CHM 101

COURSE SYNOPSIS

Atoms, molecules and structures, Electronic Configuration. Periodicity and building up of the periodic table. Chemical Reactions, Chemical Equations and stoichiometry Bonding and Intermolecular forces, Kinetic Theory of matter, derivation and calculation of all the laws involved. Thermochemistry and simple calculation based on Hess law. Rate of chemical kinetics, equilibra and related simple calculation. Important applications of equilibra like PH, solubility. Solubility of ionic solids. Electrochemistry and workings of various cells, corrosion.

QUESTIONS ON ATOMIC STRUCTURES, ATOMIC MOLECULES AND ELECTRONIC CONFIGURATION.

1. Which of the following series of spectra line is in the UV region?
    (a) Balmer   (b) Paschen   (c) Lyman   (d) Pfund

Use the Notation $_z^A X$ to answer question 2 - 4

2. A and Z respectively are
    (a) Atomic number and Mass number
    (b) Proton number and Mass number
    (c) Mass number and Atomic number
    (d) Mass number and Neutron number

3. The difference between A and Z (A - Z) will give
    (a) Number of proton   (b) Number of Neutron
    (c) Number of electron (d) Mass of the Nucleus

4. A is made up of
    (a) Proton and Neutron   (b) Proton ad Electron
    (c) Nucleus and Electron   (d) Neutron and Electron

5. The Region outside the nucleus, where there is highest probability of finding electrons is known as
    (a) Path length (b) Ware length (c) Orbits   (d) Orbitals

6. The electronics configuration of Ca^{2+} and CL are
    (a) $IS^2 2S^2 2P^6 3S^2 3p^6 4S^2$ and $IS^2 2S^2 2p^6 3S^2 3p^5$
    (b) $IS^2 2S^2 2P^6 3S^2 4S^2 3p^6$ and $IS^2 2S^2 2p^6 3S^2 3p^5$
    (c) $IS^2 2S^2 2P^6 3S^2 3p^6$ and $IS^2 2S^2 3S^2 2P^6 3p^5$
    (d) $IS^2 2S^2 2P^6 3S^2 3p^6$ and $IS^2 2S^2 2P^6 3S^2 3p^5$

7. The degeneracy of the d - orbital is
    (a) 2   (b) 4 © 5 (d) 4

8. Electron in the energy level of 3 will have the following quantum

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numbers except

(A) $l = 0, 1, 2$ (b) $Ml = -3, -2, -1, 0, 1, 2, 3$

(C) $M_s = \pm \frac{1}{2}$ (D) $M_l = 1, 0, 1$.

9. Carbon occurs in nature as mixture of $^{12}_6C$ and $^{13}_6C$, if the atomic mass of $^{12}_6C$ is exactly $12.0u$, $^{13}_6C$ is $13.003u$ and the relative atomic mass of carbon is 12.011 u. The % compositions of $^{12}_6C$ and $^{13}_6C$ isotopes in carbon atoms are respectively

(A) 95.6 and 4.4   (B) 97.3 and 3.7

© 98.9 and 1.1   (D) 99.8 and 0.2

10. Alpha particles has properties has properties similar to that of

(a) He   (b) Be   © Li   (d) Ne

11. For the shell $n = 4$, the possible values of 1 are:

(A) 1, 2, 3, 4   (b) 2, 3, 4, 5   (c) 0,1,2,3   (d) 4,3,2,1

12. What are the possible values of m for n subshell with $I = 1$

(A) 0,1,2   (b) -1,0,1   (c) 1,2,3   (d) -1,2,1

13. A possible value of spin quantum no is

(A) ½   (b) 1   (c) 0   (d) 2

14. How many orbitals are found in a d subshell?

(A) 3   (b) 4   (c) 5   (d) 6

15. Which of the following is a possible set of quantum numbers for a 2p electron?

(A) 1,0,0-1/2 (b) 2,0,0,+1/2 (c) 2,0,1,-1/2 (d) 2,1,0,-1/2

16. Which of the following gives a 3-dimensional model of the atomic structure?

(A) Bohr   (b) Rutherford   (c) Schrodinger (d) Mendeleev.

(17) What is the maximum number of electron in the orbital that has the follow quantum numbers $n = 2, I = 0, m = 0$?

(A) 6   (b) 2   (c) 10   (d) 14

18. For the shell $n = 3$, the possible values for L are

(A) 1,2,3   (b) 2,1,1,   (c) 0,1,2   (d) 3,2,1

19. Which of the following is a possible set of quantum numbers for a 3p electron?

(A) 3,0,0,-½   (b) 3,1,1, +1/2 (c) 3,0,1,1/2   (d) 2,1,0, - ½

20. Which of the following is an allowed combination of the n, 1 and m quantum numbers when $n = 2$

(A) 2, -1, +1   (b) 2,0,1   (c) 2,0,0   (d) 2,-1,1

21. On hydrogen atom emission spectrum a drop from higher energy level to $n = 2$ is designated as

(A) Lyman series (b) Balmer Series (c) Paschen Series (d) Pfund Series

22. Which of the hydrogen atom emission spectrum corresponds to the ultraviolet region of the cmr?

(A) Lyman Series

(c) Paschen Series   (b) Balmar Series

(d) Pfund Series

23. Electron has dual nature because its possesses

(A) Mass and Wavelength   (B) Mass and Volume

(c) Weight and density   (d) Fluidity and frequency

24. The wave nature of electron gives rise to the concept of

(A) Mole   (b) Orbital   (c) hybridization   (d) equivalence

25. "No two electrons can have the same value of each of the four quantum numbers: This is known as

(A) Hund's rule   (b) Aufbau principle

(c) Pauli's exclusion principle   (d) Ruther ford rule.

