gaseous, paramagnetic nitrogen oxide (A), is allowed to react with excess O_2 and the mixture passed through a trap at –120ºC, in which condenses a colourless solid (B). Identify compounds (A) and (B).

(A) NO and NO_2 respectively **(B)** NO and N_2O_4 respectively

(C) NO and N_2O_3 respectively **(D)** NO_2 and N_2O_4 respectively

77. Which of the following oxides of nitrogen is responsible for photochemical degradation of ozone?

(A) N_2O **(B)** NO **(C)** NO_2 **(D)** None of these

78. A colourless, diamagnetic solid nitrogen oxide (X) reacts with F_2 to form a colourless gas (Y). Compound (Y) reacts with gaseous boron trifluoride to form a colourless solid (Z). When compound (Z) is dissolved in water, it reacts to make two moles of H_3O^+ per mole of (Z). Ideantify compound (X), (Y) and (Z).

(A) $X = NO_2$; $Y = NO_2F$; $Z = NO_2^+BF_4^-$ **(B)** $X = N_2O_4$; $Y = NO_2F$; $Z = NO_2^+BF_4^-$

(C) $X = NO$; $Y = N_2F_4$; $Z = F_3N^+ – BF_3^-$ **(D)** $X = N_2O_5$; $Y = NF_3$; $Z = F_3N^+ – BF_3^-$

79. Which of the following is due to H-bonding?

(A) H_3PO_4 is a syrupy liquid **(B)** Boiling point of H_2O is more than HF

(C) Boiling point of PH_3 is less than NH_3. **(D)** None of these

80. Which of the following hydride of nitrogen is/are acidic in nature?

(A) NH_3 **(B)** N_2H_4 **(C)** N_3H **(D)** NH_2OH

81. In which of the following reaction $POCl_3$ is formed?

(A) $PCl_5 + CH_3COOH \longrightarrow$ **(B)** $PCl_5 + H_2SO_4 \longrightarrow$

(C) $PCl_5 + P_4O_{10} \longrightarrow$ **(D)** $PCl_5 + SO_2 \longrightarrow$

82. In which of the silicate there is Si—O—Si linkage.

(A) Orthosilicates **(B)** Pyrosilicates **(C)** Ring silicates **(D)** Chain silicates

83. Which of the following is correct regarding N_2O?

(A) It is called laughing gas **(B)** It support combustion

(C) It is used as propellant gas in whipped cream **(D)** It is isoelectronic with CO_2

84. Which of the following reaction is used for preparation of N_2O ?

(A) $NH_4NO_3 \xrightarrow{\Delta}$ **(B)** $NO + SO_2 + H_2O \xrightarrow{\Delta}$

(C) $Zn + HNO_3(dil) \longrightarrow$ **(D)** $NH_2OH + HCl + NaNO_2 \longrightarrow$

85. On the basis of molecular orbital theory which of the following is/are paramagnetic?

(A) B_2 (vapour) **(B)** C_2 (vapour) **(C)** S_2 (vapour) **(D)** O_2

86. Which of the following is/are **correct**?

(A) Graphite is thermodynamically most stable allotropic form of carbon.

(B) Black phosphorous is thermodynamically most stable allotropic form of phosphorous.

(C) Rhombic sulphur is thermodynamically most stable allotropic form of sulphur.

(D) White tin is stable at high temperature.

87. Ammonium compound which on heating give NH_3 is/are

(A) $(NH_4)SO_4$ **(B)** $(NH_4)_2CO_3$ **(C)** NH_4NO_2 **(D)** NH_4Cl

88. With respect to graphite and diamond, which of the following statement(s) given below is/are **correct**?

(A) Graphite is softer than diamond

(B) Graphite has layer structure while diamond is a network solid.

(C) Graphite has sp^2 hybridized carbon atoms

(D) Diamond has sp^3 hybridized carbon atoms

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

89. **MATCH THE COLUMN :**

	Column 1 (Mixtures)		**Column 2 (Solution used for separation)**
(A)	N_2 and CO	**(p)**	Water
(B)	N_2 and O_2	**(q)**	H_2SO_4
(C)	N_2 and NH_3	**(r)**	Ammonical Cu_2Cl_2
(D)	PH_3 and NH_3	**(s)**	Pyrogallol

90. **MATCH THE COLUMN :**

	Column 1 (Reaction of Metal with HNO_3)		**Column 2 (Main product)**
(A)	Mg + very dil. HNO_3	**(p)**	NO
(B)	Zn + dil. HNO_3	**(q)**	H_2
(C)	Sn + dil. HNO_3	**(r)**	N_2O
(D)	Pb + dil. HNO_3	**(s)**	NH_4NO_3

91. MATCH THE COLUMN :

	Column 1		Column 2
(A)	Hypo phosphoric acid	**(p)**	All hydrogen are ionizable in water
(B)	Pyro phosphoric acid	**(q)**	Lewis acid
(C)	Boric acid	**(r)**	Monobasic in water
(D)	Hypo phosphorus acid	**(s)**	sp^3 hybridized central atom
		(t)	Reducing agent

92. MATCH THE COLUMN :

	Column 1		Column 2
(A)	CO_2	**(p)**	Acidic oxide
(B)	SO_2	**(q)**	Colourless
(C)	NO_2	**(r)**	Paramagnetic
(D)	N_2O	**(s)**	Coloured

93. MATCH THE COLUMN :

	Column 1		Column 2
(A)	$Na_2B_4O_7.10H_2O$	**(p)**	Basic solution
(B)	Na_2CO_3	**(q)**	Acidic solution
(C)	$K_2SO_4.Al_2(SO_4)_3.24H_2O$	**(r)**	Can react with NaOH
(D)	NH_4Cl	**(s)**	Swells up on heating

94. MATCH THE COLUMN :

	Column 1		Column 2
(A)	$B(OH)_3$	**(p)**	Acidic
(B)	$Al(OH)_3$	**(q)**	Amphoteric
(C)	$Ga(OH)_3$	**(r)**	Insoluble in water
(D)	$Tl(OH)_3$	**(s)**	Basic

95. MATCH THE COLUMN :

	Column 1		Column 2
(A)	Orthosilicate	**(p)**	Co-ordination number of Si is four
(B)	Pyrosilicate	**(q)**	One or more oxygen atoms are shared
(C)	Single chain silicate	**(r)**	SiO_4^{4-}
(D)	Ring silicate	**(s)**	$Si_2O_7^{6-}$
		(t)	$(SiO_3^{2-})_n$

96. **MATCH THE COLUMN :**

	Column 1 (Reagent)		**Column 2 Reaction)**
(A)	O_3	**(p)**	$SnCl_2 \rightarrow SnCl_4$
(B)	H_2O_2	**(q)**	$\text{Arsenite} \rightarrow \text{Arsenate}$
(C)	HNO_3	**(r)**	$PbS \rightarrow PbSO_4$
(D)	H_3PO_3	**(s)**	$MnO_4^- \rightarrow Mn^{2+}$
		(t)	$AgNO_3 \longrightarrow Ag$

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

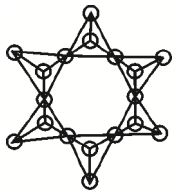
97. The number of $R_2Si(OH)_2$ units required to prepare a linear silicone polymer containing eight Si–O–Si linkages, is _____.

98. Asbestos $\left[CaMg_3O(Si_4O_{11})\right]$ is an example of "amphiboles", which is a special type of chain silicates in which two strands are cross-linked. The magnitude of charge on silicate anion is_____.

99. How many of the following amines can be used for the symmetrical cleavage of diborane? $B_2H_6 + 2L \rightarrow 2BH_3 \leftarrow L$

CH_3NH_2, $(CH_3)_2NH$, $(C_2H_5)_3N$, $(CH_3)_3N$, $(C_2H_5)_2NH$, $C_2H_5NH_2$, C_5H_5N, $(i\text{-}Pr)_3N$, quinuclidine

100. The number of oxygen atoms in empirical formula of the silicate having structure as shown in figure, is....



101. How many of the following ammonium salts on dry heating evolve ammonia gas?

NH_4NO_3, NH_4NO_2, NH_4HS, NH_4Cl, NH_4COONH_2, $(NH_4)_2Cr_2O_7$, $(NH_4)_2CO_3$, $(NH_4)_2C_2O_4$, NH_4ClO_4

102. Each B–H–B bridge in B_2H_6 is formed by the sharing of *x* electrons. The numerical value of *x* is …… .

103. What is the number of free electrons present on each carbon atom in graphite?

104. In pyrophosphoric acid, $H_4P_2O_7$ number of $d\pi - p\pi$ bonds are _____.

105. The brown complex obtained in the detection of nitrate radical is formulated as $[Fe(H_2O)_5NO]SO_4$. What is the oxidation number of Fe in this complex.

106. How many moles of CO are obtained when one mole of potassium ferrocyanide is heated with conc. sulphuric acid?

107. The number of P–P bonds in a molecule of white phosphorus (P_4) are____.

108. Methylchlorosilanes, Me_nSiCl_{4-n}, can be hydrolysed to form a silicone Polymer. What should be the valve of n to obtained a cross linked polymer?

109. The number of π-bonds in $(B_3N_3H_6)$ borazine are _____.

110. The number of P–O–P bonds in cyclic trimeric metaphosphoric acid are _____.

111. What is the co-ordination number of aluminium in dimeric structure of anhydrous aluminium chloride?

112. Beryl, $Be_3Al_2Si_6O_{18}$ is a silicate. How many oxygen atom of structural unit SiO_4^{4-} are shared with neighboring unit in Beryl.

113. The number of acidic ionizable hydrogen atom(s) in acidic nitrogen hydride is (are) _____.

114. 0.01 mol of an ionic compound nitronium tetrafluoroborate dissolved in water and titrated with *x*M NaOH to a phenolphthalein end point, which requires 20 ml of the titrant. What is the numerical value of *x*.

115. What is the co-ordination number of silicon in silica (SiO_2)?

Advanced Problem Package	p-Block Elements - II

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is :
(A) Cl_2O **(B)** Cl_2O_7 **(C)** ClO_2 **(D)** Cl_2O_6

2. H_2S does not produce metallic sulphide with :
(A) $CdCl_2$ **(B)** $ZnCl_2$ **(C)** $COCl_2$ **(D)** $CuCl_2$

3. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with highest boiling point is :
(A) H_2O because of hydrogen bonding **(B)** H_2Te because of higher molecular weight
(C) H_2S because of hydrogen bonding **(D)** H_2Se because of lower molecular weight

4. Which of the following has greatest reducing power?
(A) HI **(B)** HBr **(C)** HCl **(D)** HF

5. As the atomic number of halogen increases, the halogens :
(A) Lose their outermost electrons less readily **(B)** Become lighter in colour
(C) Gain electron less easily **(D)** Become less dense

6. Which one of the following oxyacids of chlorine is the least oxidizing in nature?
(A) HOCl **(B)** HCO_2 **(C)** $HClO_3$ **(D)** $HClO_4$

7. Which one of the following oxides of chlorine is obtained by passing dry chlorine over silver chlorate at 90º?
(A) Cl_2O **(B)** Cl_2O_6 **(C)** ClO_2 **(D)** Cl_2O_7

8. Which of the following hydrogen halide is most volatile?
(A) HF **(B)** HCl **(C)** HBr **(D)** HI

9. The outermost electronic configuration of the element which does not show positive oxidation state at all pertains to :
(A) $2s^2 2p^3$ **(B)** $2s^2 2p^4$ **(C)** $2s^2 2p^5$ **(D)** $2s^2 2p^6$

10. A greenish yellow gas reacts with an alkali metal hydroxide to form a halate, which can be used in fire works and safety matches. The gas and halate respectively are :
(A) $Br_2, KBrO_3$ **(B)** $Cl_2, KClO_3$ **(C)** $I_2, NaIO_3$ **(D)** $Cl_2, NaClO_3$

11. Reduction of thiosulphate with iodine gives :
(A) Sulphate ion **(B)** Sulphite ion **(C)** Tetrathionate ion **(D)** Sulphide ion

12. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155, 244, 193 and 151 kJ/mol. The weakest bond will be in :
(A) Br_2 **(B)** Cl_2 **(C)** F_2 **(D)** I_2

13. The solution of which of the following has maximum pH?
(A) NaClO **(B)** $NaClO_2$ **(C)** $NaClO_3$ **(D)** $NaClO_4$

14. The correct order of acidic strength is :
(A) $Cl_2O_7 > SO_3 > P_4O_{10}$ **(B)** $CO_2 > N_2O_5 > SO_3$
(C) $Na_2O > MgO > Al_2O_3$ **(D)** $K_2O > CaO > MgO$

15. Anhydrous mixture of KF and HF contains which ions :

(A) K^{+1}, H^+, F^- **(B)** $(KF)^+, (HF)^-$ **(C)** KH^+, F^- **(D)** K^+, HF_2^-

16. Which of the following statement is not true about noble gases?

(A) Their ionization energies are very high **(B)** Their electron affinities are nearly zero

(C) They don't form any chemical compounds **(D)** They are not easily liquefied

17. Which of the following statements is false :

(A) Radon is obtained from the decay of radium **(B)** Helium is an inert gas

(C) Xenon is the most reactive among the rare gases

(D) The most abundant rare gas found in the atmosphere is helium

18. Which is planar molecule?

(A) XeO_4 **(B)** XeF_4 **(C)** $XeOF_4$ **(D)** XeO_2F_2

19. The most abundant inert gas in the atmosphere is :

(A) He **(B)** Ne **(C)** Ar **(D)** Kr

20. When same amount of zinc is treated separately with excess of sulphuric acid and excess of sodium hydroxide solution, the ratio of volumes of hydrogen evolved is :

(A) 1 : 1 **(B)** 1 : 2 **(C)** 2 : 1 **(D)** 9 : 4

21. An inorganic compound first melts, then resolidifies and then liberates a gas. It may be :

(A) $KClO_3$ **(B)** K_2SO_3 **(C)** Al_2O_3 **(D)** MnO_2

22. Detection/test of ozone can be done by :

(A) Hg **(B)** Ag **(C)** Na **(D)** None of these

23. What is formed when KI is heated with conc. H_2SO_4 :

(A) HI **(B)** I_2 **(C)** HIO_3 **(D)** conc. H_2SO_4

24. Which of the following reactions is possible :

(A) $3Br_2 + 5NaF \longrightarrow BrF_5 + 5NaBr$ **(B)** $I_2 + NaCl \longrightarrow ICl + NaI$

(C) $I_2 + 2NaCl \longrightarrow Cl_2 + 2NaI$ **(D)** $Cl_2 + 2NaBr \longrightarrow Br_2 + 2NaCl$

25. The bleaching action of moist chlorine is due to the formation of :

(A) HCl **(B)** HOCl **(C)** $HClO_3$ **(D)** $HClO_4$

26. Sodium thiosulphate $(Na_2S_2O_3.5H_2O)$ is used in photography to :

(A) Reduce AgBr to metallic silver

(B) Convert Ag to Ag salt

(C) To remove undecomposed AgBr as a soluble silver thiosulphate complex

(D) To remove Ag

27. The geometry of ICl_2^- is :

(A) Trigonal **(B)** Trigonal bipyramidal

(C) Octahderal **(D)** Square planar

28. A one litre flask is full of brown bromine vapour. The intensity of brown colour of vapour will not decrease appreciably on adding to the flask some :

