## Topics Covered by <u>Chemistry</u> Aptitude Test for Admission and Placement

Subject	Items
1- Atomic structure for chemical compounds and their physical properties	Elements, compounds and mixtures - State of Matter and Properties - Chemical symbols - Predicting the number of elements in a compound - Predicting the number of atoms in a compound - Density - Periodic table - Atomic structure - Eelectronic configuration - Predicting the number of protons, neutrons and electrons - Chemical bonds - Isotopes.
2- Chemical equations and naming of inorganic compounds-chemical calculations	Chemical formulae - Naming of inorganic compounds - lonic compounds - Calculating the formula mass - Calculating the number of moles - Calculating the number of grams - Calculating the mass of one atom - Atom and mole ratio in a compound - Calculating the number of atoms and molecules - Balancing chemical equations - Predicting the products of chemical reactions - Predicting the mole ratio from a balanced chemical equation - Predicting the type of chemical reaction - Calculating the percentage.
3- Chemical equilibrium for acids, bases, salts and oxidation - reduction reactions	Predicting the number of ions in a formula unit - Assigning oxidation numbers - Assigning atoms changing their oxidation state in redox reactions - Acids and bases - Acid-base reactions - Calculating the [H $^{\dagger}$ ] and pH - Calculating the [OH $^{\dagger}$ ] and pOH - Acid dissociation constants ( $K_a$ ) - Base dissociation constants ( $K_b$ ) - Buffer solutions - Acid - base titration - Equilibrium expressions - Equilibrium constants - The solubility and solubility product ( $K_{sp}$ ).
4- Solution chemistry	Molarity - Saturated, Unsaturated and Supersaturated solutions.
5- Organic compounds and functional groups	Hydrocarbon compounds - Arematic hydrocarbons - Functional groups.

## **Details of the Test Topics**

The students should be able to understand the following basic concepts in chemistry and solve problems related to items for each concept.

i) Elements, Comp	or Chemical Compo oounds and Mixtures	•	*
anemia. Vitamin	B <sub>12</sub> has the molecular	ary for proper health formula, C <sub>63</sub> H <sub>88</sub> CoN	<ol> <li>It is used in the treatment of N<sub>14</sub>O<sub>14</sub>P. How many elements are</li> </ol>
present in Vitam			38.74
A) 5	B) 181	C) 6	D) 7
Example 1.2: W	hich of the following i	s classified as a mixt	ure?
A) Water	B) A pure gold co	in C) Table sa	alt D) Air
i) State of Matter	and Properties:		
		substances exist as a	liquid under ordinary conditions
of temperature ar			
A) Sodium car		B) Carbon	monoxide
C) Mercury		D) Hydrog	
Example 1.4: H	ow many phases are	present in the follow	ving well-mixed system: [sand +
salt + sugar + wa	ter + gasoline]		
A) 5	B) 3	C) 2	D) 4
Example 1.5: A chemical propert		are properties of o	xygen. Which one represents a
A) It is a gas at		B) It cause	s iron to form rust
C) It can be co		D) It freeze	
C) it can be co	mpressed	D) ii ireeze	28 at -219 C
water, can be ma			th a density greater than that of tich of the following properties is
<ul> <li>A) Specific heat</li> </ul>	at B) Surface ter	ision C) Melting	point D) Viscosity
ii) Chemical Symb	ools:		
Example 1.7: W	hich of the following e	lements is paired wit	th the wrong symbol?
A) Silver - Ag		B) Nitroger	n - Ni
<ul><li>C) Magnesium</li></ul>	- Mg	D) Lithium	ı-Li
v) Predicting the	Number of Elemen	ts in a Compound	& Predicting the Number of
Atoms in a Com		12	
	hich of the following	oxyanions (anion co	ontaining oxygen atoms) contain
A) Nitrate	B) Sulfate	C) Carbonate	D) Bicarbonate
See example 1.1		C) Caroonale	of Diemodiate