26. Which of the following is false?

(A) The atom of an element all has the same mass number

(B) The atoms of an element are identical, but different from atoms of other elements

(C) Mass number = atomic no + number of neutrons

(D) 1 ammu = one twelve of the mass of one atom of $^{13}_{6}C$.

27. The electronic configuration of CL and CL- respectively are

(a) $IS^2 2S^1 P^6 3S^2 3p^5$ and $IS^2 2S^2 p^6 3S^2 3p^6$

(b) $IS^2 2S^2 P^6 3S^2 3p^6$ and $IS^2 2S^2 p^6 3S^2 3p^5$

(C) $IS^2 2S^3 P^3 3S^1 3p^6$ and $IS^2 2S^2 p^6 3S^2 3p^6$

(d) $IS^2 2S^1 P^6 3S^2 3p^5$ and $IS^2 2S^2 p^6 3p^6$

28. Two Isotopes of silver has atomic weight of 106.91 and 108.909. If the relative atomic mass of silver is 107 the % abundance of the isotopes respectively are

(A) 6.45 and 993.55   (B) 4.45 and 95.55

(C) 6.45 and 93.55   (D) 95.55 and 4.45

29. The probability of finding the electron at a point or in a region of space is

(A) Unknown (b) Orbit (c) Quantum No (d) Orbital

30. Light scattering experiments was performed by

(A) Schrodinger   (b) Louis de-Broglie

(c) Geiger Muller   (d) Ernest Rutherford.

32. One mole of a chemical substance contains

(A) Faraday numbers of particles

(B) Quantum number of particles

(C) Atomic number of particles

(D) Avogadro's number of particles

32. Statement of Dalton atomic theory include the following except

(A) Atom of each element are identical

(B) Atom of different element are similar

(C) Chemical combination of atoms are in simple whole number

(D) Atom is the discrete particles of an element.

Answer to atomic structures, atomic molecules and electronic configurati

1. **Option C**

Lyman series lies in the UV region, Lyman series originates when electron moves from any outer orbit to the first orbit (n = 1)

$N_2 = \ldots\ldots\ldots, 5, 4, 3, 2 \text{--------------} > n = 1$

2. **Option C**

A = Mass Number

$^A Z_x$

Z = Atomic number

And $A = Z + N$

Where Z = Atomic Number

N = Neutron Number

(3) **Option B**

Since $A = Z + N$

A = Mass Number, Z = Atomic / Proton number

N = Neutron No

$\therefore N = A - Z$

4. **Option A**

Atomic mass is made up of both positively charged proton and neutral neutron in the nucleus of an atom.

$A = Z + N$ or $A = P^+ + n$.

(5) **Option D**

The orbital is the region around the nucleus of an atom where there is highest probability of locating an electron, the ware function which are solution of ware equation are commonly called orbitals

6. **Option C**

$Ca^{2+} = IS^2 2S^2 2P^6 3S^2 3p^6$

$Cl = IS^2 2S^2 3S^2 2P^6 3p^5$

7. **Option C**

The degeneracy of d orbital is 5 which are d_{xy}, d_{yx}, d_{xz}, d_{x2-y2} and d_{z2}

Proof: Since s = 0, p = 1, d = 2, f = 3 where 0, 1, 2, 3 are the Azimuthal quantum numbers, L,

$M = 2L + 1$ Where L = 2

ford.

$M_1 = 2 (2) + 1 = 5$

8. **Option B**

Since the quantum numbers are n, L = 0 to L = n - 1, ml = - L to +L

$Ms = +- \frac{1}{2}$

n	L	M_1	Ms
3	0	0	
	1	-1, 0, 1	
	2	-2, -1, 0, 1, 2	

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(9)   **Option C**

Given Ar of $^{12}_6C = 12.0u$

Ar of $^{13}_6C = 13.003u$

Ar of c = 12.011u

Let x = % of $^{12}_6C$

And 100 - x = % of $^{13}_6C$

$$Ar(c) = \frac{12.0x + (100-x)\,13.003x}{100}$$

$$12.011 = \frac{12.0x + (100-x)\,13.003x}{100}$$

X = 98.9

∴ 100 - x = 100 - 98.9

= 1.1

10.   **Option A**

α particles is a helium nucleus with Mass of 4amu and a + 2 change. It is represented as ^4_2He

11.   **Option C**

Azimuthal quantum number L is the number of subshell is in a shell and (it determines the shape of orbital.

(It is Integral values are

L = o to l = n - 1

L = o to l = 4-1 = 3 ∴ 0, 1, 2, 3.

12.   **Option B**

The possible value of magnetic quantum number in for a subshell with L = 1 are -1, 0, 1

If L = 1, M_i = -L to +L = 1, 0, +1

13.   **Option A**

The spin quantum number is ±1/2 and it describes the spin property of the electron either clockwise or anti-clockwise.

14.   **Option C**

The number of orbitals in a subshell is determined by the Magnetic quantum no, M_i Since

Value for d subshell is 2

$M_L = 2L + 1 = 2(2) + 1 = 5$

15.   **Option D**

2P - represent the subshell L = 1

2 Represent the principal Quantum number = n=2

	s	p	d	f
L	0	1	2	2

n	L	ML	ms ±1/2
2	o (s)	0	±½
	I(p)	-1,1,+1	±½

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The possible sets of quantum numbers for a 2p electron are 2, 1, 0, ± ½

16. **Option C**
Schrödinger describes the electron as a three dimensional waveforms rather than a point particles. He used the idea of Louis de Broglie's to develop a Mathematical Model of an atom that described the electrons as 3 Dimensional Waveforms

17. **Option B**
Given $n = 3$, $L = 0$, $M = 0$
The orbital is 3s and Maximum electron in the S-Orbital is 2 because the electron spin limits the number of electrons top two per orbital.