(A) Pieces of marble **(B)** Animal charcoal powder

(C) Carbon tetrachloride **(D)** Carbon disulphide

29. A white solid reacts with dil. HCl to give colourless gas that decolourises aqueous bromine. The solid is most likely to be :

(A) Sodium carbonate **(B)** Sodium chloride

(C) Sodium acetate **(D)** Sodium thiosulphate

30. There is S—S single bond in :

(A) $H_2S_2O_7$ **(B)** $H_2S_2O_8$ **(C)** $H_2S_2O_6$ **(D)** $H_2S_2O_3$

31. Which of the following oxide of chlorine is paramagnetic?

(A) Cl_2O **(B)** ClO_2 **(C)** Cl_2O_6 **(D)** Cl_2O_7

32. Inter halogen compounds are :

(A) Ionic compound **(B)** Co-ordinate compound

(C) Nonpolar molecular compounds **(D)** Covalent compounds

33. Hydrolysis of one mole of peroxo dilsulphuric acid produces :

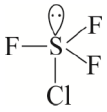
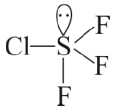
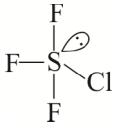
(A) Two moles of sulphuric acid

(B) Two moles of peroxo monosulpuric acid

(C) One mole of sulphuric acid and one mole of peroxy mono sulphuric acid

(D) One mole of sulphuric acid, one mole of peroxy mono sulphuric acid and one mole of hydrogen peroxide

34. Which of the following structure of highly reactive molecule SF_3Cl is **most** stable?

(A)  **(B)**  **(C)**  **(D)** 

35. Which of the following molecular species having 16th group element as central atom is **NOT** known ?

(A) SF_3Cl **(B)** SeF_3Cl **(C)** TeF_3Cl **(D)** OF_3Cl

36. The oxidation of SO_2 to H_2SO_4 in acid rain is thought to occur by the following mechanism.

$$SO_2(aq) + 2H_2O(l) \longrightarrow HSO_3^-(aq) + H_3O^+(aq)$$

$$2HSO_3^-(aq) + O_2(aq) \longrightarrow S_2O_7^{2-}(aq) + H_2O(l)$$

$$S_2O_7^{2-}(aq) + 3H_2O(l) \longrightarrow 2SO_4^{2-}(aq) + 2H_3O^+(aq)$$

Which species in this mechanism can be given the following designation?

	Reactant	**Catalyst**	**Intermediate**
(A)	$SO_2(aq)$	$H_2O(l)$	$HSO_3^-(aq), H_3O^+(aq)$
(B)	$SO_2(aq)$	$HSO_3^-(aq)$	$S_2O_7^{2-}(aq)$
(C)	$SO_2(aq), H_2O(l)$	$S_2O_7^{2-}(aq)$	$HSO_3^-(aq)$
(D)	$SO_2(aq), H_2O(l)$	none	$HSO_3^-(aq), S_2O_7^{2-}(aq)$

37. Moist air is less dense than dry air at the same temperature and barometric pressure. Which is the best explanation for this observation?

(A) H_2O is a polar molecular but N_2 and O_2 are not

(B) H_2O has a higher boiling point than N_2 or O_2

(C) H_2O has a lower molar mass than N_2 or O_2

(D) H_2O has a higher heat capacity than N_2 or O_2

38. Which element is used to form cross links between the strands of latex rubber?

(A) Fe **(B)** N **(C)** P **(D)** S

39. Which of the following is a photoconductor?

(A) Graphile **(B)** Selenium **(C)** Silicon **(D)** caesium

40. Which of the following are isostructural?

(I) Ring silicate $Si_3O_9^{6-}$ **(II)** Trimeric cyclic metaphosphate, $P_3O_9^{3-}$

(III) Trimeric cyclic sulphur trioxide, S_3O_9 **(IV)** Inorganic benzene, borazine $B_3N_3H_6$.

(A) I, II and III **(B)** II, III and IV **(C)** I, II and IV **(D)** All

Paragraph for Questions 41 - 44

It has been known for a number of years that the noble gas atoms form strong bonds to certain other atoms. In 1962 M. Bartlett found that molecular oxygen forms a compound with PtF_6 that can be represented as $O_2^+ PtF_6^-$, since xenon has nearly the same ionization energy as oxygen. Bartlett observed a reaction between xenon & PtF_6 and be demonstrated that xenon is not totally an inert gas. The most stable and best characterized of the noble-gas compounds are the xenon fluorides, oxyflourids and oxides. The oxygen compounds of xenon are obtained by hydrolysis of the fluorides. XeO_3 is easy to synthesize but it is very explosive when dry. In aqueous solution however it is well behaved and have large positive enthalpy of formation. The structures of the xenon compounds fit the patterns established by other isoelectronic species, so far as is known for example, XeO_3 is isoelectronic with the IO_3^- ion and has the same trigonal pyramidal structure.

41. $XeO_3(aq.) + OH^- \rightarrow X + Y$

The compounds (X) and (Y) are respectively :

(A) Xe and XeO_2 **(B)** XeO and XeO_2 **(C)** XeO_2 & XeO_6^{4-} **(D)** Xe & XeO_6^{4-}

42. XeF_6 can act as :

(A) Flouride ion donor **(B)** Flouride ion acceptor

(C) Reducing agent **(D)** All of these

43. Which of the following can be used as general oxidizer due to lack of extra complication of oxidation reactions.

(A) $K_2Cr_2O_7$ **(B)** XeF_2 **(C)** XeO_3 **(D)** XeO_6^{4-}

44. $XeOF_4$ is isoelectronic with compound 'A'. The compound 'A' and shape of $XeOF_4$ are respectively :

(A) BrF_5 & square pyramidal **(B)** XeO_6^{4-} & octahedral

(C) XeO_6^{4-} & square pyramidal **(D)** BrF_5 & octahedral

Paragraph for Questions 45 - 49

Several features of sulfuric acid are given below

Preparation of sulfuric acid:

Sulfuric acid is commonly prepared by the combustion of elemental sulfur to sulfur dioxide, followed by the catalytic oxidation of sulfur dioxide to sulfur trioxide. Sulfur trioxide is then absorbed into a 98% aqueous solution of H_2SO_4 and water is added to maintain a 98% concentration. SO_3 reacts with the water in the aqueous solution according to reaction-1

$SO_3(g) + H_2O \longrightarrow H_2SO_4(l)$ …… Reaction -1

Properties of sulfuric acid: Concentrated sulfuric acid is 98% H_2SO_4 and 2% water by mass. It has a density of 1.84 g/ml and a boiling point of 338ºC.

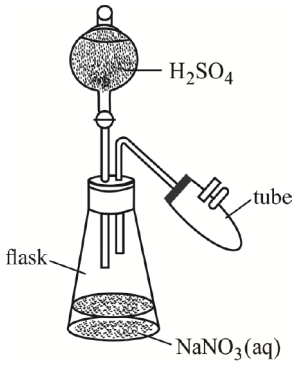
Preparation of other acids: $HCl(g)$ and HNO_3 may be prepared by the reaction between sulfuric acid and the sodium salt of the corresponding conjugate base (Cl^- or NO_3^- respectively)

Formation of SO_2 : Sulfuric acid forms SO_2 gas when it reacts with several compounds. For example, I_2 and SO_2 are formed when I^- reacts with concentrated H_2SO_4; Br_2 and SO_2 are formed when Br^- reacts with concentrated H_2SO_4.Cu^{2+} and SO_2 are formed in hot solutions of Cu(s) in H_2SO_4. This last reaction is unusual, because most metal reacts with solutions of H_2SO_4 to form hydrogen gas and a metal sulfate.

45. When sulfuric acid reacts with copper. How does the oxidation number of the sulfur change?

(A) From +4 to +6 **(B)** From +6 to +4 **(C)** From +6 to +8 **(D)** From +8 to +6

46. The apparatus shown below can be used to prepare HNO_3 (boiling point = 86ºC). The yield of HNO_3 collected in the tube can be maximized by maintaining the temperatures of the flask and tube, respectively, at ……..&……..



(A) 0ºC and 100ºC

(B) 100ºC and 0ºC

(C) 350º and 150ºC

(D) 350º and 100º

47. Which of the following is the balanced equation describing the combustion of elemental sulfur?

(A) $2H_2S + 3O_2 \longrightarrow 2SO_2 + 2H_2O$ **(B)** $H_2S + 2O_2 \longrightarrow SO_3 + H_2O$

(C) $2SO_3 \longrightarrow 2S + 3O_2$ **(D)** $S + O_2 \longrightarrow SO_2$

48. In the second step of preparing H_2SO_4 from elemental sulfur (the catalytic oxidation of SO_2), which strategy is most likely to increase the yield of SO_3 formed?

(A) Reducing the reaction temperature **(B)** Reducing the reaction pressure

(C) Removing SO_3 from the reaction mixture **(D)** Removing O_2 from the reaction mixture

49. Which of the following expression can be used to determine the number of moles of water in 1 ml. of concentrated H_2SO_4?

(A) $\frac{1.84\times 0.98}{98}+\frac{1.84\times 0.02}{18}$ **(B)** $\frac{1.84\times 0.02}{18}$

(C) $\frac{1.84\times 0.98}{18}$ **(D)** $\frac{1.84\times 0.98\times 18}{98}$

Paragraph for Questions 50 - 52

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion force between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation number +2, +4 and +6. XeF_4 reacts violently with water to give XeO_3. The compounds of xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

50. Argon is used in arc welding because of its :

(A) Low reactivity with metal **(B)** Ability to lower the melting point of metal

(C) Flammability **(D)** High calorific value

51. The structure of XeO_3 is :

(A) Linear **(B)** Planar **(C)** Pyramidal **(D)** T-shaped

52. XeF_4 and XeF_6 are expected to be :

(A) Oxidizing **(B)** Reducing **(C)** Both (A) & (B) **(D)** Strongly basic

Paragraph for Questions 53 - 55

A, B, C and D all are different triatomic compounds that exist as gases under normal conditions. A and B have a linear geometry whereas C and D are bent molecules. Elemental analysis establishes the presence of common constituents in gases B and C. Gas B does not react with water while A and D both forms weak diprotic acids on hydrolysis, gas C readily disproportionate in water to give a strong acid and a diatomic species E. Each of the species A to D can be prepared by one of the following preparative routes.

$NH_4NO_{3(s)} \xrightarrow{250^\circ}$

$CaCO_{3(s)} \xrightarrow{\Delta}$

$S_{8(s)} + O_{2(g)} \xrightarrow{\Delta}$

$E_{(g)} + O_{2(g)} \longrightarrow$

When equimolar quantities of C and E are passed through a solution of aqueous caustic soda a salt F is formed. Treatment of F with sulphuric acid produces a weak acid G and sodium sulphate. G readily decomposes to give a strong acid, water and substance E.

53. Which gas is used as a mild anesthetic and a propellant for whipped cream?

(A) E **(B)** B **(C)** C **(D)** D

54. The correct statements are :

1. A, C and D all turns moist blue litmus to red.

2. C, D, G and E all turns orange colouration of acidified potassium dichromate solution to green.

3. The decomposition reaction of G is a disproportionation reaction.

4. Both D and E are paramagnetic.

5. Both A and D turns lime water milky.

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

55. Which two gases on reacting in equimolar amounts at –30ºC form ***BLUE LIQUID*** ?

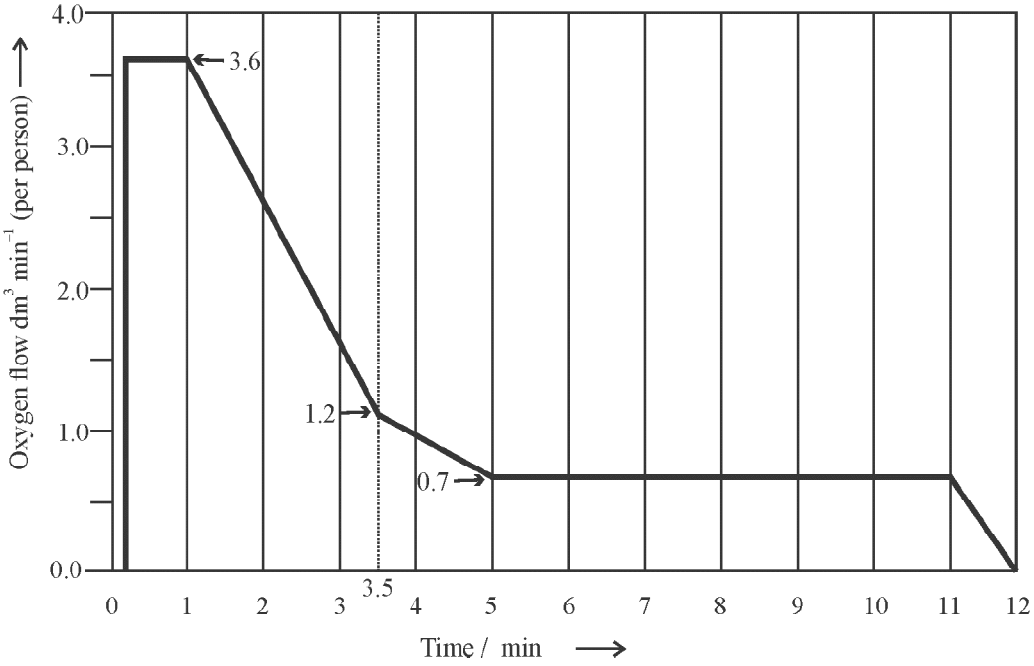
(A) A and B **(B)** B and C **(C)** C and E **(D)** B and E

Paragraph for Questions 56 - 58

Rather than carrying highly pressurized heavy oxygen cylinders, most aeroplanes rely on chemically generated oxygen in the event of an emergency.

These generators are typically composed of a mixture of sodium chlorate (V), $NaClO_3$, iron fillings and barium peroxide, BaO_2. Once initiated, the sodium chlorate (V) undergoes thermal decomposition producing oxygen gas. The iron combines with some of the oxygen to produce enough heat to sustain the reaction. The barium peroxide removes toxic side products which include chlorine and chloric (I) acid, HClO. Barium chloride and oxygen are common products in these two reactions.

When a mask is deployed for inhaling purpose, the flow rate of oxygen gas is designed to change over time as the aeroplane arrives to a safe altitude. Shown below in graph is the typical specification for the flow rate from one such oxygen generator.



Ten seconds after being activated, the flow rate is at its maximum of 3.6 $dm^3\ min^{-1}$. This lasts for approximately 50 seconds before falling as shown in the graph.

A portable, self-contained closed circuit breathing apparatus contains a chemical supply of oxygen similar to that in an aeroplane. It also contains a means to remove exhaled carbon dioxide. Very often potassium superoxide (KO_2) is used for this. KO_2 reacts with water, liberating further oxygen, and the by-product of this reaction absorbs the CO_2.