				30.0 mL. H			e placed s are in t			a cynnae
	A) 60	iner rever	B) 40			32		25		
		T	V21 ¥				02-025			
VI	) Periodic Number of			Structure r of Neutro				nligurati	on-Predic	eting the
				configurati				atom (M	g) in the	outermos
	shell (last c			50		44				
	A) 2s <sup>2</sup> 2p		B) 3s	L	C)	2s <sup>2</sup> 2p <sup>1</sup>	D)	3s <sup>2</sup> 3p <sup>1</sup>		
	Example 1	.11: How	many ne	utrons are i	n the i	on ${}^{52}_{24}\text{Cr}^3$	*9			
	A) 24		B) 28	:	C)	25	D)	27		
vii	i) Chemical	Bonds:								
			bond for	med betwee	n amr	nonia mo	lecule (	NH <sub>3</sub> ) and	i hydrogei	n ion (H
	is known as						Santana Marie Contract	A THE LEWIS CO.		
	A) Ionic	bond				B) C	ovalent	bond		
	C) Coord	linate cov	alent bon	d (dative be	ond)	D) N	detallie	bond		
	hemical Eq									
						nula that	,			
	A) AICl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H-SO <sub>4</sub>		Sodiun Carbon	nium chlorio 1 nitrate 1 monoxide						
	A) AICl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub>	Algorithm (Algorithm)	Alumir Sodiun	nium chlorio 1 nitrate 1 monoxide						
ii)	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub>	pounds:	Alumir Sodiun Carbon Sulfuri	nium chlorio 1 nitrate 1 monoxide e acid	ie				1.7	3.
ii)	A) AICl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example	pounds: 2.2: Ho	Alumir Sodium Carbon Sulfuri w many	nium chlorio 1 nitrate 1 monoxide e acid	ie				d if you	dissolv
ii)	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce(	pounds: 2.2: Ho	Alumir Sodium Carbon Sulfuri w many w water?	nium chlorio i nitrate i monoxide e acid ions per	ie	da unit		you fin		dissolv
li)	A) AICl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example	pounds: 2.2: Ho	Alumir Sodium Carbon Sulfuri w many	nium chlorio i nitrate i monoxide e acid ions per	ie					dissolv
	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce( A) 3	pounds: 2.2: Ho NO <sub>3</sub> ), in	Alumir Sodium Carbon Sulfuri w many water? B) 9	nium chlorid i nitrate i monoxide e acid ions per	le form	ıla unit C) 2	would	you fin		dissolv
	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce( A) 3	pounds: 2.2: Ho NO <sub>3</sub> ), in	Alumir Sodium Carbon Sulfuri w many water? B) 9	nium chlorid i nitrate i monoxide e acid ions per	de formi	da unit C) 2 SO <sub>4</sub> ,7H <sub>2</sub> O	would	you fin		dissolv
	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce( A) 3	pounds: 2.2: Ho NO <sub>3</sub> ) <sub>6</sub> ] in ig the Fo	Alumir Sodium Carbon Sulfuri w many a water? B) 9	nium chlorid i nitrate i monoxide e acid ions per	de formi	ola unit C) 2 SO <sub>4</sub> ,7H <sub>2</sub> O B) 126.	would ). 14 g/mo	you fin D) t		dissolv
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iii	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce( A) 3 ) Calculatin Example 2 A) 120.3 C) 246.5	pounds: 2.2: Ho NO <sub>3</sub> ) <sub>6</sub> ] in ig the Fo .3: Calcu 7 g/mole 4 g/mole	Alumir Sodium Carbon Sulfuri w many n water? B) 9	nium chlorio n nitrate n monoxide c acid ions per ions per ass:	de formi	ola unit C) 2 SO <sub>4</sub> ,7H <sub>2</sub> O B) 126.	would ). 14 g/mo	you fin D) t		dissolv