18. **Option C**

n	L	M_L
3	0	0
	1	-1,0,+1
	2	-2,1,0,+1,+2

n	L	M_L
3	0	0
	1	-1,0,+1
	2	-2,1,0,+1,+2

20. *Same as question 19*
Option D

21. **Option B**
Balmer series lies in the visible region and originates when electrons moves from any outer orbit to the second orbit
(Or first excited states)
$n_h = ...5,4,3 ----> n_L = 2$

22. **Option A**
Lyman series lies in the UV region and originates when electrons moves from any outer orbit to the ground state ($n = 0$) or first orbit
$n_L = ...5,4,3,2, ------> n_L = 1$

23. **Option A**
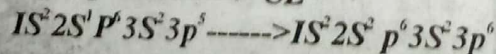$= h/mv = h/=Q$ *De Broglie*

24. **Option B**
The wave nature of electron gives rise to the concept of orbital. The location of electron is described in terms of probability of finding it in a certain position at any time.

25. **Option C**
26. **Option A**
27. **Option A**
$CL + e^- -----------> CL^-$
$1S^2 2S^1 P^6 3S^2 3p^5 ----->1S^2 2S^2 p^6 3S^2 3p^6$

28. **No Answer**

$$RAM = \frac{A1(100 - x) + A2(x)}{100}$$

$$107.7 = \frac{106.911(100 - x) + 108.909x}{100}$$

$$10691.1 - 106.911x + 108.909x = 10770$$

$$X = 39.49$$

$$\therefore 100 - x = 60.51$$

29. **Option D**

An orbital is the Region around the Nucleus of an atom where there is highest probability of finding electron. An orbital is described by four set of Quantum numbers.

30. **Option D**

31. **Option D**

1 mole of a substance contains 6.023×10^{23} numbers of particles. This number is referred to as Avogadro's number.

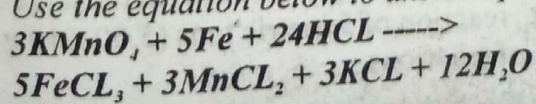32. **Option B**

Questions on Periodic Table

1. The following are the trends observed in the periodic table of elements except
   (A) Atomic radii increase down the group.
   (B) Atom size decreases across the period
   (C) Ionization energies increases across the period
   (D) Atomic size increase across the period.

2. Why does sodium not form the Na^{2+} ion in its compounds?
   (A) Because of low 1st ionization energy
   (B) Because of high electropositivity.
   (C) Because of high 2nd Ionization energy
   (D) All of the above.

Answer on Periodic Table

1. **Option D**
   Atomic size increase across the period of incorrect because atomic size decreases across the period progressively with increaSing atomic number. This is because when moving across a period, an electron and proton are being added to atoms. Thus there is a greater attractive force between the nucleus and the electrons cáuSing a decrease in atomic size.

2. **Option B**

Questions on Stoichiometry

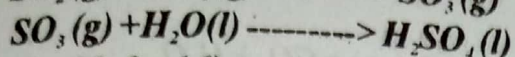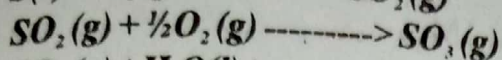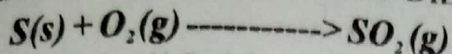Use the equation below to answer question 1 and 2

$$3KMnO_4 + 5Fe + 24HCL \longrightarrow$$
$$5FeCL_3 + 3MnCL_2 + 3KCL + 12H_2O$$

If 156g of Fe were consume
$(Fe = 56, Mn = 55, K = 39, 0 = 16)$.

1. What Mass of $KmnO_4$ is consumed?
(A) 170g   (b) 264g (c) 180g   (d) 160g

2. How many grains of $MnCl_2$ are produced?
(A) 60.4g   (b) 56.6g   (d) 70.2k   (d) 210g

3. $26cm^3$ of a solution containing 10.5g of impure hydrochloric acid solution in $250cm^3$ titrated against $25cm^3$ of 0.1M sodium trioxocarbonate (iv) solution. Calculate the concentration of the pure acid in mole / dm3.
(A) 0.2913M (b) 0.3923M (c) 0.1528M (d) 0.1813M (e) 0.1923M

4. Methane is converted to carbon dioxide and water when burned in a plentiful supply of oxygen (complete combustion).
$CH_4(g) + 2O_2(g) \text{-------} > CO_2(g) + 2H_2O (l)$
If 10g of CO_2 were obtained when 16g of CH_4 were burned in a limited supply of oxygen gas, what would be the percentage yield of carbondioxide?
(A) 23% (b) 2.3% (c) 11.5% (d) 62.5%

5. Zinc reacts with heated copper (II) oxide to form zinc oxide and copper metal. If 3.0g of zinc are reacted with 3.0g copper (II) oxide, which is the excess reagent? What is the mass of copper metal formed?
$(Cu = 63.5, Zn = 65.5)$
(A) Zn, 0.045g   (b) CuO, 2.91g   (c) CuO, 2.4g   (d) Zn, 2.4g

6. A standard solution was prepared by dissolving 2.6061g of Anhydrous Sodium Carbonate in deionized water and the solution diluted to $250cm^3$. A 25cm3 portion of this solution was titrated against hydrochloric acid, uSing a suitable indicator. The end point was reached after $18.7cm^3$ of acid had been added. Calculate the cone of the acid $(Na = 23, CL = 35.5, C = 12)$
(A) 0.098m   (b) 9.263m   (c) 0.131m   (d) 0.98m

7. How many moles of Mg_3N_2 will be produced by Reaction of 1.50mol of Mg with excess N_2? $(Mg = 24, N = 14)$
(A) 0.100mol   (b) 0.260mol   (c) 0.400mol   (d) 0.500mol.