56. The mass of sodium chlorate needed to produce nearly 60 dm^3 of oxygen under the condition at which molar volume of a gas is 24 dm^3, is :

(A) 365 g **(B)** 178 g **(C)** 399 g **(D)** 266 g

57. The approximate volume of oxygen produced by the generator by using the graph to estimate will be :

(A) 15 dm^3 **(B)** 18 dm^3 **(C)** 16 dm^3 **(D)** 12 dm^3

58. The correct balanced equation for the reaction between barium peroxide and chloric(I) acid is :

(A) $BaO_2 + 2HClO \rightarrow Ba(ClO)_2 + H_2O_2$ **(B)** $BaO_2 + 2HClO \rightarrow BaCl_2 + \frac{1}{2}O_2 + H_2O$

(C) $BaO_2 + 2HClO \rightarrow Ba(ClO)_2 + \frac{1}{2}O_2 + H_2O$ **(D)** $BaO_2 + 2HClO \rightarrow BaCl_2 + 1\frac{1}{2}O_2 + H_2O$

Paragraph for Questions 59 - 61

Sodium sulphite (Na_2SO_3) is added to meat as a preservative. The presence of Na_2SO_3 can be detected by adding dil. H_2SO_4 when the pungent smelling gas evolved turns the lime water milky. The gas evolved was detected as sulphur dioxide. The SO_2 evolved was dissolved in water and it requires I_2 solution in order to oxidize SO_2 to SO_4^{2-} in titration

$$SO_2 + 2H_2O + I_2 \longrightarrow 4H^+ + SO_4^{2-} + +2I^-$$

In order to check the results of titration, excess barium chloride is added to the final solution. The resulting precipitate is collected and weighed.

59. SO_2 and CO_2 both turns lime water milky. Which of the following reagent can be used to distinguish these two gases?

(I) $K_2Cr_2O_7/H_2SO_4$ **(II)** $KMnO_4/H+$ **(III)** I_2 solution

(A) I, II, III correct **(B)** I, III only correct

(C) II, III only correct **(D)** III only correct

60. SO_2 gas is used as a bleaching agent. Its bleaching action is :

(A) Temporary and due to its oxidizing nature **(B)** Temporary and due to its reducing action

(C) Permanent and due to its oxidizing action **(D)** Permanent and due to its reducing action

61. Which of the following compounds is formed, when Na_2SO_3 is boiled with sulphur.

(A) Na_2SO_4 **(B)** $Na_2S_2O_5$ **(C)** $Na_2S_2O_6$ **(D)** $Na_2S_2O_3$

Paragraph for Questions 62 - 64

A and B are elements in the same group of the periodic table. In nature they are not found as free elements but found as ions in various minerals and sea water. Ionic salts containing either A or B reacts with phosphoric acid (H_3PO_4) to give, H_xA or H_xB a gaseous product, respectively, on heating. Aqueous solution of H_xA is weakly acidic while of H_xB is strongly acidic. H_xA can also be formed when the above reaction was carried out using sulfuric acid instead of H_3PO_4, however, ionic salts containing B gave B_2 under these conditions. Compound A_2 can be produced via electrolysis of the molten salt KHA_y whereas B_2 is stable in an aqueous medium.

Diatomic molecules A_2 and B_2 exist as a gas and a volatile solid, respectively, under normal conditions.

Reaction of A_2 with B_2 produces one of four compounds of the type BA_n depending on the stoichiometry of the reaction. All four are reactive species.

62. The elements 'A' and 'B' are :

(A) O and S **(B)** N and P **(C)** F and I **(D)** Cl and Br

63. Incorrect statement for A and B is :

(A) Electron gain enthalpy of B is less than that of A.

(B) Element B shows positive oxidation state in its compound.

(C) A_2 disproportionates in water or alkali.

(D) The hydracid of A is able to form glasses through itching.

64. Shape of BA_3 molecules is :

(A) Triangular planar **(B)** Trigonal pyramidal

(C) T–shape **(D)** Tetrahedral

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

65. Which of the following is/are **correct** balanced equation(s) for the formation of $P_2O_7^{4-}$?

(A) $2H_3PO_4 \xrightarrow[250\text{-}260^\circ C]{\Delta} H_4P_2O_7 + H_2O$ **(B)** $5H_3PO_4 + POCl_3 \longrightarrow 3H_4P_2O_7 + 3HCl$

(C) $P_4O_{10} + 4H_2O \longrightarrow 2H_4P_2O_7$ **(D)** $H_3PO_4 + H_3PO_3 \longrightarrow H_4P_2O_7 + H_2$

66. Which of the following ions have single S–S linkage?

(A) $S_2O_8^{2-}$ **(B)** $S_2O_6^{2-}$ **(C)** $S_2O_5^{2-}$ **(D)** $S_2O_3^{2-}$

67. The element which exist(s) in the liquid state at or near normal room temperature is(are) :

(A) Bromine **(B)** Mercury **(C)** Gallium **(D)** Lithium

68. Which among the following is/are paramagnetic?

(A) O_2 **(B)** ClO_2 **(C)** S_2 **(D)** KO_2

69. Which of the following is(are) not the characteristic of inter-halogen compounds?

(A) They are more reactive than halogens

(B) They are quite unstable, but none of them is explosive

(C) They are covalent in nature

(D) They have low boiling point

70. Which of the following is **correct** about the reaction?

$$3NaClO \xrightarrow{\Delta} NaClO_3 + 2NaCl$$

(A) It is a disproportionation reaction

(B) Oxidation number of Cl decreases as well as increases in this reaction

(C) This reaction is used for the manufacture of halates

(D) It is a comproportionation reaction

71. Chlorine is manufactured from :

(A) Electrolysis of brine solution

(B) Electrolysis of Fused KCl

(C) Electrolysis of bleaching powder

(D) Oxidation of HCl by O_2 using $CuCl_2$ as catalyst.

72. Select the correct statement about $Na_2S_2O_3.5H_2O$

(A) It is known as hypo **(B)** It is used in photography to form complex with AgBr

(C) It is used to remove stain of I_2 **(D)** It can be used as an antichlor

73. Which of the following exist in different allotropic forms?

(A) Carbon **(B)** Phosphorous **(C)** Sulphur **(D)** Tin

74. Which of the following is/are covalent solids?

(A) Diamond **(B)** Black phosphorous **(C)** Boron **(D)** Iodine

75. Which of the following is/are network solids?

(A) Quartz (SiO_2) **(B)** Diamond **(C)** Sulphur **(D)** Iodine

76. Thionyl chloride ($SOCl_2$) is an important chemical reagent, for which of the following change it can be used?

(A) Hydrated ferric chloride $\rightarrow$ anhydrous ferric chloride

(B) Ethyl alcohol $\rightarrow$ Ethyl chloride

(C) Acetic acid $\rightarrow$ Acetyl chloride

(D) White phosphorous $\rightarrow$ Phosphorous trichloride

77. The following substances are covalent or molecular solids and also exist in diatomic form in vapour phase. Which of the following have paramagnetic diatomic form?

(A) Carbon **(B)** Boron **(C)** Sulphur **(D)** None of these

78. Which of the following allotropic transformation takes place on decreasing temperature ?

(A) Diamond $\rightarrow$ Graphite **(B)** Rhombic sulphur $\rightarrow$ monoclinic sulphur

(C) White phosphorous $\rightarrow$ Black phosphorous **(D)** White tin $\rightarrow$ Grey tin

79. Which of the following is(are) correct order of increasing number of pi-bonds?

(A) $B_2 < C_2 < SO_3$ **(B)** $NO < CO < XeO_3$

(C) $SO_2 < SO_3 < XeO_4$ **(D)** $ClO_2^- < ClO_3^- < ClO_4^-$

80. Which of the following is/are used for preparation of pseudohalogen, cyanogen $(CN)_2$?

(A) Reaction of excess KCN with $CuSO_4$ solution **(B)** Heating ammonium oxalate with P_2O_5

(C) Heating thalium (III) cyanide **(D)** Heating ammonium formate with P_2O_5

81. Which of the following dissociation results in an increase in paramagnetism?

(A) $2O_3 \xrightarrow{\Delta} 3O_2$ **(B)** $N_2O_4 \xrightarrow{\Delta} 2NO_2$

(C) $N_2O_3 \xrightarrow{\Delta} NO + NO_2$ **(D)** $S_8 \xrightarrow{\Delta} 4S_2$

82. Which of the following can be used for dehydrating readily hydrolysable inorganic halides?

(A) conc. H_2SO_4 **(B)** P_4O_{10} **(C)** CaO **(D)** $OSCl_2$

83. Identify correct statement(s) related to two stable allotropes of oxygen i.e. dioxygen (O_2) and ozone (O_3) :

(A) In ozone central oxygen atoms is sp^2 hybridized.

(B) Ozone has a nonzero dipole moment.

(C) Dioxygen is weakly attracted to strong magnetic field.

(D) Ozone is weakly repelled by magnetic field.

84. Identify correct statement(s)

(A) Polyatomic S_8 allotropic form of sulphur is more stable than diatomic S_2.

(B) Polyatomic O_3 allotropic form of oxygen is less stable than diatomic O_2.

(C) S_2 and O_2 both are paramagnetic. **(D)** S_8 and O_3 both are diamagnetic.

85. Which substance has a zero standard free energy of formation.

(A) Pb(s) **(B)** Hg(l) **(C)** $Cl_2(g)$ **(D)** $Br_2(l)$

86. Which of the following pair(s) have identical structure?

(A) XeF_2 and I_3^- **(B)** $XeOF_2$ and ClF_3 **(C)** XeO_3F_2 and PF_5 **(D)** $XeOF_4$ and IF_5

87. Which of the following uses of noble gases is correctly matched?

(A) He : Helium is mixed with O_2 in 4 : 1 ratio to provide an artificial atmosphere for divers.

(B) Ne : Neon is used in discharge tubes for advertisement display purposes.

(C) Ar : Argon is used to provide an inert atmosphere in high temperature metallurgical process.

(D) He : Helium is used in filling balloons for meteorological observations.

88. Which of the following reaction(s) represent strong oxidizing power of xenon fluorides?

(A) $XeF_6(s) + 3H_2O(l) \longrightarrow XeO_3(aq) + 6HF(g)$

(B) $XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4HF(g) + O_2(g)$

(C) $XeF_4(s) + Pt(s) \longrightarrow PtF_4(s) + Xe(g)$

(D) $2XeF_6(s) + 3SiO_2(s) \longrightarrow 2XeO_3(s) + 3SiF_4(g)$

89. Which of the following is correct regarding structure of xenon fluorides?

(A) XeF_2 is linear **(B)** XeF_4 is square planar

(C) XeF_6 is distorted octahedral **(D)** XeF_8^{2-} is square antiprism

90. XeF_4 is expected to be :

(A) oxidizing **(B)** reducing **(C)** unreactive **(D)** fluorinating agent

91. Formation of ozone from oxygen is endothermic hence O_3 is prepared by

(A) Heating oxygen at 298 K.

(B) Passing dry stream of oxygen through a silent electrical discharge.

(C) Passing fluorine in water.

(D) Treating H_2O_2 with fluorine.

92. Which of the following compound(s) is/are thermodynamically unstable at 298 K?

(A) O_3 **(B)** H_2O_2 **(C)** XeO_3 **(D)** O_2F_2

93. Which of the following compounds can't be prepared by direct combination of the constituent elements at 298 K?

(A) N_2O **(B)** XeO_3 **(C)** XeF_2 **(D)** P_4O_{10}

94. Which of the following reaction is/are used for preparation of xenon oxide, XeO_3?

(A) $2Xe + 3O_2 \longrightarrow 2XeO_3$ **(B)** $XeF_2 + \frac{3}{2}O_2 \longrightarrow XeO_3 + F_2$

(C) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$ **(D)** $Xe + Al_2O_3 \longrightarrow XeO_3 + 2Al$

95. Select the correct statement(s).

(A) Boiling point of HF is lower than the boiling point of H_2O

(B) HF has stronger hydrogen bonds than water

(C) HF is stronger acid than water

(D) Liquid HF is more viscous than water

96. Which of the following is correct regarding oxides of halogens?

(A) OF_2 is oxygen fluoride

(B) ClO_2 is used as a bleaching agent for paper pulp

(C) I_2O_5 is used in the estimation of carbon monoxide

(D) BrO_3 is least stable halogen oxide

97. Which of the following reaction(s) of halogen with water is correctly represented?

(A) $2F_2(g) + 2H_2O(l) \longrightarrow 4HF(aq) + O_2(g)$

(B) $Cl_2(g) + H_2O(l) \longrightarrow HCl(aq) + HOCl(aq)$

(C) $Br_2(l) + H_2O(l) \longrightarrow HBr(aq) + HOBr(aq)$

(D) $2I_2(s) + 2H_2O(l) \longrightarrow 4HI(aq) + O_2(g)$

98. Which of the following can be used as bleaching agent?

(A) ClO_2 **(B)** H_2O_2 **(C)** Cl_2 **(D)** SO_2

99. Which of the following is/are correct?

(A) All the chlorine oxides are endothermic and unstable

(B) XeO_3 is endothermic and unstable.

(C) Ozone is endothermic and decomposes on heating.

(D) H_2O_2 disproportionate on heating.

100. Which of the following is/are correct statement(s)?

(A) Formation of ozone from oxygen is an endothermic process.

(B) Ozone is violet black in solid form.

(C) Ozone molecule is angular.

(D) Ozone is polar molecule.