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iii	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce( A) 3 ) Calculatin Example 2 A) 120.3 C) 246.5	pounds: 2.2: Ho NO <sub>3</sub> ) <sub>6</sub> ] in  ig the Fo .3: Calcu 7 g/mole 4 g/mole ig the Nu .4: How	Alumir Sodium Carbon Sulfuri w many a water? B) 9	nium chlorio n nitrate n monoxide c acid  ions per  ass: nolar mass o	ie form of MgS	C) 2 SO <sub>4</sub> ,7H <sub>2</sub> O B) 126. D) 222.	would ). 14 g/mo 57 g/mo re in 75.	you fin D) ( ole ole	6	dissolv
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iii	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce(A) 3 Calculatin Example 2 A) 120.3 C) 246.5 Calculatin Example 2 C <sub>36</sub> H <sub>18</sub> O <sub>4</sub> N A) 0.224	pounds: 2.2: Ho NO <sub>3</sub> ) <sub>6</sub> ] in ing the Fo .3: Calcu 7 g/mole 4 g/mole ing the Nu .4: How [2S? [mole	Alumir Sodium Carbon Sulfuri w many m water?  B) 9 ormula M date the many mo ar mass of B) 0	nium chlorio n nitrate n monoxide c acid  ions per  ass: nolar mass o Moles: les of nitros f penicillin	form of MgS gen (N = 334.	(C) 2 (C) 2 (SO <sub>4</sub> ,7H <sub>2</sub> O (B) 126, (D) 222, (atoms a 28 g/mole (C) 0.44	would 14 g/mo 57 g/mo re in 75, c]	you find D) to ble ble O g of pe D) t	6 enicillin, 0.296	dissolv
iii	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce(A) 3 Calculatin Example 2 A) 120.3 C) 246.5 Calculatin Example 2 C <sub>36</sub> H <sub>18</sub> O <sub>4</sub> N A) 0.224	pounds: 2.2: Ho NO <sub>3</sub> ), in  ing the Fo 3: Calcu 7 g/mole 4 g/mole 4 g/mole 4: How 2S? [mole	Alumir Sodium Carbon Sulfurion w many many mula Malate the many moar mass of B) 0 h of the fe	nium chlorio n nitrate n monoxide c acid ions per ass: nolar mass o Moles: les of nitrog f penicillin	form of MgS gen (N = 334.	(a unit C) 2 SO <sub>4</sub> .7H <sub>2</sub> O B) 126. D) 222. ) atoms at 28 g/mole C) 0.44 2.00 mol	would  14 g/mo 57 g/mo re in 75, c] 9	you find D) to ble ble O g of pe D) t	6 enicillin, 0.296	dissolvi
iii	A) AlCl <sub>3</sub> B) NaNO <sub>3</sub> C) CaO D) H <sub>2</sub> SO <sub>4</sub> Ionic Com Example (NH <sub>4</sub> ) <sub>2</sub> [Ce(A) 3 Calculatin Example 2 A) 120.3 C) 246.5 Calculatin Example 2 C <sub>16</sub> H <sub>18</sub> O <sub>4</sub> N A) 0.224 Example 2	pounds: 2.2: Ho [NO <sub>3</sub> ) <sub>6</sub> ] in  ing the Fo [.3: Calcu 7 g/mole 4 g/mole ing the Nu [.4: How [.5? [mole ].5: Whice gethane (	Alumir Sodium Carbon Sulfurion w many many mula Malate the many moar mass of B) 0 h of the for C <sub>2</sub> H <sub>6</sub> )	nium chlorida nitrate i monoxide i monoxide cacid ions per ass: nolar mass of molar mass of penicillinates of mitrograms of mitrograms of penicillinates of penicillinates of mitrograms of penicillinates of penici	form of MgS gen (N = 334.	(C) 2 (C) 2 (C) 2 (C) 304.7H <sub>2</sub> O (B) 126. (D) 222. (E) 310ms at 28 g/mole (C) 0.44 (E) 0.44 (E) 2.00 mole (B) 26.0	would  14 g/mo 57 g/mo re in 75, e] 9 es of ca	you find the ple ble Dig Thomator ator	6 enicillin, 0.296	dissolv