8. What mass of Li_3N will be produced by the reaction of 2.75g of Lithium metal with excess nitrogen gas? $(Li = 6.9)$
(A) 4.5g   (b) 5.49g   (c) 45.9g   (d) 54.9g

9. Iron (II) Sulfate is oxidized by potassium permanganate in acid solution. The overall ionic equation is
$5Fe^{2+} (aq) + MnO_4^- (aq) + 8H^+ (aq) \text{----} >$
$Mn^{2+} (aq) + 4H_2O (l) + 5Fe^{3+} (aq)$
What volume of $0.010mol\ dm^3$ Iron II sulphate will be oxidized by $25.00cm^3$ of $0.020moldm^3$ permanganate solution?
(A) $25cm^3$ (B) $250cm^3$ (c) $2.5cm^3$ (d) $2500cm^3$

10. Calculate the Mass of sulphuric acid (The chemical produced) in the largest tennage in the world produced by the reaction of 5 metric tons (5.00×10^6g) of sulphur in the following sequence of reactions.

$$S(s) + O_2(g) ----------> SO_2(g)$$
$$SO_2(g) + \frac{1}{2}O_2(g) ---------> SO_3(g)$$
$$SO_3(g) + H_2O(l) --------> H_2SO_4(l)$$

$(S = 32, 0 = 16)$

(A) $1.53 \times 10^7 g$ (b) $1.35 \times 10^7 g$ (c) $5.3 \times 10^6 g$ (d) $3 \times 10^6 g$

11. $25dm^3 g$ of a solution containing 3g of Impure Sodium hydroxide in $250cm^3$ was neutralized by $30cm^3$ of 0.1m tetraoxosulphate (vi) Acid Solution. Calculate the concentration of the pure NAOH in moles / dm3.

$$2NaOH(aq) + H_2SO_4(a) -------> Na_2SO_4(aq) + 2H_2(L)$$

(A) $0.14 \, mol / dm^3$ (b) $0.20 mole/dm^3$
(c) $0.24 mol/dm^3$ (d) $0.19 mol/dm^3$

12. $20.50 cm^3$ of 0.IM HNO_3 was titrated against $25cm^3$ of 11.14g of $X_2CO_3.10H_2)$ per dm^3 solution. Calculate the molar Mass of the base $X_2CO_3.10H_2)$
(A) $386 g \, mol^{-1}$ (b) $1.86 g mol^{-1}$ (c) $286 g mol^{-1}$ (d) $486 g mol^{-1}$

13. Calculate the Mass of the solute present in the following solution: trioxocarbonate (iv) in $2dm^3$ of 2M solution
(A) $352g$ (b) $552g$ (c) $452g$ (d) $424g$

14. The number of mole of sodium carbonate in 8.5g of the salt is
(A) 0.28 (b) 0.08 (c) 2 (d) 18

15. The percentage composition of sulphur(s) In $FeSO_4. 10H_2)$ is
(A) 6.9% (b) 5.6% (c) 9.6% (d) 5.8%

16. Calculate the number of ions present in 2 moles of potassium on
(A) 6.02×10^{23} ion   (b) 12.04×10^{23} ion
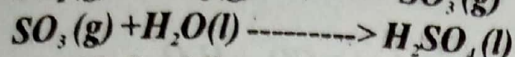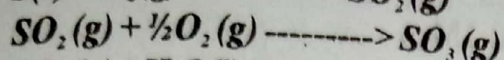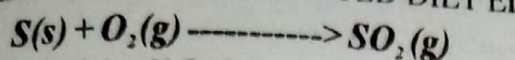(C) 6.02×10^2 ion   (d) 12.04×10^{24} ion.

Answer to stoichiometry

1. **Option B**
$$3KMnO_4 + 5Fe + 24HCL -------> 5FeCL_3 + 3MnCL_2 + 3KCL + 12H_2O$$
3 Mole of $KMnO_4$ reacts with 5moles of Fe
$\therefore 5 (56g)$ of Fe reacts with $3 (158g)$ of $KMnO_4$
$\therefore 156g$ of Fe reacts with $\frac{(156 \times 474)}{280}$

$= 264g \, of \, KMnO_4$

2. **Option D**
3 Moles $KMnO_4$ produces 3 Moles $MnCL_2$
$3 (158g) KMnO_4$ propduces $3 (126g) MnCL_2$
$47g KMnO_4$ produces $378g MnCL_2$
$264g KMnO_4$ produces $\frac{(264 \times 378)}{474} MnCL_2$

$= 210.53g$

If 156g of Fe were consume
$(Fe = 56, Mn = 55, K = 39, 0 = 16)$.

1. What Mass of $KmnO_4$ is consumed?

   (A) 170g   (b) 264g (c) 180g   (d) 160g

2. How many grains of $MnCl_2$ are produced?

   (A) 60.4g   (b) 56.6g   (d) 70.2k   (d) 210g

3. $26cm^3$ of a solution containing 10.5g of impure hydrochloric acid solution in $250cm^3$ titrated against $25cm^3$ of 0.IM sodium trioxocarbonate (iv) solution. Calculate the concentration of the pure acid in mole / dm3.