101. Which of the following is/are correctly matched?

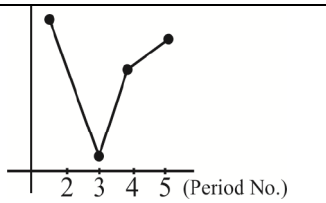
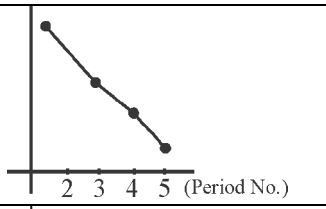
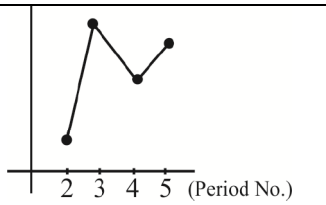
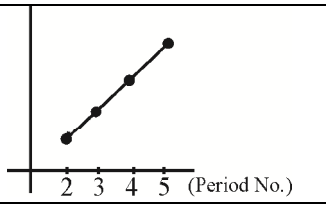
(A) $Al_2Cl_6; sp^3$ hybridized central atom **(B)** $B_2H_6; sp^3$ hybridized central atom

(C) $S_2F_{10}; sp^3d^2$ hybridized central atom **(D)** $Be_2Cl_4; sp^2$ hybridized central atom

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

102. MATCH THE COLUMN :

Column 1		Column 2	
(A)	Bond energies of the hydra acids of the halogens fluorine, chlorine, bromine, iodine	**(p)**	
(B)	Boiling points of the hydrides of the 16 group elements oxygen, sulphur, selenium, tellurium	**(q)**	
(C)	The stability of monochlorides of group 13 elements boron, aluminium, gallium, indium	**(r)**	
(D)	Melting points of the dioxides of the group 14 elements carbon, silicon, germanium, tin	**(s)**	

103. MATCH THE COLUMN :

Column 1		Column 2	
(A)	Maximum solubility in water	**(p)**	F_2
(B)	Corrosive liquid	**(q)**	Cl_2
(C)	Maximum intermolecular distance	**(r)**	Br_2
(D)	Enthalpy of dissociation (maximum)	**(s)**	I_2

104. MATCH THE COLUMN :

Column 1 (Gaseous Substance)		Column 2 (Absorbent)	
(A)	Cl_2	**(p)**	Potash solution
(B)	O_2	**(q)**	Ammonical cuprous chloride
(C)	CO	**(r)**	$FeSO_4$ solution
(D)	NO	**(s)**	Alkaline pyrogallol solution

105. MATCH THE COLUMN :

Column 1		Column 2	
(A)	XeF_4	**(p)**	Pyramidal
(B)	XeF_6	**(q)**	Trigonal bipyramidal
(C)	XeO_3	**(r)**	Distorted octahedral
(D)	XeO_2F_2	**(s)**	Square planar

106. MATCH THE COLUMN :

Column 1		Column 2	
(A)	F_2	**(p)**	Shows only one non zero oxidation state
(B)	Cl_2	**(q)**	Coloured
(C)	Br_2	**(r)**	Readily dipsroportiotes in alkali
(D)	I_2	**(s)**	Stronger oxidizing agent
		(t)	More negative electron gain enthalpy

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

107. Among the following, the number of elements showing only one non-zero oxidation state is_____.
O, Cl, F, N, P, S*n*, T*l*, Na, Mg

108. Find out total number of lone pairs in KI_3.

109. To an aqueous solution containing anion a few drops of acidified $KMnO_4$ are added. How many of the following anions if present will not decolourize the $KMnO_4$ solution.
$I^-, CO_3^{2-}, NO_2^-, Cl^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, Br^-, C_2O_4^{2-}$.

110. An acid is formed by heating orthophosphoric acid at 250 – 260°C. The number of series of salts formed by this acid are _____.

111. The ratio of lone pairs and the number of S–S bonds in S_8 molecules is _____.

112. How many of the following are pseudo halides?
$I_3^-, CN^-, SCN^-, OCN^-, CNO^-, NNN^-, HCOO^-, S_2^{2-}, ICl_2^-$

113. How many of the following oxoacids are mono basic acids?

$H_3BO_3, H_2CO_3, H_2SO_3, H_2SO_4, H_3PO_4, H_3PO_3, H_3PO_2, HPO_3$

114. The number of non-ionizable hydrogen atoms attached to phosphorus atom in hypophosphorus acid are _____.

115. How many of the following chlorides can be hydrolysed?

$BCl_3, CCl_4, SiCl_4, NCl_3, PCl_3, AsCl_3, SbCl_3, SCl_4, ICl_3$

116. How many of the following oxides are mixed anhydrides?

$N_2O_3, NO_2, P_4O_6, P_4O_8, P_4O_{10}, Cl_2O_7, SO_3, I_2O_5, N_2O_5, Cl_2O_6.$

117. How many of the following on heating liberate O_2 ?

$HgO, Pb_3O_4, Ag_2O, Ag_2CO_3, AgNO_3, NaNO_3, LiNO_3, KClO_3, Mg(NO_3)_2,$

118. How many of the following oxides are only acidic in nature?

$MgO, Al_2O_3, SO_2, Cl_2O_7, CO_2, N_2O_5, Mn_2O_7, CrO_3, V_2O_5$

119. How many of the following oxides are neutral?

$Na_2O, CaO, Al_2O_3, CO, NO, CO_2, N_2O, Cl_2O, B_2O_3.$

120. Total number of lone pair of electrons in XeF_2 are_____.

121. Xe reacts with fluorine in 1 : *x* ratio at high temperature and pressure to form XeF_4. What is the value of *x* ?

122. Treating Ba_2XeO_6 with concentrated sulphuric acid produces an explosive unstable gaseous substance XeO_4. The number of $d\pi - p\pi$ bonds in XeO_4 are_____.

123. Solution containing $(SO_3^{2-}) \xrightarrow{\text{dil. HCl}} \underset{\text{(pungent smell)}}{\text{Gas 'A'}} \xrightarrow[\text{(Orange solution)}]{K_2Cr_2O_7, H^+}$ solution turns Green. What is change in oxidation state of Sulphur on reaction with Orange solution?

Advanced Problem Package	d-Block Elements

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Colourless solutions of the following four salts are placed separately in four different test tubes and a strip of copper is dipped in each one of these which solution will turn blue?

(A) KNO_3 **(B)** $AgNO_3$ **(C)** $Zn(NO_3)_2$ **(D)** $ZnSO_4$

2. $Cr_2O_7^{2-} \underset{Y}{\overset{X}{\rightleftharpoons}} 2CrO_4^{2-}$, X and Y are respectively :

(A) $X = OH^-, Y = H^+$ **(B)** $X = H^+, Y = OH^-$

(C) $X = OH^-, Y = H_2O_2$ **(D)** $X = H_2O_2, Y = OH^-$

3. Solution of MnO_4^- is purple - coloured due to :

(A) d-d-transition **(B)** Charge transfer from O to Mn

(C) Due to both d-d-transition and charge transfer **(D)** None of these

4. The transition elements are more metallic than representative elements (s and p-block elements) due to :

(A) Availability of d-orbitals for bonding

(B) Variable oxidation states are not shown by transition elements

(C) All electrons are paired in d-orbitals **(D)** *f*-orbitals are available for bonding

5. During estimation of oxalic acid using $KMnO_4$, the self indicator is :

(A) $KMnO_4$ **(B)** oxalic acid **(C)** K_2SO_4 **(D)** $MnSO_4$

6. The most common oxidation state of lanthanides is :

(A) +3 **(B)** +2 **(C)** +4 **(D)** +5

7. $Y \xleftarrow{KI} CuSO_4 \xrightarrow{\text{dil } H_2SO_4} X$ (Blue colour), X and Y are :

(A) $X = I_2, Y = [Cu(H_2O)_4]^{2+}$ **(B)** $X = [Cu(H_2O)_4]^{2+}, Y = I_2$

(C) $X = [Cu(H_2O)_4], Y = I_2$ **(D)** $X = [Cu(H_2O)_6]^{2+}, Y = I_2$

8. Transition elements are usually characterized by variable oxidation states but Zn does not show this property because of

(A) Completion of np-orbitals **(B)** Completion of (n-1)d orbitals

(C) Completion of ns-orbitals **(D)** Inert pair effect

9. $CuSO_4$ solution reacts with KCN to give :

(A) $Cu(CN)_2$ **(B)** CuCN **(C)** $K_2[Cu(CN)_2]$ **(D)** $K_3[Cu(CN)_4]$

10. The higher oxidation states of transition elements are found to be in the combination with A and B, which are :

(A) F, O **(B)** O, N **(C)** O, Cl **(D)** F, Cl

11. In the equation: $4M + 8CN^- + 2H_2O + O_2 \longrightarrow 4[M(CN)_2]^- + 4OH^-$, metal M is :

(A) Pt **(B)** Au **(C)** Cu **(D)** Hg

12. Among following, the compound which shows the lowest degree of paramagnetism per mole at 298 K is :

(A) $CuSO_4.5H_2O$ **(B)** $NiSO_4.6H_2O$ **(C)** $FeSO_4.6H_2O$ **(D)** $MnSO_4.4H_2O$

13. Solid $CuSO_4.5H_2O$ having covalent, ionic as well as co-ordinate bonds. Copper atom/ion forms ___ co-ordinate bonds with water.

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

14. The main product obtained when a solution of sodium carbonate reacts with mercuric chloride is :

(A) $Hg(OH)_2$ **(B)** HgO **(C)** $HgCO_3$ **(D)** $HgCO_3 \cdot Hg(OH)_2$

15. The aqueous solution of $CuCr_2O_7$ is green because it contains :

(A) Green Cu^{2+} ions **(B)** Green $Cr_2O_7^{2-}$ ions

(C) Blue Cu^{2+} ions and green $Cr_2O_7^{2-}$ ions **(D)** Blue Cu^{2+} ions and yellow $Cr_2O_7^{2-}$ ions

16. Manganese steel is used for making railways because :

(A) it is hard with high percentage of Mn **(B)** it is soft with high percentage of Mn

(C) it is hard with small concentration of manganese with impurities

(D) it is soft with small concentration of manganese with impurities

17. In nitroprusside ion, the iron exists as Fe^{2+} and NO as NO^+ rather than Fe^{3+} and NO respectively. These forms of ions are established with the help of :

(A) Magnetic moment in solid state **(B)** Thermal decomposition method

(B) By reaction with KCN **(D)** By action with K_2SO_4

18. Transition elements in lower oxidation states act as Lewis acid because :

(A) They form complexes **(B)** They are oxidizing agents

(B) They donate electrons **(D)** They do not show catalytic properties

19. The shape of gaseous $SnCl_2$ is :

(A) tetrahedral **(B)** bent **(C)** linear **(D)** distorted tetrahedral

20. The solubility of silver bromide in hypo solution is due to the formation of :

(A) Ag_2SO_3 **(B)** $Ag_2S_2O_3$ **(C)** $[Ag(S_2O_3)]^-$ **(D)** $[Ag(S_2O_3)_2]^{3-}$

21. An extremely hot copper wire reacts with steam to give :

(A) CuO **(B)** Cu_2O **(C)** Cu_2O_2 **(D)** CuO_2

22. Which of the following is obtained when SO_2 gas is bubbled through a solution of $CuCl_2$.

(A) Cu **(B)** Cu_2Cl_2 **(C)** $CuSO_4$ **(D)** CuS

23. On strongly heating $AgNO_3$, the gases evolved are :

(A) N_2O and NO **(B)** NO_2 and O_2 **(C)** NO and O_2 **(D)** NO_2 and NO

24. A white solid halide of mercury forms a black mixture with ammonium hydroxides. The halide is:

(A) $HgCl_2$ **(B)** HgI_2 **(C)** Hg_2I_2 **(D)** Hg_2Cl_2

25. Which of the following pair cannot exist together?

(A) $Cu(NO_3)_2$ and $AgNO_3$ **(B)** $HgCl_2$ and $SnCl_2$

(C) $FeCl_3$ and $FeCl_2$ **(D)** None of these

26. Which of the following is not the characteristics of zinc?

(A) It is a volatile metal **(B)** It dissolves in alkali forming sodium metazincate

(C) It is brittle at very high temperature **(D)** Zinc dust is used as a reducing agent

27. Mercury is transported in metal containers made of :

(A) Silver **(B)** Lead **(C)** Iron **(D)** Aluminium

28. Splitting of silver is :

(A) Reduction of ammonical silver nitrate solution by tartrate

(B) Making of silver amalgam during filling of teeth

(C) A extraction of silver from its ore Ag_2S by hydrometallurgy

(D) Cooling of molten silver with the evolution of oxygen causing violent spurting

29. $CuCl_2$ and $CuBr_2$ exist as :

(A) Monomer **(B)** Dimer **(C)** Trimer **(D)** Polymer

30. Acidified potassium permanganate solution is decolourised by

(A) Bleaching powder **(B)** White vitriol

(C) Mohr's salt **(D)** None of these

31. A metal which is not affected by conc. H_2SO_4, HNO_3 alkalis forms a compound X. This compound X can be used to give a complex which finds its application for toning in photography? The metal is :

(A) Au **(B)** Ag **(C)** Hg **(D)** Cu

32. Philosopher's wool when heated with BaO at 1100°C gives a compound. Identify the compound :

(A) $BaZnO_2$ **(B)** $Ba + ZnO_2$ **(C)** $BaCdO_2$ **(D)** $BaO_2 + Zn$

33. The formula for corrosive sublimate is :

(A) $HgCl_2$ **(B)** Hg_2Cl_2 **(C)** Hg_2O **(D)** Hg

34. Which of the following does not give a precipitate with excess of NaOH?

(A) $HgCl_2$ **(B)** $HgNO_3$ **(C)** $FeSO_4$ **(D)** $ZnSO_4$

35. KI and $CuSO_4$ solution when mixed give :

(A) $CuI_2 + K_2SO_4$ **(B)** $Cu_2I_2 + K_2SO_4$

(C) $Cu_2I_2 + I_2 + K_2SO_4$ **(D)** $K_2SO_4 + CuI_2 + I_2$

36. Au is insoluble in nitric acid but dissolves in aqua regia. The enhanced solubility of Au arises from :

(A) oxidizing strength of HNO_3 **(B)** oxidizing strength of NO_3

(C) oxidizing strength of H^+ **(D)** ability of Cl to form complexes

37. A solution of sodium thiosulphate on addition of few drops of ferric chloride gives violet colour due to the formation of

(A) $Na_2S_4O_6$ **(B)** $Fe_2(SO_4)_3$ **(C)** $Fe_2(S_2O_3)_3$ **(D)** $Fe_2(S_2O_3)_2$

38. The colour of light absorbed by Prussian blue is :
(A) Orange - red **(B)** Blue-green **(C)** Yellow **(D)** Violet

39. When HCl reacts with finely powdered iron it forms :
(A) $FeCl_2$ and H_2 **(B)** $FeCl_3$ and H_2 **(C)** $FeCl_2.6H_2O$ & H_2 **(D)** $FeCl_3.6H_2O$ & H_2

Paragraph for Questions 40 - 43

Light green (Compound 'A') $\xrightarrow{\Delta}$ White Residue **(B)** $\xrightarrow[\text{Temp.}]{\text{High}}$ C + D + E.

Light green (Compound 'A') $\xrightarrow{BaCl_2}$ white ppt. insoluble in HCl and HNO_3

(i) 'D' and 'E' are two acidic gas.

(ii) 'D' is passed through $HgCl_2$ solution to give yellow ppt.

(iii) 'E' is passed through water first and then H_2S is passed, white turbidity is obtained.

(iv) A is water soluble and addition of $HgCl_2$ in it, white ppt is obtained but white ppt does not turn into grey on addition of excess solution of 'A'.