Example 1.9: A graduated cylinder contains 50.0 mL of water. Uniform stones, each

v) Density:

	v) Calculating the	Number of Grams:					
Exar	nple 2.6: Which of the	e following substances	contains the greatest	mass of chlorine (Cl <sub>2</sub> )?			
	A) 5.0 g Cl <sub>2</sub>		B) 0.50 mol	e Cl-			
	C) 0.10 mole KCI		D) 30.0 g M				
		rathle services and a service service		27 J. Charles			
		Mass of one Atom:					
	Example 2.7: W	hat is the mass of one		46.5			
	A) 1.99 x 10 <sup>-23</sup>	ş	B) 0.502 x 1				
	C) 0.502 x 10°	. g	D) 1.99 x 10	) <sup>23</sup> g			
	vii) Atoms and Mo	le Ratio in a Compou	ind:				
		or baking soda, NaHCC		atio of C to O?			
	A) 1:1	B) 3:1	C) 1:2	D) 1:3			
	viii) Colculating th	e Number of Atoms a	and Molasulass				
		ne mole of any elemen					
	A) 3.011 x 10 <sup>2</sup>	atoms	B) 6.022 x 1	0 <sup>23</sup> atoms			
	C) 1.506 x 10 <sup>2</sup>	atoms	D) 12.04 x 1				
	C) 1.500 x 10	atoms	D) 12.04 A 1	o atoms			
	ix) Balancing Cher	nical Equations:					
		Considering the following	ng reaction:				
		q) + CaBr <sub>2</sub> (aq)		a(NO <sub>3</sub> ) <sub>2</sub> (aq)			
	the coefficient l		Secretary Management (1997)	T WALL D			
	A) I	B) 2	C) 4	D) 5			
				id to form three products; salt,			
	<ul> <li>A) Hydrogen</li> </ul>	A MARCHINE AND A SECOND	B) Carbon m	ionoxide			
	C) Chlorine		D) Carbon d				
	Example 2.12: 0 2NH <sub>3</sub> (g)	Note Ratio from a Balaiven the balanced equi- + 3O <sub>2</sub> (g) + 2CH <sub>4</sub> (g) ratio for the mole conv	ation:  → 2HCN(	$g) + 6H_2O(1)$			
	A) 3 mole O <sub>2</sub> /1			/2 mole HCN			
	C) 2 mole HCN			2/2 mole HCN			
		Type of Chemical Re-					
	2KClO <sub>3</sub> (s	$\frac{\text{MnO}_2}{\text{Heat}} \rightarrow 2\text{KC}$	$(s) + 3O_2(g)$				
	A) Single displa		B) Decompo	sition			
	<ul> <li>A) Single displacement</li> <li>C) Double displacement</li> </ul>		D) Combustion				
3-	Chemical Fauilibri	ium for Acids Doses	Salte and Oxidation	Daduation Boostians.			
	Chemical Equilibrium for Acids, Bases, Salts and Oxidation-Reduction Reactions:  i) Predicting the Number of Ions in a Formula Unit:						
	Example 3.1: How many ions per formula unit would you find if you dissolve KClO <sub>3</sub> in water?						
	A) 3	B) 9	C) 2	D) 6			
	See example 2.2	STEP FOR EX	1500 E	200 B 100			

ii)	Assigning Oxidation Numbers and Atoms changing their Oxidation State in Redox
	Reactions:  Example 3.2: Which of the following is an oxidation-reduction reaction?
	A) $HC_2H_3O_2(aq) + H_2O(\ell) = H_3O'(aq) + C_2H_3O_2(aq)$
	B) $Zn^{2+}(aq) + H_2(g) = Zn(s) + 2H'(aq)$
	C) $HNO_2(aq) + H_2O(\ell)$ $\longrightarrow$ $H_3O'(aq) + NO_2(aq)$

Example 3.3: The oxidation number of nitrogen atom in NaNO<sub>2</sub> is:

A) +3

B) -2

C) -3

D) +1

iii) Acids and Bases, and Acid-Base Reactions:

D)  $2H_2O(g)$   $\longrightarrow$   $2H_2(g) + O_2(g)$ 

Example 3.4: A neutral solution can be obtained by mixing equal volumes of the same concentration of:

A) HCl and NH<sub>3</sub>
B) CH<sub>3</sub>COOH and NaOH
C) HCOOH and KOH
D) HCl and NaOH

iv) Calculating the [H+] and pH, and Calculating [OH] and pOH:

Example 3.5: The pH is defined as:

A) 
$$pH = -log[H^+]$$
  
B)  $pH = log[H^+]$   
C)  $pH = [H^+]$   
D)  $pH = [H^+]^2$ 

v) Acid Dissociation Constants (Ka) and base Dissociation Constants (Kb):

Example 3.8: Given the following equilibrium system, what is the expression of K<sub>a</sub>?

$$HC_2H_3O_2(aq) + H_2O(1)$$
  $\longrightarrow$   $C_2H_3O_2(aq) + H_3O^{\dagger}(aq)$ 

$$\begin{array}{lll} A) \ \ K_a = & \frac{ \left[ C_2 H_3 O_2 \right] \left[ H_3 O^4 \right] }{ \left[ H C_2 H_3 O_2 \right] } \\ C) \ \ K_a = & \frac{ \left[ C_2 H_3 O_2 \right] \left[ H_3 O^4 \right] }{ \left[ H C_2 H_3 O_2 \right] \left[ H_2 O \right] } \\ D) \ \ K_a = & \frac{ \left[ H C_2 H_3 O_2 \right] \left[ H_3 O^4 \right] }{ \left[ C_2 H_3 O_2 \right] \left[ H_2 O \right] } \\ \end{array}$$

vi) Buffer Solutions:

Example 3.9: Which of the following constitute a buffer?

A) HCl and NaCl
B) KOH and HCl
C) NH<sub>3</sub> and NH<sub>4</sub>Cl
D) BaCl<sub>2</sub> and AgNO<sub>3</sub>

vii) Acid-Base Titration:

Example 3.10: What volume of 1.80 M of an automobile sulfuric acid. (H<sub>2</sub>SO<sub>4</sub>) neutralizes 42.10 cm<sup>3</sup> of 1.90 M NaOH?

A) 22.2 cm<sup>3</sup> B) 42.1 cm<sup>3</sup> C) 44.4 cm<sup>3</sup> D) 39.9 cm<sup>3</sup>

	viii) Equilibrium Expr Example 3.11: Giv $N_2(g) + 3H_2(g) =$	ressions and Equilibre the following equil 2NH3(g)	ium Constants: ibrium system, what is t	he expression of K <sub>c</sub> ?		
	A) $K_c = [NH_3]^2 / C$ ) $K_c = [N_2][H_2]$	$[N_2] + 3[H_2]$ 3/ $[NH_3]^2$	B) $K_c = [NH_3]^2 / D$ D) $K_c = 2[NH_3] / D$			
	ix) The Solubility and Example 3.12: The A) $K_{sp} = 2[Ag^{+}][$ C) $K_{sp} = [2Ag^{+}][$	solubility product cor CrO <sub>4</sub> <sup>2</sup> ']	Constant $(K_{sp})$ : astant $(K_{sp})$ of $Ag_2CrO_4$ B) $K_{sp} = 1/[Ag^*]$ D) $K_{sp} = [Ag^+]^2$	<sup>2</sup> [CrO <sub>4</sub> <sup>2</sup> ]		
4-		t is the molarity of a so ske 2.75 L of solution? B) 0.873 M	olution made by dissolvi C) 0.255 M	ng 2.40 mole of KI in D) 0.542 M		
5-	Organic Compounds and Functional Groups:  - Hydrocarbon Compounds, Aromatic Hydrocarbons, and Functional Groups:  Example 5.1: Not all carbon containing compounds are organic compounds. Which of the following compounds is an inorganic compound?  A) CH <sub>4</sub> (methane)  B) CH <sub>3</sub> OH(methanol)  C) CH <sub>2</sub> Cl <sub>2</sub> (dichloromethane)  D) CaCO <sub>3</sub> (calcium carbonate)					
	Example 5.2: Which A) Methane	ch of the following is a B) Ethanol	n <u>aromatic compound?</u> C) Benzene	D) Acetaldehyde		

Example 5.3: What is the functional group the compound (-C-) in CH<sub>3</sub>-C-CH<sub>3</sub>?

B) Hydroxyl group D) Aldehyde group

A) Carbonyl group
 C) Carboxylic acid group