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   $(Cu = 63.5, Zn = 65.5)$

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   (A) 4.5g   (b) 5.49g   (c) 45.9g   (d) 54.9g

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   $5Fe^{2+} (aq) + MnO_4^- (aq) + 8H^+ (aq) \text{---->}$
   $Mn^{2-}(aq) + 4H_2O (l) + 5Fe^{3-} (aq)$

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$$S(s) + O_2(g) \xrightarrow{\hspace{1cm}} SO_2(g)$$
$$SO_2(g) + \tfrac{1}{2}O_2(g) \xrightarrow{\hspace{1cm}} SO_3(g)$$
$$SO_3(g) + H_2O(l) \xrightarrow{\hspace{1cm}} H_2SO_4(l)$$

$(S = 32, O = 16)$

(A) $1.53 \times 10^7 g$ (b) $1.35 \times 10^7 g$ (c) $5.3 \times 10^6 g$ (d) $3 \times 10^6 g$

11. $25dm^3 g$ of a solution containing 3g of Impure Sodium hydroxide in $250cm^3$ was neutralized by $30cm^3$ of $0.1m$ tetraoxosulphate (vi) Acid Solution. Calculate the concentration of the pure NAOH in moles / dm3.

$$2NaOH(aq) + H_2SO_4(a) \xrightarrow{\hspace{1cm}} Na_2SO_4(aq) + 2H_2(L)$$

(A) $0.14 \, mol/dm^3$ (b) $0.20 mole/dm^3$

(c) $0.24 mol/dm^3$ (d) $0.19 mol/dm^3$

12. $20.50cm^3$ of $0.IM$ HNO_3 was titrated against $25cm^3$ of 11.14g of $X_2CO_3.10H_2)$ per dm^3 solution. Calculate the molar Mass of the base $X_2CO_3.10H_2)$

(A) $386g \, mol^{-1}$ (b) $1.86 g mol^{-1}$ (c) $286 g mol^{-1}$ (d) $486 g mol^{-1}$

13. Calculate the Mass of the solute present in the following solution: trioxocarbonate (iv) in $2dm^3$ of 2M solution

(A) $352g$ (b) $552g$ (c) $452g$ (d) $424g$

14. The number of mole of sodium carbonate in 8.5g of the salt is

(A) 0.28   (b) 0.08   (c) 2   (d) 18

15. The percentage composition of sulphur(s) In $FeSO_4.10H_2)$ is

(A) 6.9%   (b) 5.6%   (c) 9.6%   (d) 5.8%

16. Calculate the number of ions present in 2 moles of potassium on

(A) 6.02×10^{23} ion   (b) 12.04×10^{23} ion

(C) 6.02×10^2 ion   (d) 12.04×10^{24} ion.

Answer to stoichiometry

1. **Option B**

$$3KMnO_4 + 5Fe + 24HCL \xrightarrow{\hspace{1cm}} 5FeCL_3 + 3MnCL_2 + 3KCL + 12H_2O$$

3 Mole of $KMnO_4$ reacts with 5moles of Fe

∴ 5 (56g) of Fe reacts with 3 (158g) of $KMnO_4$

∴ 156g of Fe reacts with $\dfrac{(156 \times 474)}{280}$

$= 264g \text{ of } KMnO_4$

2. **Option D**

3 Moles $KMnO_4$ produces 3 Moles $MnCL_2$

3 (158g) $KMnO_4$ propduces 3 (126g) $MnCL_2$

47g $KMnO_4$ produces 378g $MnCL_2$

264g $KMnO_4$ produces $\dfrac{(264 \times 378)}{474} MnCL_2$

$= 210.53g$

3. Option E

$V_a = 26cm^3$, $V_b = 25cm^3$, $C_b = 0.1M$

C pure A = ?
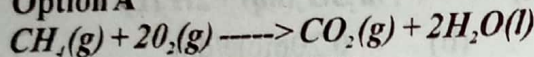
$$2HCL(aq) + Na_2CO_3 \longrightarrow 2NaCL(aq) + CO_2 + H_2O$$
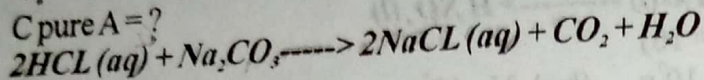
Using $\dfrac{CaVa}{CbVb} = \dfrac{n_a}{n_b}$

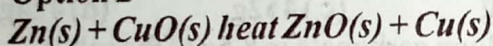$Ca = \dfrac{0.1 \times 25 \times 2}{26 \times 1} = 0.1923 Moldm^{-3}$

4.   **Option A**

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$$

16g of CH_4 yield 44g of CO_2

Theoretical yield of CO_2 is 44g

% yield = $\dfrac{Actual\ yield \times 100}{Theoretical yield}$

$= \dfrac{10g \times 100}{44g} = 23\%$

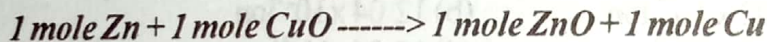**5.**   **Option D**

$$Zn(s) + CuO(s) \xrightarrow{heat} ZnO(s) + Cu(s)$$
   65.5g   79.5g

No of moles of Zn = $\dfrac{3.0}{65.5} = 0.0458$ moles

No of moles of CuO = $\dfrac{3}{79.5} = 0.03774$ moles

$$1\ mole\ Zn + 1\ mole\ CuO \longrightarrow 1\ mole\ ZnO + 1\ mole\ Cu$$

0.0458 mole	0.03774 mole	0.03774	0.03774
0.03774 mole	0.03774 mole	0.03774	0.03774
0.00806 mole			