40. 'D' and 'E' are respectively.
(A) SO_2 and SO_3 **(B)** SO_3 and SO_2 **(C)** SO_2 and CO_2 **(D)** CO_2 and CO

41. Yellow ppt in the above observation is:
(A) Mercuric oxide **(C)** Basic mercury (I) sulphite
(C) Basic mercury (II) sulphate **(D)** Mercuric iodide

42. 'C' is soluble in :
(A) dil. HCl **(B)** dil. H_2SO_4 **(C)** conc. CH_3COOH **(D)** Boiled conc. HCl

43. What happens when H_2S gas is passed in solution of 'C' in conc HCl?
(A) Light green colour turns to yellowish green and yellow turbidity
(B) Yellowish green solution turns to greenish yellow and white turbidity
(C) Yellowish green ppt
(D) Black ppt

Paragraph for Questions 44 - 47

Transition metal and their compounds are used as catalysts in industry and in biological system. For example, in the Contact Process, vanadium compounds in the +5 state $(V_2O_5 \text{ or } VO_3^-)$ are used to oxidise SO_2 to SO_3.

$$SO_2 + \frac{1}{2}O_2 \xrightarrow{V_2O_2} SO_3$$

It is thought that the actual oxidation process takes place in two stages. In the first step, V^{5+} in the presence of oxide ions converts SO_2 to SO_3. At the same time, V^{5+} is reduced to V^{4+}.

$$2V^{5+} + O^{2-} + SO_2 \longrightarrow 2V^{4+} + SO_3$$

In the second step, V^{5+} is regenerated from V^{4+} by oxygen: $2V^{4+} + \frac{1}{2}O_2 \longrightarrow 2V^{5+} + O^{2-}$

The overall process is, of course, the sum of these two steps: $SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$

44. Transition metals and their compound catalyse reactions because:

(A) They have completely filled s-subshell

(B) They have a comparable size due to poor shielding of d-subshell

(C) They introduce an entirely new reaction mechanism with a lower activation energy

(D) They have variable oxidation states differ by two units

45. During the course of the reaction:

(A) Catalyst undergoes changes in oxidation state

(B) Catalyst increases the rate constant

(C) Catalyst is regenerated in its original form when the reactants converted to the products

(D) All are correct

46. Catalytic activity of transition metals depends on

(A) Their ability to exist in different oxidation states **(B)** The size of the metal atoms

(C) The number of empty atomic orbitals available **(D)** None of these

47. Which of the following ion involved in the above process will show paramagnetism?

(A) V^{5+} **(B)** V^{4+} **(C)** O^{2-} **(D)** VO_3^-

Paragraph for Questions 48 - 51

MnO_2 is the most important oxide of manganese. MnO_2 occurs naturally as the black coloured mineral pyrolusite. It is an oxidizing agent, and decomposes to Mn_3O_4 on heating to 530°C. It is used in the preparation of potassium permanganate and in the production of Cl_2 gas. Over half a million tons per year of MnO_2 is used in dry batteries.

48. In the laboratory, MnO_2 is made by :

(A) Heating Mn in O_2 **(B)** Oxidizing Mn^{2+} in air

(C) Electrolytic oxidation of $MnSO_4$

(D) Precipitating MnO_2 from solution when performing titration of $KMnO_4$ in alkaline medium.

49. When MnO_2 is fused with KOH in the presence of air, the product formed is:

(A) purple colour $KMnO_4$ **(B)** green colour K_2MnO_4

(C) colourless MnO_4^- **(D)** purple colour K_2MnO_4

50. MnO_2 dissolved in concentrated HCl to form:

(A) Mn^{4+} ion and Cl_2 **(B)** Mn^{2+} ion and Cl_2

(C) $[MnCl_4]^{2-}$ and Cl_2 **(D)** only $[MnCl_4]^{2-}$

51. In which of the following species, the colour is due to charge transfer.

(I) $[Mn(OH)_4]^{2-}$ **(II)** MnO_4^{2-} **(III)** MnO_2 **(IV)** $KMnO_4$

(A) I, II, III correct **(B)** II, IV correct **(C)** I, III correct **(D)** only IV correct

Paragraph for Questions 52 - 54

Iron (+II) is one of the most important oxidation states, and salts are called ferrous salts. Most of the Fe(+II) salts are pale green and contain $[Fe(H_2O)_6]^{2+}$ ion. Fe(+II) compounds are easily oxidized by air and so are difficult to obtain in pure from Fe^{2+} form many complexes like $K_4[Fe(CN)_6]$.

52. Anhydrous $FeCl_2$ is made by :

(A) Heating Fe with dilute HCl **(B)** Heating Fe with gaseous HCl

(C) Reacting Fe with conc. HCl **(D)** Heating Fe with Cl_2 gas

53. $K_3[Fe(CN)_6]$ is used in the detection of Fe^{2+} ion with which it gives a deep colour. This colour is due to the formation of :

(A) $K_2Fe[Fe(CN)_6]$ **(B)** $Fe_4[Fe(CN)_6]_3$ **(C)** $Fe[Fe(CN)_6]$ **(D)** $Fe_3[Fe(CN)_6]_2$

54. $FeSO_4$ is used in brown ring test for nitrates and nitrites. In this test, a freshly prepared $FeSO_4$ solution is mixed with solution containing NO_2^- or NO_3^- and the conc. H_2SO_4 is run down the side of the test tube. If the mixture gets hot or is shaken,

I. The brown colour disappears **II.** NO is evolved

III. A yellow solution of $Fe_2(SO_4)_3$ is formed

(A) I, II, III are correct **(B)** I, III are correct

(C) II, III are correct **(D)** Only I is correct

Paragraph for Questions 55 - 58

The following observations were made on Na_2CrO_4 and $Na_2Cr_2O_7$.

(A) When CO_2 was passed over Na_2CrO_4, then $Na_2Cr_2O_7$ was formed.

(B) When Zn is added to acidic solution of $Na_2Cr_2O_7$, the colour changes from orange to green.

(C) Na_2CrO_4 when added to a nitrate salt solution gave a yellow coloured precipitate which after separation and drying followed by flame test gave a green coloured flame.

55. What is the function of CO_2 in the first observation?

(A) Acts as an oxidizing agent **(B)** Acts as a reducing agent

(B) Produces chromium and oxygen **(D)** Makes the solution acidic

56. The reason for the colour of $Na_2Cr_2O_7$ solution to first change from orange to green on adding Zn is because

(A) Zn is a reducing agent and changes Cr^{4+} to Cr^{3+}

(B) Zn is a reducing agent and changes Cr^{6+} to Cr^{3+}

(C) Zn is a reducing agent and it reduces Cr^{6+} to Cr^{2+} **(D)** None of these

57. The extent of splitting in d-orbitals is more when the chromium in the solution is in

(A) +1 oxidation state **(B)** +2 oxidation state

(C) +3 oxidation state **(D)** +6 oxidation state

58. The nitrate salt which gives a yellow precipitate with Na_2CrO_4 and the yellow precipitate gives green flame with Bunsen burner is of

(A) Pb^{2+} **(B)** Ca^{2+} **(C)** Mg^2 **(D)** Ba^{2+}

Paragraph for Questions 59 - 63

A colourless solid (A) on strong heating gives a brown gas (B) and a grey residue (C). On dissolution of solid (A) in NH_3 a solution of compound (D) is formed which oxidizes glucose. $FeSO_4$ reduces solution of (A) in water. Aqueous solution of (A) also gives a brick red precipitate (E) with K_2CrO_4 solution. On the basis of above information answer the following questions.

59. Compound (A) is :

(A) $AgNO_3$ **(B)** $Hg_2(NO_3)_2$ **(C)** $Cu(NO_3)_2$ **(D)** AgBr

60. Compound (B) is :

(A) Br_2 **(B)** NO_2 **(C)** NO **(D)** none of the above

61. Compound (C) is :

(A) Hg **(B)** Bi **(C)** Ag **(D)** Cu

62. Compound (D) is :

(A) $[Cr(NH_3)_6]^{3+}$ **(B)** $[HgI_4]^{2-}$ **(C)** $[Cu(NH_3)_4]^{2+}$ **(D)** $[Ag(NH_3)_2]^{+}$

63. Compound (E) is :

(A) HgI_2 **(B)** $K_2Cr_2O_7$ **(C)** $HgCrO_4$ **(D)** Ag_2CrO_4

Paragraph for Questions 64 - 68

A brown powdery substance (A) when heated with concentrated HCl gives compound (B) along with the liberation of a greenish yellow gas (C), which liberates a compound (D) when passed through KI solution. Compound (D) dissolves in excess of KI, forming a yellow solution. (A) when fused with KOH in presence of atmospheric oxygen gives a green mass, which on extraction with water and on treatment with a gas (E), changes to purple. Moreover the gas (E) when passed through dry KOH at low temperature gives a deep red coloured compound. On the basis of above information answer the following questions.

64. Compound (A) is :

(A) Fe_2O_3 **(B)** MnO_2 **(C)** CuS **(D)** PbS

65. Compound (B) is :

(A) $FeCl_3$ **(B)** $MnCl_2$ **(C)** $CuCl_2$ **(D)** $PbCl_2$

66. Compound (C) is :

(A) CrO_2Cl_2 **(B)** NO **(C)** Cl_2 **(D)** H_2S

67. Compound (D) is :

(A) NO_2 **(B)** I_2 **(C)** O_2 **(D)** SO_2

68. Compound (E) is :

(A) O_3 **(B)** Cl_2 **(C)** O_2 **(D)** NO_2

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

69. Which of the following is/are correctly matched?

(A) $HgCl_2$; Corrosive sublimate **(B)** HgS; Vermilion

(C) Hg_2Cl_2 ; Calomel **(D)** HgI; Amalgam

70. The ionization energies of transition elements are :

(A) less than p-block elements **(B)** more than s-block elements

(C) less than s-block elements **(D)** more than p-block elements

71. The metal(s) which does/do not form amalgam is(are)
(A) Fe **(B)** Pt **(C)** Zn **(D)** Ag

72. The highest oxidation state shown by transition elements is :
(A) +7 by Mn **(B)** +8 by Os **(C)** +8 by Ru **(D)** +7 by Fe

73. The catalytic activity of transition elements is related to their :
(A) Variable oxidation states **(B)** Surface area
(C) Complex formation ability **(D)** Magnetic moment

74. Acidified $KMnO_4$ can be decolourised by :
(A) SO_2 **(B)** H_2O_2 **(C)** $FeSO_4$ **(D)** $FeCl_3$

75. The lanthanide contraction is responsible for the fact that :
(A) Zr and H*f* have same atomic sizes
(B) Zr and H*f* have same properties
(C) Zr and H*f* have different atomic sizes
(D) Zr and H*f* have different properties

76. Which of the following is(are) not regarded as transition element(s)?
(A) Zn **(B)** Cd **(C)** Hg **(D)** Uub

77. Which of the following is(are) transition element(s)?
(A) Sc **(B)** Cu **(C)** Ag **(D)** Hg

78. Which of the following d-block elements exhibit variable oxidation states?
(A) Zn **(B)** Sc **(C)** Cu **(D)** Fe

79. Identify correct statement related with oxidation states of d-block elements?
(A) The maximum oxidation states of reasonable stability correspond in value to the sum of the s and d electrons upto manganese
(B) Variable oxidation states of transition elements differ from each other by unity
(C) In a group of d-block elements in general higher oxidation states are favoured by the heavier members
(D) In metal carbonyls transition elements are found in lower oxidation state

80. Cr^{2+} is reducing while Mn^{3+} is oxidizing because :
(A) Both have d^4 configuration
(B) In Cr^{2+} its electronic configuration changes from d^4 to d^3
(C) In Mn^{3+} its electronic configuration changes from d^4 to d^5
(D) Of the increasing stability of the species to which they are converted

81. Which of the following d-block elements do not form trihalides?
(A) Fe **(B)** Ni **(C)** Cu **(D)** Zn

82. Which of the following is(are) mixed oxides?
(A) Mn_3O_4 **(B)** Fe_3O_4
(C) Co_3O_4 **(D)** $Fe_{0.93}O$

83. Which of the following halides of copper is(are) not known?

(A) CuF **(B)** CuI **(C)** CuI_2 **(D)** $CuCl_2$

84. Identify correct statement(s) related with Cu?

(A) The standard reduction potential for the reduction of Cu^{2+} to Cu is positive

(B) $Cu^{2+}_{(aq)}$ is more stable than $Cu^{+}_{(aq)}$

(C) Copper (I) compounds undergo disproportionation in aqueous solution

(D) CuI_2 is stable

85. Identify correct statement(s) related with halides of transition elements.

(A) VF_5, CrF_6 and MnF_7 all are known

(B) $VCl_5 + H_2O \rightarrow VOCl_3 + HCl$

(C) $2CuI_2 \rightarrow 2CuI + I_2$

(D) $2FeCl_{3(aq)} + H_2S_{(aq)} \rightarrow 2FeCl_{2(aq)} + 2HCl_{(aq)} + S_{(s)}$

86. Which of the following is/are alloy of transition metals with non transition metals?

(A) Brass **(B)** Bronze

(C) Zinc-amalgam **(D)** German silver

87. The reaction $Fe(CNS)_6^{3-} \rightarrow FeF_6^{3-}$ takes place with :

(A) Increase in spin only magnetic moment **(B)** Change in hybridization state

(C) Change in geometry **(D)** Decrease in number of isomers

88. $[Sc(H_2O)_6]^{3+}$ ion is :

(A) colourless **(B)** diamagnetic

(C) yellow coloured **(D)** paramagnetic

89. Which of the following pair(s) of elements is(are) called "chemical twins" because of their very similar chemical properties?

(A) Li and Mg **(B)** Be and Al

(C) Hf and Zr **(D)** Al and Zn

90. A certain metal will liberate hydrogen from dilute acids. It will react with water to form hydrogen only when the metal is heated and water is in the form of steam. The metal is probably

(A) Iron **(B)** Copper

(C) Zinc **(D)** Sodium

91. $CuSO_{4(aq)} + X \longrightarrow Y +$ other products. 'X' and 'Y' respectively are :

(A) $PH_3; Cu_3P_2$ **(B)** $NH_{3(aq)}, [Cu(NH_3)_4]SO_4$

(C) KI; $Cu_2I_2 + I_2$ **(D)** $KCN; K_3[Cu(CN)_4] + (CN)_2$

92. Many of the metals and/or their compounds are essential catalysts in the chemical industry. Identify correctly matched catalyst and process.

(A) V_2O_5 Catalyses the oxidation of SO_2 in the manufacture of H_2SO_4

(B) $TiCl_4$ and $Al(CH_3)_3$; manufacture of polyethylene

(C) Fe; Manufacture of NH_3 **(D)** Ni; Hydrogenation of fats

93. The correct statement(s) about lanthanides is/are :

(A) Ce^{4+} is a strong oxidizing agent **(B)** All trivalent lanthanoid ions are coloured

(C) La^{3+} and Ce^{4+} are diamagnetic **(D)** Yb^{2+} is paramagnetic

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

94. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Kipp's apparatus waste	**(p)**	$(NH_4)_2SO_4.FeSO_4.6H_2O$
(B)	Green coloured compound	**(q)**	$Cu(OH)_2.CuCO_3$
(C)	Leave(s) brown residue on heating	**(r)**	$FeSO_4$
(D)	Leaves(s) black residue on heating	**(s)**	$CuCl_2.2H_2O$

95. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Fe	**(p)**	Variable oxidation state
(B)	Cu	**(q)**	Coloured aqua complex
(C)	Zn	**(r)**	Extracted from sulphide ores
(D)	Mn	**(s)**	Extracted from oxide ores
		(t)	Becomes passive with conc. HNO_3

96. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	$FeCl_3 \cdot 6H_2O$	**(p)**	Cannot be dehydrated by heating
(B)	$FeSO_4 \cdot 7H_2O$	**(q)**	Can be dehydrated by heating
(C)	$CuSO_4 \cdot 5H_2O$	**(r)**	Paramagnetic
(D)	$ZnSO_4 \cdot 7H_2O$	**(s)**	Coloured salt
		(t)	Forms two oxides of sulphur on heating strongly.

97. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Fe	**(p)**	Catalyst in Haber's process
(B)	Ni	**(q)**	Catalyst in Hydrogenation of vegetable oil
(C)	Pt	**(r)**	Catalyst in contact process
(D)	Pd	**(s)**	Does not form amalgams
		(t)	Absorb large amount of H_2.

98. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Acidic $KMnO_4$	**(p)**	$H_2S \rightarrow S$
(B)	Acidic $K_2Cr_2O_7$	**(q)**	$NO_2^- \rightarrow NO_3^-$
(C)	$FeCl_3$ solution	**(r)**	$I^- \rightarrow I_2$
(D)	$CuSO_4$ solution	**(s)**	Coloured solution

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

99. How many hydrogen bonded water molecule(s) are associated with $CuSO_4 \cdot 5H_2O$?

100. The number of equivalent Cr–O bond(s) in dichromate $(Cr_2O_7^{2-})$ ion are _____.

101. How many ions are formed on dissolving one molecules of Mohr's salts in water?

102. How many of the following hydrated metal halides on heating directly can form anhydrous halides.
$MgCl_2 \cdot 6H_2O$, $AlCl_3 \cdot 6H_2O$, $FeCl_3 \cdot 6H_2O$, $CrCl_3 \cdot 6H_2O$, $LiCl \cdot 2H_2O$, $BaCl_2 \cdot 6H_2O$, $CaCl_2 \cdot 6H_2O$, $SnCl_2 \cdot 2H_2O$, $ZnCl_2 \cdot 2H_2O$

103. Iron is x^{th} most abundant element in the earth's crust. The numerical value of x is _____.

104. The number of peroxide bonds in $Cr_2O_{12}^{2-}$ are_____.

105. Copper sulphate reacts with sodium cyanide and forms a cyanide complex. Write the balanced equation and find out the number of NaCN molecules involved in the equation for one mole of $CuSO_4$?

106. What is the stoichiometric coefficient in balanced reaction of Cu with HNO_3 to produce NO and NO_2 in the ratio 2 : 1?

107. The number of electrons in 5d orbital of Pt (atomic number = 78) are_____.

108. The number of electrons in 5s orbital of Pd (atomic number = 46) are_____.

109. The total number of electrons in s-orbitals of Cu (atomic number = 29) are_____.

110. Predict how many of the following will be coloured in aqueous solution?

$Ti^{3+}, V^{3+}, Cu^{+}, Sc^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+}, Cu^{2+}, Zn^{2+}$

111. Decide how many of the following atomic number are the atomic numbers of the inner transition elements;

29, 59, 74, 95, 102, 104.

112. How many of the following elements of 1st series of d-block elements do not exhibit variable oxidation state?

Sc, Ti, V, Cr, Mn, Fe, CO, Ni, Cu, Zn

113. A well known alloy of lanthanoids is ***misch metal*** which consist of a lanthanoid metal (~ x%) and iron (~ y%) and traces of S, C, Ca and Al. What is the value of y?

114. With how many of following reagents Cu^{2+} gives blue colour solution/precipitation.

(i) $NH_2CH_2CH_2NH_2$ (ii) aq. KCN

(iii) aq. $K_4[Fe(CN)_6]$ (iv) aq. KI

Advanced Problem Package	Qualitative Analysis

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In the precipitation of the iron group in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to

(A) decrease concentration of OH^- ions.

(B) prevent interference by phosphate ions.

(C) increase concentration of Cl^- ions.

(D) increase concentration of NH_4^+ ions.

2. A salt gives violet vapours when treated with conc. H_2SO_4, it contains :

(A) Cl^- **(B)** I^- **(C)** Br^- **(D)** NO_3^-

3. The acidic solution of a salt produced a deep blue colour with starch iodide solution. The salt may be

(A) chloride **(B)** nitrite **(C)** acetate **(D)** bromide

4. When a mixture of solid NaCl, solid $K_2Cr_2O_7$ is heated with conc. H_2SO_4, orange red vapours are obtained. These are of the compound :

(A) chromous chloride **(B)** chromyl chloride

(C) chromic chloride **(D)** chromic sulphate

5. Which of the following pairs of ions would be expected to form precipitate when dilute solution are mixed?

(A) Na^+, SO_4^{2-} **(B)** NH_4^+, CO_3^{2-}

(C) Na^+, S_2^{2-} **(D)** Fe^{3+}, PO_4^{3-}

6. When bismuth chloride is poured into a large volume of water the white precipitate produced is

(A) $Bi(OH)_3$ **(B)** Bi_2O_3 **(C)** BiOCl **(D)** Bi_2OCl_3

7. A mixture, on heating with conc. H_2SO_4 and MnO_2, liberates brown vapour of

(A) Br_2 **(B)** NO_2 **(C)** HBr **(D)** I_2

8. Nitrate is confirmed by ring test. The brown colour of the ring is due to formation of

(A) ferrous nitrite **(B)** nitroso ferrous sulphate

(C) ferrous nitrate **(D)** $FeSO_4 \cdot NO_2$

9. $Fe(OH)_3$ can be separated from $Al(OH)_3$ by addition of

(A) dil.HCl **(B)** NaCl solution

(C) NaOH solution **(D)** NH_4Cl and NH_4OH

10. If NaOH is added to an aqueous solution of zinc ions a white precipitate appears and on adding excess NaOH, the precipitate dissolves. In this solution zinc exist in the

(A) cationic part

(B) anionic part

(C) both in cationic and anionic parts

(D) there is no zinc ion in the solution

11. Sometimes yellow turbidity appears while passing H_2S gas even in the absence of II group radicals. This is because of

(A) sulphur is present in the mixture as impurity.

(B) IV group radicals are precipitated as sulphides.

(C) the oxidation of H_2S gas by some acid radicals.

(D) III group radicals are precipitated as hydroxides.

12. The ion that cannot be precipitated by H_2S and HCl is :

(A) Pb^{2+} **(B)** Cu^{2+} **(C)** Ag^{+} **(D)** Ni^{2+}

13. In V group, $(NH_4)_2CO_3$ is added to precipitate out the carbonates. We do not add Na_2CO_3 along with NH_4Cl because

(A) $CaCO_3$ is soluble in Na_2CO_3.

(B) Na_2CO_3 increases the solubility of V group carbonate.

(C) $MgCO_3$ will be precipitated out in V group.

(D) None of these

14. Which of the following cations is detected by the flame test?

(A) NH_4^+ **(B)** K^+ **(C)** Mg^{2+} **(D)** Al^{3+}

15. Which one among the following pairs of ions cannot be separated by H_2S in dilute HCl?

(A) Bi^{3+}, Sn^{4+} **(B)** Al^{3+}, Hg^{2+}

(C) Zn^{2+}, Cu^{2+} **(D)** Ni^{2+}, Cu^{2+}

16. A metal salt solution gives a yellow precipitate with silver nitrate. The precipitate dissolves in dil. nitric acid as well as in ammonium hydroxide. The solution contains

(A) bromide **(B)** iodide

(C) phosphate **(D)** chromate

17. A metal salt solution forms a yellow precipitate with potassium chromate in acetic acid, a white precipitate with dilute sulphuric acid, but gives no precipitate with sodium chloride or iodide, it is:

(A) lead carbonate **(B)** basic lead carbonate

(C) barium nitrate **(D)** strontium nitrate

18. Which is soluble in NH_4OH?

(A) $PbCl_2$ **(B)** $AgCl$ **(C)** $PbSO_4$ **(D)** $CaCO_3$

19. Prussian blue is formed when

(A) ferrous sulphate reacts with $FeCl_3$

(B) ferric sulphate reacts with $K_4[Fe(CN)_6]$

(C) Ammonium sulphate reacts with $FeCl_3$

(D) ferrous ammonium sulphate reacts with $FeCl_3$

20. Which of the following will not give positive chromyl chloride test?

(A) Copper chloride, $CuCl_2$

(B) Mercuric chloride, $HgCl_2$

(C) Zinc chloride, $ZnCl_2$

(D) Anillinium chloride, $C_6H_5NH_3Cl$

21. A while crystalline substance dissolves in water. On passing H_2S gas in this solution, a black precipitate is obtained. The black precipitate dissolves completely in hot HNO_3. On adding a few drops of conc. H_2SO_4, a white precipitate is obtained. This precipitate is that of

(A) $BaSO_4$ **(B)** $SrSO_4$

(C) $PbSO_4$ **(D)** $CdSO_4$

22. When excess of $SnCl_2$ is added to a solution of $HgCl_2$, a white precipitate turning grey is obtained. The grey colour is due to the formation of

(A) Hg_2Cl_2 **(B)** $SnCl_4$ **(C)** Sn **(D)** Hg

23. Of the following sulphides which one is insoluble in dil. acids but soluble in alkalies.

(A) PbS **(B)** CdS **(C)** FeS **(D)** As_2S_3

24. When chlorine water is added to an aqueous solution of potassium halide in presence of chloroform, a violet colour is obtained. On adding more of chlorine water the violet colour disappears, and a colourless solution is obtained. The test confirms the presence of the following in aqueous solution.

(A) Iodide **(B)** Bromide

(C) Chloride **(D)** Iodide and bromide

25. An aqueous solution of colourless metal sulphate M, gives a white precipitate, with NH_4OH. This was soluble in excess of NH_4OH. On passing H_2S through this solution a white precipitate is formed. The metal M in the salt is

(A) Ca **(B)** Ba **(C)** Al **(D)** Zn

26. A substance on treatment with dil. H_2SO_4 liberates a colourless gas which produces (i) turbidity with baryta water and (ii) turns acidified dichromate solution green. The reaction indicates the presence of

(A) CO_3^{2-} **(B)** S^{2-} **(C)** SO_3^{2-} **(D)** NO_2^-

27. A white solid is first heated with dil H_2SO_4 and then with conc. H_2SO_4. No action was observed in either case. The solid salt contains

(A) sulphide **(B)** Sulphite

(C) thiosulphate **(D)** sulphate

28. On the adding of a solution containing CrO_4^{2-} ions to the solution of Ba^{2+}, Sr^{2+} and Ca^{2+} ions, the precipitate obtained first will be of

(A) $CaCrO_4$ **(B)** $SrCrO_4$

(C) $BaCrO_4$ **(D)** a mixture of all the three

29. A mixture of chlorides of copper, cadmium, chromium, iron and aluminium was dissolved in water acidified with HCl and hydrogen sulphide gas was passed for sufficient time. It was filtered, boiled and a few drops of nitric acid were added while boiling. To this solution ammonium chloride and sodium hydroxide wre added in excess and filtered. The filtrate shall give test for

(A) sodium and iron ion

(B) sodium, chromium and aluminium ion

(C) aluminum and iron ion

(D) sodium, iron, cadmium and aluminium ion

30. A white precipitate obtained durring analysis of a mixture becomes black on treatment with NH_4OH. It may be

(A) $PbCl_2$ **(B)** AgCl **(C)** $HgCl_2$ **(D)** Hg_2Cl_2

31. A salt on treatment with dil. HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The solution gives a yellow precipitate with potassium chromate. The salt is:

(A) $NiSO_4$ **(B)** BaS_2O_3

(C) PbS_2O_3 **(D)** $CuSO_4$

32. Which compound does not dissolve in hot dilute HNO_3?

(A) HgS **(B)** PbS **(C)** CuS **(D)** CdS

33. Which of the following compound on reaction with NaOH and Na_2O_2 gives yellow colour?

(A) $Cr(OH)_3$ **(B)** $Zn(OH)_2$

(C) $Al(OH)_3$ **(D)** None of these

34. An aqueous solution of a substance gives a white precipitate. on treatment with dil. HCl, which dissolves on heating. When hydrogen sulphide is passed through the hot acidic solution, a black precipitate is obtained. The substance is a

(A) Hg^{2+} salt **(B)** Cu^{2+} salt

(C) Ag^{+} salt **(D)** Pb^{2+} salt

35. Which of the following gives a precipitate with $Pb(NO_3)_2$ but not with $Ba(NO_3)_2$?

(A) Sodium chloride **(B)** Sodium acetate

(C) Sodium nitrate **(D)** Sodium hydrogen phosphate

36. Which of the following is soluble in yellow ammonium sulphide?

(A) CuS **(B)** CdS **(C)** SnS **(D)** PbS

37. Which of the following gives blood red colour with KCNS?

(A) Cu^{2+} **(B)** Fe^{3+} **(C)** Al^{3+} **(D)** Zn^{2+}

38. Which of the following is insoluble in excess of NaOH?

(A) $Al(OH)_3$ **(B)** $Cr(OH)_3$ **(C)** $Fe(OH)_3$ **(D)** $Zn(OH)_2$

39. Potassium chromate solution is added to an aqueous solution of a metal chloride. The precipitate thus obtained are insoluble in acetic acid. These are subjected to flame test, the colour of the flame is:

(A) Lilac **(B)** Apple green

(C) Crimson red **(D)** Golden yellow

40. $MgSO_4$ on reaction with NH_4OH and Na_2HPO_4 forms a white crystalline precipitate. What is its formula?

(A) $Mg(NH_4)PO_4$ **(B)** $Mg_3(PO_4)_2$

(C) $MgCl_2 \cdot MgSO_4$ **(D)** $MgSO_4$

Paragraph for Q. 41 - 43

A white solid (A) reacts with dilute H_2SO_4 to produce a colourless gas (B) and a colourless solution (C). The reaction between (B) and acidified dichromate yields a green solution and a slightly coloured precipitate (D). The substance (D), when burnt in air, gives a gas (E) which reacts with (B) to yield (D) and a colourless liquids. Anhydrous copper sulphate turns blue with this colourless liquid. The addition of aqueous NH_3 or NaOH to (C) produces a precipitate that dissolves in an excess of the reagent to form a clear solution.

41. Which of the following gases are (B) and (E) respectively?

(A) CO_2 and SO_2 **(B)** SO_2 and H_2S **(C)** H_2S and SO_2 **(D)** CO_2 and H_2S

42. What would appear if the gas (B) is passed through an aqueous solution of $Pb(NO_3)_2$?

(A) white precipitate soluble in hot dilute HNO_3

(B) A black precipitate soluble in hot dilute HNO_3

(C) A black precipitate insoluble in hot dilute HNO_3

(D) A yellow precipitate soluble in hot concentrated HNO_3

43. Suppose the solution obtained by the treatment of the solution (C) with an excess of NaOH is acidified with acetic acid and the gas (B) is passed through it. Which of the following will obtained?