∴ Zn is excess reagent

Mole of Cu = $\dfrac{Mass\ of\ Cu}{Molar\ Mass}$

Mass of Cu = $0.03774 \times 63.5 gmol^{-1}$

= **2.4g**

6.   **Option B**

$250cm^3$ Solution contains 2.6061g Na_2CO_3

$1000cm^3$ Solution contains $\dfrac{(1000 \times 2.6061)}{250}$

= $10.4244 gdm^{-3}$

Molar Conc. = $\dfrac{Mass\ Conc.}{Molar\ Mass}$

Molar Mass of $Na_2CO_3 = 106 gmol^{-1}$

Molar Conc. in Mol dm^{-3} = $\dfrac{10.4244 gdm^{-3}}{106 gmol^{-1}}$

$0.098 moldm^{-3}$

$$2HCL(aq) + Na_2CO_3 \longrightarrow 2NaCL + H_2O + CO_2$$

Using titration formula

$$\frac{CAVa}{CBVB} = \frac{nA}{nB}$$

$$C_A = \frac{0.098 \times 25 \times 2}{18.7 \times 1}$$

$$C_A = 0.263m$$

(7)   **Option D**

$$3Mg + N_2 \longrightarrow Mg_3N_2$$
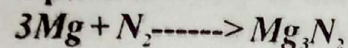
3 mol	1 mol	1 mole
1.5mol	0.5mol	0.5mol

Moles of Mg_3N_2 produced is 0.500mol

8.   **Option A**

Mole of $L_1 = \frac{2.75g}{6.99gmol^{-1}} = 0.3986$ mole

$$3L_1 + \frac{1}{2} N_2 \longrightarrow Li_3N$$
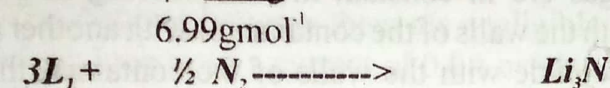
3mole	0.5mole	1 mole
0.3986mole	0.066mole	0.133mole

$$= 0.133mol \times 34.7gmole$$

$$= 4.59g$$

9.   **Option B**

$$\frac{C_{OAG} \times V_{OAG}}{C_{RAG} \times V_{RAG}} = \frac{n_{OAG}}{n_{RAG}}$$

$$\frac{0.020 \times 25}{0.010 \times V_{RAG}} = \frac{1}{5}$$

$$V_{RAG} = 250cm^3 \text{ of } FeSO_4$$

10.   **Option A**

$$S(s) + O_2(g) \longrightarrow SO_2(g)$$

32g of Sulphur produce 64g of SO_2

500 x 106g of Sulphur produce $\frac{(5 \times 106 \times 64)}{32} SO_2$

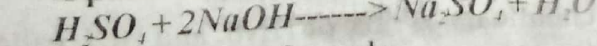$$= 1.0 \times 10^7 g \, So_2$$

$$SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$$
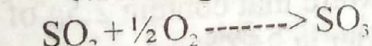
64g of SO_2 produce 80g of SO_3

$1.0 \times 10^7 g$ of SO_2 produce $\frac{(1 \times 10^7 \times 80)}{64}$ g of SO_3

$1.25 \times 10_7 g SO_3$ produces $\frac{(1.25 \times 10^7 \times 98)}{80}$ gH_2SO_4

$$= 1.53 \times 10^7 gH_2SO_4$$

11.   Option C

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + H_2O$$

Using Titration formula

$$CAVA = nA$$

$$\frac{CBVB}{CB} = \frac{nB}{} = \frac{0.1 \times 30 \times 2}{25 \times 1}$$

$CB = 0.24\,mol/dm^3$

12. **Option C**
Using titration formulae
Molar mass $= 286\,gmol^{-1}$

13. **Option D**
14. **Option B**
15. **Option C**
16. **Option B**

QUESTION ON KINETIC THEORY OF MATTER

1. Which of the following is not true of kinetic theory of gases?
A) Molecules of a gas are in constant motion moving in straight line unless they collide with the walls of the container or with another molecule
B) as the molecules collide with the walls of the container, they exert a pressure on the container
C) If the volume of the container is decreased, the molecules collide mere frequently with the container and pressure increases the case is reserve as the volume of the container is increased
D) None of the above

2. Determine the volume of ozone formed on containing $9.0m^3$ of oxygen containing 0.3mol oxygen at 1atm and $25°$ C to ozone at the same temperature and pressure.
A) $6.0m^3$ B) $9.0m^3$ C) $2.7m^3$ D) $25.0m^3$

3. Calculate the molar mass of a gas with a density of $2.5g/dm^3$ at 298k and $110kN/m^2$ (R=8.314 J1kmol)
A) 56.3g/mol   B) 101g/mol   C) 5.6g/mol   D) 20.5g/mol

4. Calculate the mean square velocity of a 50g molecule at a pressure of $105N/M^2$ given that the volume of gas and number of molecules are $50m^3$ and $15m^3$ respectively
A) 5.6m/s   B) 4.2m/s   C) 5.5m/s   D) 0.5m/s

5. Calculate the total pressure of a gas mixture that contain 2.5g of 2, 4.5g of H_2 and 5.0g of He in a 25L gas cylinder at $25°C$
A) 3.00atm   B) 4.00atm   C) 4.448atm   D) 3.48atm

6. On decomposing a $25.0m^3$ NH_3 gas according to the equation below in a cylinder with put on It was found that the volume of the cylinder increased from 100m3 at 50 N/M^3. What is the work done by the system?
A) 3750 N/M   B) -3057 N/M   C) -37500N/M   D) 3057 N/M

Use the illustration below to answer the next two questions
Gold is attacked by few chemicals. A mix of HNO_3 and HCL called Agna Regia however dissolves gold by the following equation.
If 28.4g of Au were this reaction (Au=197)

7. What is the minimum volume in mi of 12.0MHCL needed?
   A) 48.0   B) 60.2   C) 30.2   D) 48.0

8. If 16.0M HNO_3 were used, what is the minimum volume in ML required?
   A) 28.5   B) 27.0   C) 30.2   D) 48.0

9. The total volume of ml of aqua regia needed for the reaction is
   A) 75.0   B) 87.2   C) 73.0   D) 78.6

10. A solution contains 5.0×10^3 moles of H_2SO_4 dissolved in 250ml of solution

10. What is the molarity of the solution?
    A) 00.4M   B) 0.02M   C) 0.03M   D) 0.0025M

11. The molarity of H^+ ions in the solution is
    A) 0.04M   B) 0.02M   C) 0.03M   D) 0.025M

12. Gas molecules are said to be perfectly elastic because
    A) The volume occupied by them are negligible
    B) They move about in straight lines
    C) The distance between them ate negligible

13. For how long must a current of 0.2A need to pass through solution of $AgHO_3$ to deposit 0.5mole of silver (Ag=108, 1F=96,500c)
    A) 38,600s   B) 9650s   C) 96,500s   D) 241,250s

14. A gas occupies $172cm^3$ at $30°c$. At what temperature would the volume of the gas be halved?
    A) 0.88k   B) 0.087k   C) 15k   D) 152k   E) 15 C

15. What are the relative rates of diffusion of hydrogen to nitrogen gases?
    A) 1:4   B) 4:1   C) 8:1   D)14:1   E) 1:14

16. What volume would a gas at stp if at 430C and 720mmHg? It occupies $21.4cm^3$
    A) $528cm^3$ B) $378cm^3$ C) $412cm^3$ D) $252cm^3$ E) None

17. A polar substance dissolves in_____solvent and a non-polar substance dissolves in_____solvent
    A) Like poles, unlike poles   B) Non polar, polar
    C) Polar, non-polar   D) Unlike pole, like pole

18. Gas law are combination of_____,_____,_____ and_____laws
    A) Boy's, Avogadro, partial, gay
    B) Boyle's, Charles, Avogadro and Dalton's.
    C) Boy's, Gay-Lussac's, Charles, Dalton
    D) Boyle's, Charles, partial, Dalton

19. For an ideal gas equation T=?
    A) Pn/VR   B) PV/nR   C) Vn/PR   D) PVn/R

20. Calculate the number of molecules in 0.5 of the gas at a pressure of 2.0×10^2kpa and a temperature exactly 300k
    A) 1.2×10^{25} B) 3.6×10^{25} C) 2.4×10^{25} D) 4.8×10^{25}

21. According to KMT of matter, two forces are in operation. They are
    A) Centripetal and cohesive   B) Disruptive and centrifugal
    C) Centripetal and centrifugal   D) Cohesive and Disruptive

22. In a solid matter, which of the forces predominate?
    A) Centripetal   B) Disruptive   C) Cohesive   D) Centrifugal

23. Which force predominates in a liquid matter?

A) Cohesive   B) Disruptive   C) Centripetal and Centrifugal   D) None

24. The force predominating in a gaseous matter is

A) Centripetal   B) Disruptive   C) Cohesive   D) Centrifugal

25. Calculate the volume of 1.0000mol at gas at exactly 20^0c at a pressure of 101.32kpa

A) $124.055dm^3$ B) $12.055dm^3$ C) $224.055dm^3$ D) $24.055dm^3$

26. In adsorption, the substance that sticks is called _____ and the surface to which it sticks to is called_____

A) Absorpate, Absorbent   B) Absorb, Adsorber

C) Adsorbate, adsorbent   D) Adsorber, Absorbent

27. The following are some of the basic postulate of kinetic molecular theory (KMT) of matter except

A) Matter consist of atoms or molecules in continous rapid and random motion

B) The average Kinetic energy of the atoms or molecules is indirectly related to the absolute temperature of the system

C) The particles attract and repel one another and therefore possess potential energy

D) Energy is transferred from one particle to another by collisions, but the collisions are elastic with no net loss of energy.

Answer to kinetic theory of matter

1. **Option D**

Kinetic theory of gas states that

I. The molecules of gas within a container are in state of constant rapid motion in all possible direction i.e. they move in a straight line colliding with themselves and the walls of the container.

II. Every gas consists of a very large number of tiny particle called molecules.

III. The pressure exerted by gas molecule is as a result of continuous bombardment on the surface of the container by the gas molecule

IV. The absolute temp of gas molecule is a measure of kinetic energy in gas.

2. Chcck our website for solution
3. **Option A**
4. **Question not clear**
5. **Option D**
6. **Option C**
7. **Option A**
8. **Option B**
9. **Option A**

Total Volume of Agna regia

=48.0ml + 27.0ml

=75.0ml

10. **Option B**
11. **Option A**
12. **Option B**

Collision between gas molecules is perfectly elastic with no loss of energy

13.   **Option B**
14.   **Option D**
15.   **Option B**
16.   **Option E**
17.   **Option C**
18.   **Option B**
19.   **Option B**
20.   **Question not clear**
21.   **Option D**
22.   **Option C.**
       Cohesive force is predominating in solid matter because particles/molecules
       are closely bonded together.
23.   **Option D**
24.   **Option B**
25.   **Option D**
26.   **Option C**
27.   **Option B**