(A) Colourless solution **(B)** Yellow precipitate

(C) Black precipitate **(D)** White precipitate

Paragraph for Q. 44 - 47

A chemist opened a cupboard to find four bottles containing water solutions, each of which had lost its label. Bottle 1, 2 and 3 contained colourless solutions, while bottle 4 contained a blue solution. The labels from the bottles were lying scattered on the floor of the cupboard. They were:

Copper (II) sulphate; Hydrochloric acid, Lead nitrate; Sodium carbonate

By mixing samples of the contents of the bottles, in pairs, the chemist made the following observation:

Bottle 1 + Bottle 2	White precipitate
Bottle 1 + Bottle 3	White precipitate
Bottle 1 + Bottle 4	White precipitate
Bottle 2 + Bottle 3	Colourless gas evolved
Bottle 2 + Bottle 4	No visible reaction
Bottle 3 + Bottle 4	Blue precipitate

44. Bottle 3 contains

(A) copper (II) sulphate **(B)** hydrochloric acid

(C) lead nitrate **(D)** sodium carbonate

45. When bottle 1 is mixed with bottle 4, white precipitate is observed, which is

(A) $PbSO_4$ **(B)** $PbCO_3$

(C) $PbCl_2$ **(D)** $Pb(NO_3)_2$

46. Which of the following bottle will give distinctive colour with NH_3 ?

(A) Bottle 1 **(B)** Bottle 2

(C) Bottle 3 **(D)** Bottle 4

47. On mixing bottle 2 and bottle 3 sample, a colourless gas evolves. The gas is

(A) N_2 **(B)** CO_2 **(C)** SO_2 **(D)** NO_2

Paragraph for Q.48 - 50

One unknown mixture contains one or two of the following: $CaCO_3, BaCl_2, AgNO_3, Na_2SO_4, ZnSO_4$ and NaOH. The mixture is completely soluble in water and solution gives pink colour with phenolphthalein. When dilute acid is gradually added to the solution, a precipitate is formed which dissolves with further addition of the acid.

48. The mixture is soluble in water to give strong alkali, it confirms

(A) Na_2SO_4 **(B)** $CaCO_3$ **(C)** $ZnSO_4$ **(D)** NaOH

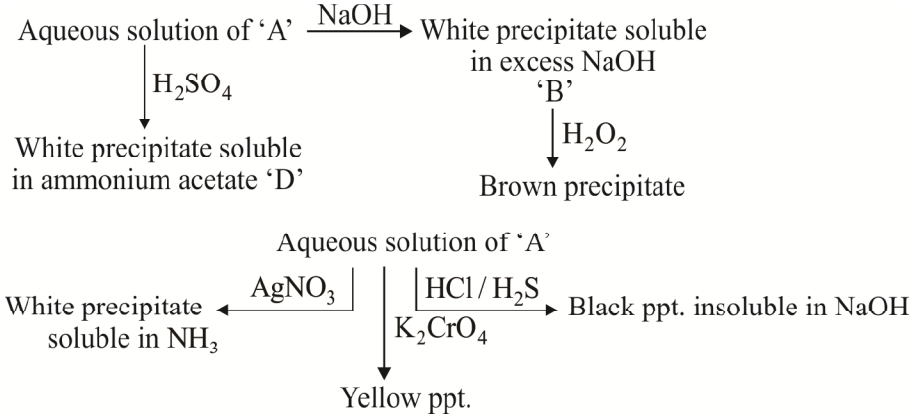
49. The aqueous solution of mixture give white precipitate with dil. HCl which dissolves in excess of dil HCl. It confirms:

(A) $BaCl_2$ **(B)** Na_2SO_4 **(C)** $ZnSO_4$ **(D)** $AgNO_3$

50. The white precipitate is

(A) $ZnSO_3$ **(B)** Na_2ZnO_2 **(C)** $Zn(OH)_2$ **(D)** $ZnCl_2$

Paragraph for Q.51 - 53



51. The complex 'B' soluble in excess NaOH is

(A) $Na[Cu(OH)_4]$ **(B)** $Na_2[Pb(OH)_4]$

(C) $Bi(OH)_3$ **(D)** Na_2SnO_2

52. Aqueous solution of 'A' on treatment with HCl and H_2S gives a black precipitate. Thus which of the following cationic species must be in the compound 'A'?

(A) Hg^{2+} **(B)** Pb^{2+} **(C)** Bi^{3+} **(D)** Cd^{2+}

53. If aqueous solution of 'A' is treated with KI solution, a yellow precipitate comes out. That is

(A) PbI_2 **(B)** AgI **(C)** Hg_2I_2 **(D)** BiI_3

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

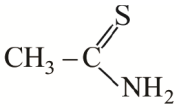
54. $[X] + H_2SO_4 \longrightarrow [Y]\,(gas)$

$[Y] + K_2Cr_2O_7 + H_2SO_4 \longrightarrow$ Green solution. [X] and [Y] respectively are

(A) SO_3^{2-}, SO_2 **(B)** Cl^-, HCl **(C)** S^{2-}, H_2S **(D)** CO_3^{2-}, CO_2

55. $FeCl_3$ (acidified) $+(P) \longrightarrow FeCl_2 +$ other products

Reagent (P) can be

(A) H_2S **(B)** Na_2S **(C)**  **(D)** None of these

56. The salt used for performing "bead" test in qualitative inorganic analysis is/are :

(A) $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ **(B)** $Na(NH_4)HPO_4 \cdot 4H_2O$

(C) $Na_2B_4O_7 \cdot 10H_2O$ **(D)** $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

57. The correct statement(s) in respect to chromyl chloride test is/are

(A) formation of lead chromate **(B)** formation of chromyl chloride

(C) liberation of chlorine **(D)** formation of red vapours

58. $K_4[Fe(CN)_6] + X \longrightarrow Y$

'X' and Y respectively are :

(A) $Fe^{3+}; Fe_4[Fe(CN)_6]_3$ **(B)** $Cu^{2+}; Cu_2[Fe(CN)_6]$

(C) $Zn^{2+}; Zn_2[Fe(CN)_6]$ **(D)** $H_2O_2; K_3[Fe(CN)_6]$

59. Which of the following metal ion form a black precipitate on reaction with H_2S?

(A) Pb^{2+} **(B)** Cu^{2+} **(C)** Hg^{2+} **(D)** Ni^{2+}

60. Fe^{2+} ion and Fe^{3+} ion can be distinguished by

(A) NH_4SCN **(B)** $K_4[Fe(CN)_6]$

(C) CH_3COONa **(D)** $K_3[Fe(CN)_6]$

61. In which of the following salt basic radical can be identified by borax bead test?

(A) $CuSO_4$ **(B)** $FeSO_4$

(C) $NiCl_2$ **(D)** $Co(NO_3)_2$

62. In which of the following salts basic radical can be identified by flame test?

(A) NaCl **(B)** $CaCl_2$ **(C)** $BaCl_2$ **(D)** KNO_3

63. $Salt + H_2SO_4 \xrightarrow{\Delta} Gas.$

Identify correctly matched, salt and gas, pair(s).

(A) Acetic slat; gas with smell of vinegar.

(B) Nitrite salt; gas with brown colour

(C) Sulphide salt; gas with smell of rotten eggs.

(D) Sulphite salt; gas with pungent smell.

64. Mark the correct statement(s).

(A) I group basic radicals precipitates as chlorides

(B) IV group basic radicals precipitates as sulphides.

(C) V group basic radicals precipitates as carbonates.

(D) III group basic radicals precipitates as hydroxides.

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column I are labelled as (A), (B), (C) & (D) whereas statements in Column II are labeled as p, q, r, s & t. More than one choice from Column II can be matched with Column I.

65. MATCH THE COLUMN:

Column –I		Column –II	
(A)	S^{2-}	**(p)**	White precipitate. with $AgNO_3$
(B)	NO_2^-	**(q)**	Evolution of pungent smell gas with (Al + conc. NaOH)
(C)	SO_3^{2-}	**(r)**	Brown fumes with conc. H_2SO_4 (hot)
(D)	CH_3COO^-	**(s)**	Decolourises acidified $KMnO_4$

66. MATCH THE COLUMN:

Column –I (Radicals)		Column –II (Reagents)	
(A)	Pb^{2+}	**(p)**	Dil. HCl
(B)	Co^{2+}	**(q)**	$H_2S + HCl$ (very dil.)
(C)	Zn^{2+}	**(r)**	H_2S (alkaline)
(D)	Hg^{2+}	**(s)**	NH_4OH / OH^-

67. MATCH THE COLUMN:

Column –I (Radicals)		Column –II (Reagents)	
(A)	Cl^-	**(p)**	$K_2Cr_2O_7, H^+$
(B)	SO_3^{2-}	**(q)**	H_2SO_4 (conc.)
(C)	S^{2-}	**(r)**	H_2SO_4 (dil.)
(D)	NO_3^-	**(s)**	$AgNO_3$ solution

68. MATCH THE COLUMN:

Column –I (Radicals)		Column –II (Precipitating form)	
(A)	Pb^{2+}	**(p)**	Hydroxide
(B)	Ni^{2+}	**(q)**	Sulphide
(C)	Cr^{3+}	**(r)**	Carbonate
(D)	Ag^+	**(s)**	Chloride

69. MATCH THE COLUMN:

Column –I (Mixture of radicals)		Column –II (Reagents which are not useful to separate mixture components)	
(A)	Pb^{2+}, Ag^+	**(p)**	HCl, hot water
(B)	Pb^{2+}, Cu^{2+}	**(q)**	KI
(C)	Fe^{3+}, Mn^{2+}	**(r)**	H_2S
(D)	Cd^{2+}, Zn^{2+}	**(s)**	$K_4[Fe(CN)_6]$

70. MATCH THE COLUMN:

Column –I (Radicals)		Column –II Colour of precipitate formed with group reagent in systematic qualitative analysis	
(A)	Fe^{3+}	**(p)**	White
(B)	Pb^{2+}	**(q)**	Black
(C)	Ag^+	**(r)**	Yellow
(D)	Bi^{3+}	**(s)**	Red brown

Numerical value type questions
Inorganic Chemistry

71. Consider the reaction $BCl_3 + 2LiAlH_4 \longrightarrow X$

Compound X contains electron deficient-bonds. Find the maximum number of atoms of compound X that are lying in the same plane.

72. Number of sp^2 hybrid boron atoms in the anion of borax, $Na_2B_4O_7 \cdot 10H_2O$ is_____.

73. How many among the following species contain P-P linkage(s)?

(i) Red phosphorous (ii) $H_4P_2O_5$

(iii) $H_4P_2O_7$ (iv) $(PO_3^-)_3$

(v) P_4O_{10} (vi) P_4S_3

(vii) P_4O_6 (viii) P_4

74. How many of the following reagents will produce at least one oxide of nitrogen in significant quantity?

(i) $Ag + \text{conc. } NHO_3$ (ii) $Sn + \text{cold, dil.}HNO_3$

(iii) heated $Cu + HNO_3$ vapors (iv) $Mg + \text{hot dil. } HNO_3$

(v) $Cr + \text{conc. } HNO_3$ (vi) $Mn + 2\% \ HNO_3$ (very dilute)

(vii) $P_4 + \text{conc. } HNO_3$ (viii) $S_8 + \text{conc.}HNO_3$

(ix) $Cu + \text{dil.}HNO_3$

75. How many of the following on reaction with aqueous HCl as well as with NaOH solution liberate H_2?

B, Al, B_2H_6, B_2O_3, $NaAlH_4$, Al_2O_3

76. How many of the following metallurgical extractions involve leaching for concentration of ore?

$Al_2O_3 \longrightarrow Al$,; $Ag_2S \longrightarrow Ag$; $Au \longrightarrow Au$; $CuFeS_2 \longrightarrow Cu$; $PbS \longrightarrow Pb$

$MgCl_2 \longrightarrow Mg$; $FeCO_3 \longrightarrow Fe$; $HgS \longrightarrow Hg$

77. How many of the following compounds do not impart characteristic colour to the Bunsen flame?

NaCl, $BeCl_2$, KOH, $BaSO_4$, $MgCl_2$, CsCl, Na_2SO_4, $Mg(OH)_2$, K_2CO_3

78. How many geometrical isomers are possible for octahedral complex $[Pt(gly)_2Cl_2]$?

79. Find the number of reducing agents involved in the extraction of pig iron from haematite ore using blast furnace.

80. How many of the following will liberate reddish brown gas on complete reaction with conc. HNO_3?

$H_2C_2O_4$, Fe, Cu, $AgNO_3$, Ag, $FeSO_4$, S_8, $Na_2S_2O_3$

81. How many oxides are soluble in moderately concentrated aqueous solution of NaOH?

SO_3 , Cl_2O_7 , N_2O_5 , CO

K_2O , Cr_2O_3 , BaO , GeO_2

82. How many of the following metals are extracted using self-reduction method? Hg, Cu, Al, Mg, Pb, Fe, Sn .

83. How many of the following species are not known?

$PH_3, PH_5, SF_6, PbI_4, NCl_5, OF_2, OF_4, HFO_4, FeI_3, KHF_2$, HOF

84. How many of the following relations is/are correct?

(a) $Mg > Al$ (electropositive character) (b) $Al > Ga$ (electronegativity)

(c) $N^+ > N$ (Ionization energy) (d) $Se > S$ (magnitude of $\Delta_{eg}H$)

(e) $He^+ > H$ (Atomic size) (f) $O_2^{2-} < O_2$ (paramagnetic nature)

(g) $C_2 > N_2$ (Number of π bonds) (h) $F_2 > B_2$ (bond order)

85. How many oxygen atoms in emerald $[Be_3Al_2Si_6O_{18}]$ are part of a ring?

86. Find the number of compounds where $d_{x^2-y^2}$ orbitals will not take part in hybridisation.

(1) $[Pt(NH_3)Cl(H_2O)Br]$ (2) SF_4

(3) $[Cu(NH_3)_4]^{2+}$ (4) XeO_3F_2

(5) XeO_2F_2 (6) $[Co(en)_3]^{3+}$

(7) $[Fe(CO)_5]$ (8) $POCl_3$

(9) XeF_4 (10) XeO_6^{4-}

(11) $[Ni(dmg)_2]$ (12) $[Ni(PPh_3)_2Cl_2]$

(13) $[PdCl_4]^{2-}$ (14) $[Cu(CN)_4]^{3-}$

(15) $[Fe(NO)(H_2O)_5]^{2+}$ (16) SNF_3

(17) ICl_4^-

87. How many of the following oxides are anhydrides of dibasic oxy-acid?

(i) SO_2 (ii) P_4O_{10} (iii) NO_2

(iv) CO_2 (v) N_2O (vi) CO

(vii) ClO_2 (viii) Cl_2O (ix) I_2O_5 (x) SeO_2

88. Number of pairs of ions which are coloured in aqueous solutions?

(i) Ti^{3+}, V^{3+} (ii) Cu^+, Sc^{3+} (iii) Fe^{2+}, Fe^{3+}

(iv) Co^{2+}, Ni^{2+} (v) Zn^{2+}, Ag^+ (vi) Mn^{2+}, Cr^{3+}

(vii) Al^{3+}, Bi^{3+}

89. How many of the following pairs of ions can be separated by using H_2S in dilute HCl?

Bi^{3+} and Sn^{4+}, Al^{3+} and Hg^{2+}, Cd^{2+} and Zn^{2+}, Fe^{3+} and Cu^{2+}, As^{3+} and Sb^{3+}

90. The number of completely filled orbitals in $_{29}Cu$ which have atleast two radial nodes is/are:

91. How many of the following are used for extraction of metal by electrometallurgy?

$NaCl, Cr_2O_3, MgCl_2, Al_2O_3, CaCl_2, Fe_2O_3$

92. Depending upon the nature of oxides, they are classified as acidic, basic, amphoteric and neutral oxides. Among the following, the total number of acidic oxides are:

$NO_2, CuO, CO_2, P_4O_6, CO, PbO_2, Cr_2O_3, SnO_2, CrO_3, Mn_2O_7, OsO_4, I_2O_5, BeO, Al_2O_3$.

93. In how many of the following reactions, one of the products is obtained as a yellow precipitate?

$Ba^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow$ products

$Ag^{+}(aq) + Br^{-}(aq) \longrightarrow$ products

$Pb^{2+}(aq) + I^{-}(aq) \longrightarrow$ products

$NH_4^{+}(aq) + [PtCl_6]^{2-}(aq) \longrightarrow$ products

$Cd^{2+} + Na_2S \rightarrow$ Products

$Na_3PO_4 + (NH_4)_2M_0O_4 \rightarrow$ Products

94. How many of the following on heating with NaOH produce a gaseous substance?

Cl_2, S_8, P_4, Al, B, Fe, Be, Zn, F_2, XeO_3

95. How many of the following do not have lone pair of electrons on central atom?

(i)	XeF_4	**(ii)**	NH_3	**(iii)**	SO_2	**(iv)**	NO_3^-
(v)	O_3	**(vi)**	$XeOF_4$	**(vii)**	ICl_3	**(viii)**	IF_7
(ix)	SO_4^{2-}	**(x)**	XeO_3				

96. In how many of the following complex ions, the central metal ions use (n – 1)d, ns and np orbitals for hybridisation?

$[Mn(CN)_6]^{4-}, [Ni(NH_3)_6]^{2+}, [Co(NO_2)_6]^{4-}, [AgF_4]^{-}, [Ni(CN)_4]^{2-}, [PdCl_4]^{2-}, [Pd(CN)_4]^{2-}, [Co(SCN)_4]^{2-}$

97. A complex, Prussian blue, has formula $Fe_4[Fe(CN)_6]_3$. What is the sum of oxidation numbers of iron in ionisation sphere and coordination sphere?

98. Find the value of spin only magnetic moment in BM for species X in the reaction given below? $Mn^{2+} + S_2O_8^{2-} \longrightarrow [X] + SO_4^{2-} + H^{+}$.

99. How many of the following orders are correct:

(i) $Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Ba(OH)_2$ Basic character

(ii)	$BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$	Decomposition temperature
(iii)	$Na^+ > Mg^{2+} > Li^+ > Be^{2+}$	Size in gas phase
(iv)	$Li_2CO_3 > Na_2CO_3 > K_2CO_3 > Rb_2CO_3 > Cs_2CO_3$	Water solubility
(v)	$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$	Thermal Stability
(vi)	$NaF < NaCl < NaBr < NaI$	Melting point
(vii)	$He < O_2 = CO_2 < O_3 = CH_4$	Value of poison's ratio (γ)
(viii)	$Na_2O_2 < KO_2 < O_2[AsF_4]$	$O-O$ bond length

100. How many of the following oxides show amphoteric nature?
$V_2O_3, V_2O_5, CrO, CrO_3, Cr_2O_3, Mn_2O_7, FeO, Cu_2O, ZnO$.

101. Reaction of hydrated ferric chloride $(FeCl_3 \cdot 6H_2O)$ with thionyl chloride gives anhydrous ferric chloride with evolution of hydrochloric acid (HCl) and sulphur dioxide (SO_2) gases. The number of sulphur dioxide (SO_2) molecules involved in the balanced chemical equation is:

102. An unknown metal, M, with excess chlorine to give the metal chloride, MCl_x. When 0.396 g of the chloride is dissolved in water and passed through an anion exchange column charged with hydroxide ions, the solution required 23.55 mL of 0.195 M HCl for neutralization.

(a) Calculate the number of moles of HCl used in the titration

(b) Determine the mass of chlorine and the mass of metal in this sample of MCl_x

(c) Assuming that x in MCl_x is 1, 2 and 3, calculate possible atomic masses for M

(d) Use for knowledge of the Periodic Table to write formulas for the possible compounds between chlorine and metals and identify those expected to be stable

103. The behaviour of elements can often be predicted based on their positions in the Periodic Table. Use your knowledge about trends in the behaviour of elements to answer the following questions about the recently isolated elements 114, 116 and 118.

(a) Give the names and symbols of the elements in the row above 114, 116 and 118 in the Periodic Table

(b) Predict the relative ionization energies of elements 114, 116 and 118 and describe how the ionization energy of one of them is expected to compare with the ionization energy of the element above it, giving reasons for your answers

(c) Predict the oxidation states expected for element 114 and indicate which oxidation state is expected to be most stable, giving reasons for your answer

(d) Suggest a reason that elements 114, 116 and 118 have been made, but elements 113, 115 and 117 have not

104. When a mixture of a metal carbonate, MCO_3, and its oxide, MO, is heated to release carbon dioxide gas and is converted completely to the metallic oxide, MO.

(a) If a 0.6500 g sample of MCO_3 and MO forms 0.1575 L of carbon dioxide gas at 25.0 °C and a barometric pressure of 700.0 mm Hg, determine the number of moles of CO_2 formed.

(b) When the 0.3891 g of MO resulting from the process in a is titrated with 0.500 M HCl, 38.60 mL are required. Determine the number of moles of MO in 0.3891 g.

(c) Determine the atomic mass of the metal M and give its symbol.

(d) Determine the mole percentages of MCO_3 and MO in the original sample.

105. This question concerns the chemistry of the Group 13 elements (B - Tl). Base your answers on principles of atomic structure and bonding.

(a) The first ionization energies (IE) of most main group elements decrease steadily upon descending the family whereas the first IE of B-Tl are [B 801, Al 578, Ga 579, In 558, Tl 589] $kJ\,mol^{-1}$.

(i) Explain briefly why the IEs for most families decreases steadily upon descending a family.

(ii) Suggest a reason that the IE for Ga is essentially the same as that for Al and the IE for Tl is greater than that for In.

(b) The members of this family exhibit oxidation states of +1 and/or +3.

(i) Account for the fact that the stable oxidation states are +1 and -3 and a + 2 oxidation state is not observed.

(ii) Account for the fact that B and Al show the +3 oxidation state exclusively while the +3 state for Tl is a strong oxidizing agent.

(c) BCl_3 and $AlCl_3$ are strong Lewis acids.

(i) Write an equation to illustrate BCl_3 acting as a Lewis acid with an appropriate Lewis base. Explains what occurs in a Lewis acid-base reaction.

(ii) Account for the fact that the Lewis acidity of the other tri-chlorides decreases down the family.

106. Explain each of the following observations using acid-base principles.

(a) The acids HCl and HBr appear equally strong in H_2O but HBr is a stronger acid in 100% (glacial) acetic acid.

(b) The acidity of anhydrous H_2SO_4 is much less than the acidity of fuming H_2SO_4 (a saturated solution of SO_3 in H_2SO_4).

(c) The first and second ionization constants for sulfurous acid, H_2SO_3 (aq), differ by a factor of $\sim 2\times10^5$ while the first and second ionization constants of hydrosulfuric acid, H_2S (aq), differ by a much greater factor $(\sim 1\times10^{12})$.

107. A salt containing chromium, chlorine, and water has the formula $CrCl_n(H_2O)_m$.

(a) A sample of the salt is electrolyzed for 1310 s using n current of 1.24 A and deposits 0.292 g metallic Cr,. What is the value of n in the salt ?

(b) A 3.000 g sample of the chromium salt is heated carefully at $600°C$ to drive off any water in the salt, until the sample achieves a constant mass of 1.783 g. What is the value of m in the salt ?

(c) A 0.300 g sample of the chromium salt is dissolved in 10 mL water to which a few drops of Na_2CrO_4 solution have been added. A 0.400 M solution of silver nitrate is titrated quickly into the solution until the appearance of a dark red colour ; this requires 2.81 mL of the $AgNO_3$ solution.

(i) Write balanced chemical equations for the reaction taking place during the titration and the reaction that takes place at the endpoint.

(ii) How many moles of chloride are detected in this titration per mole of chromium present ?

(d) Propose an explanation for the result in part (c) (ii).

108. Chlorine is an industrially and biologically important element.

(a) Give the ground state electron configuration for gas-phase atomic Cl.

(b) Draw a Lewis structure for molecular chlorine, including all lone pairs and any formal charges.

(c) Which would have a greater first ionization energy, atomic Cl or molecular chlorine ? Justify your answer.

(d) Which would have a larger radius, atomic Cl or the chloride ion (Cl^-) ? Justify your answer.

(e) Explain why the oxoanions ClO^-, ClO_2^-, ClO_3^- and ClO_4^- all form stable salts, but the oxoanion ClO_5^- is unknown.

109. A compound used as a fertilizer contains only the elements C, H, N and O.

(a) Combustion of 1.000 g of the fertilizer in an oxygen atmosphere produces 0.5637 g CO_2, 0.6924 g H_2O, and 0.3589 g N_2. What are the mass percentages of C, H and N in the fertilizer ?

(b) Give the empirical formula of the fertilizer.

(c) A solution of 1.000 g of the fertilizer dissolved in 20.00 g water has a freezing point of $-2.38\,°C$. What is the apparent molar mass of the fertilizer? Combined with the result in (b), what is the implication of this molar mass ? (For water, the freezing point depression constant $K_f = 1.86\ °C/m$).

(d) Propose a structure for the fertilizer compound.

110. Oxygen and sulfur form a number of binary fluorides.

(a) Draw the Lewis structure of dioxygen difluoride, O_2F_2, and sketch or describe the three-dimensional shape of this polar molecule.

(b) Explain why the $O-F$ bonds in dioxygen difluoride, O_2F_2 (157.5 pm) are much longer than those in oxygen difluoride, OF_2 (140.5 pm).

(c) Disulfur difluoride, S_2F_2, exists as two structural isomers. One isomer is analogous in structure to dioxygen difluoride, O_2F_2, but the second, more thermodynamically stable isomer, has a structure in which the two sulfur atoms are in different chemical environments. Draw a Lewis structure of the more stable isomer of disulfur difluoride, S_2F_2, and sketch or describe its three dimensional shape.

(d) Sulfur difluoride, SF_2, is very unstable, converting to disulfur tetraflouride, S_2F_4, in which all four fluorines are in different environments. Clearly show a chemical reasonable three-dimensional structure of disulfur tetrafluoride, S_2F_4, and explain how the structure accounts for the inequivalence of all four fluorine atoms.

(e) Sulfur tetrafluoride, SF_4 (bp $-38\,°C$), has a higher boiling point than sulfur hexafluoride, SF_6 (bp $-64\,°C$). Explain why sulfur tetrafluoride, SF_4 is less volatile than sulfur hexafluoride, SF_6.

111. Studtite is a mineral that contains only hydrogen, oxygen, and a metal M. Its empirical formula is $MO_x(H_2O)_y$, where x and y are integers.

A 1.0000 g sample of studtite is heated at $520\,°C$, which cause it to decompose to molecular oxygen, water vapour, and the solid metal trioxide MO_3. The gases from this reaction are collected in a rigid container with a volume of 1.000 L. When this container is maintained at $200.0\,°C$, the pressure is 355.0 mm Hg. When the container is cooled to

25°C, some of the water vapor condenses to the liquid, and the pressure in the container falls to 48.65 mm Hg. The vapour pressure of water at 25.0°C is 23.80 mm Hg.

(a) Calculate the number of moles of O_2 produced in this reaction.

(b) Calculate the number of moles of H_2O produced in this reaction.

(c) Calculate the mass of solid MO_3 produced in this reaction.

(d) What is the identity of the metal M ? Support your answer.

(e) What is the oxidation state of the metal M in the mineral studtite ? Explain your answer.

112. The chemistry of beryllium (Be) has a number of interesting features.

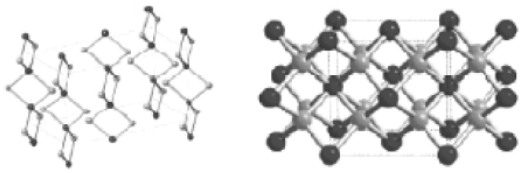
(a) Explain the difference between Be and its heavier congener, barium (Ba), with regard to the following properties.

(i) Be has a higher ionization energy ($900\,kJ\,mol^{-1}$) than Ba ($563\ kJ\ mol^{-1}$).

(ii) Adding an electron to gas-phase Be atom requires energy, while adding an electron to a gas-phase Ba atom releases a small amount of energy ($14\ kJ\,mol^{-1}$).

(iii) $BeCl_2$ (s) has a more positive ΔH_f° ($-496.2\ kJ\,mol^{-1}$) than $BaCl_2$ (s) ($-858.6\,kJ\,mol^{-1}$)

(iv) Solid $BeCl_2$ adopts the structure shown on the left, while solid $BaCl_2$ adopts the structure shown on the right (metal = black spheres, chlorine = gray spheres).



$BeCl_2$ $BaCl_2$

(b) In the vapor phase, $BeCl_2$ exists as a mixture of $BeCl_2$ monomers and Be_2Cl_4 dimers. Draw or clearly describe the geometries of these two gas-phase species.

(c) At 800 K, K_p for dimerzation of $BeCl_2(g)$ is 2.9.

$$2BeCl_2(g) \rightleftharpoons Be_2Cl_4(g) \qquad K_p = 2.9$$

Calculate the mole fraction of dimeric Be_2Cl_4 in $BeCl_2$ vapor at a total pressure of 1.100 bar at 800 K.

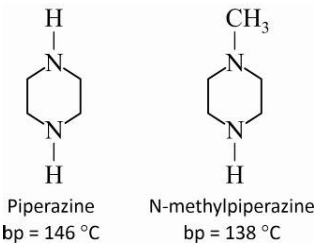
113. Borazine, $B_3N_3H_6$, has a structure consisting of a six-membered ring with alternating BH and NH groups.

(a) Draw a Lewis structure for borazine, including non-zero formal charges if needed. Show all major resonance structures of borazine.

(b) Two other compounds containing boron, nitrogen, and hydrogen are BH_3NH_3 and BH_2NH_2. Draw Lewis structures for these two compounds, again including any formal charges and major resonance structures.

(c) The B – N distances in $B_3N_3H_6$, BH_3NH_3 and BH_2NH_2 are 139.1, 142.9 and 156.4 pm (not necessarily in that order). Assign each B – N distances to the proper compound and explain your reasoning.

(d) Typically, when one replaces a hydrogen attached to N with a CH_3 group, the boiling point of the compound decreases. For example, piperazine has a normal boiling point of 146°C while N-methylpiperazine has a normal boiling point of 138°C. Explain this observation.



Piperazine bp = 146 °C | N-methylpiperazine bp = 138 °C

(e) In contrast to the situation in (d), when one $N-H$ group in borazine (bp = 55 °C) is changed to an $N-CH_3$ group, the normal boiling point of N-methylborazine increases significantly, to 84 °C. Explain why the usual trend in boiling points is not observed for borazine and N-methylborazine.