QUESTIONS ON THERMOCHEMISTRY

1.   If the specific heat capacity of Benzene is 2.4 J/g c. Calculate the temperature change when 1625J is removed from 75g of benzene initially at 25°c
      A) -25°c   B) 50°c   C) -9°c   D) 298°c

2.   If the heat absorbed by 50g of NH_3 gas from the surrounding at
3   0°c was 50 at constant pressure. Determine the enthalpy change of the chemical system
      A) 7500J   B) 50J   C) 1000J   D) 70J

3.   Determine the heat absorbed by 250g of water heated for 20mins and had a temperature increase of 45°c (specific heat capacity of water = 4.184j/g°c
      A) 47,070j   B) 25500j   C) 30,500j   D) 101151j

4.   Determine the change in internal energy (ΔN) of a chemical system undergoing an exothermic process with a heat flow. If 10.5j and the work done by the system is 200j
      A) +210.5j   B) +189.5j   C) -210.5j   D) -189.5j

5.   Calculate the work done associated with expansion of ammonia gas cylinder from 200m³ to 50m³ at a constant external pressure of 20N/M²
      A) -600Nm   B) 600Nm   C) 270Nm   D) -270Nm

6.   It was found that the volume of the cylinder and position increased to 100m³ at 50N/M². What is the work done by the system?
      A) 3750Nm   B) -3057Nm   C) -3750Nm   D) 3057 Nm

7.   Calculate the enthalpy of reaction below
      A) -8686Kj   B) 8686JKj   C) 8900kj   D) -8990Kj

8. In the compound SH_4 the central atom S, has bounding election in four molecule as a predicted by VSEPR is
   A) Linear   B) Trigonal planar
   C) Tetrahedral   D) Trigonal Bipyramidal

9. Given $HCl(aq) + NaOHcaq \rightarrow Nacl(aq) + H_2(cl)$ $\Delta H = -57kj$
   Calculate the heat changes which would occur when $50cm^3$ of $0.01m$ NaOH solution and $100cm^3$ of $0.01m$ HCL
   A) -57j   B) -114j   C) +57j
   D) +114j   E) None of the above

10. Determine the ΔH for the reaction $2NH_4NO_3 \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$
    A) $-41.4kjmol^{-1}$ B) $41.4kjmol^{-1}$ C) $4.4kjmol^{-1}$
    D) $414.4kjmol^{-1}$ E) None of the above

11. 0.02mole of Anhydrous NH_4CL was added to 45g of H_2O. In a polysterene Cup in order to determine the standard enthalpy change of solution of $NH4CL$ (Given $\Delta T = 1.5°c$, S.H.C of $H_2O = 4200kjkg^{-1}k^{-1}$ neglect S.H.C of the polystyrene
    A) 1000kj/mol   B) 2.8kj/mol   C) 0.284kj/mol
    D) 14.2kj/mol   E) None

12. Which of the following is false on melting a solid?
    A) Solids will only melt when the forces of vibration overcomes the binding forces
    B) The presence of impurity in solids will raise the melting point of such solids
    C) The presence of impurity may cause a solid to have a melting point
    D) The presence of impurity in solids will lower the melting point on such solids
    D) None

13. Given the information, calculate the lattice energy of MgCL(s).
    $Mg(s) + 1/2CL_2(g) \rightarrow MgCL(s)$
    $\Delta H°F = -128kj/mol$
    $\Delta H°atom [Mg(s)] = +150kj/mol$
    $\Delta H°atom [1/2CL2(g)] = +121kj/mol$
    $\Delta H° IE [Mg(g)] = +736kj/mol$
    $\Delta H° EA[CL(g)] = -364 KJ/mol$

    A) -771   B) -862   C) 647   D) 537

14. Solid particles cannot overcome the strong forces of attraction holding them together and therefore posses
    A) Vibrational, Rational and translational motion
    B) Vibrational and Rotational   C) Vibrational and translational
    D) Translational and Rotational   E) Vibrational only

15. Internal energy (E) is a state function because
    A) It is the sum of all the energies of all the atoms, molecules or icons with a system which it has under the specific conditions of state
    B) It is made up of coulomb energy between the electrons and the Nuclei in atoms

C) The change in internal energy (ΔE) during the shift of a system from state I to state II is independent of path followed

D) $\Delta E = q = w$ E) It is made up of translation energy of molecules

16. What is the value of the standard enthalpy of formation ΔHF of nitrogen at 298k

A) Zero   B) 298Kj   C) 100kj

D) -2183Kj   E) -507Kj

17. The heat content of Z is greater than that of x. Then the reaction $X \rightarrow Z$ is

A) Exothermic   B) Endothermic

C) Neither exothermic nor endothermic

D) Activation complex   E) Specific heat capacity

18. Given $A+B \rightarrow C+D$ $\Delta H = -1.0kj$. Calculate ΔH for the reaction $C+D \rightarrow A+B$

A) -10Kj   B) 20Kj   C) 503Kj

D) 10Kj E) 50Kj

19. What is the relation between ΔH and ΔE for reactions which do not involve gases?

A) $\Delta H = \Delta E$ B) $\Delta V = 0$ C) $\Delta H = \Delta E + P \Delta V$

D) ΔV is constant   E) ΔV is too small

20. What is Δn gas for the combination of one mole of tungsten carbide WC, when both reactants and product are at 298K?

$$WC(s) + 5/2O_2(g) \rightarrow WO_3(s) + CO_2(g)$$

A) 1   B) ½   C) -3/2 D) -2   E) -3/2

21. In which of the following reactions would ΔH be most nearly equal to ΔE?

A) $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ B) $H_2(g) + CL_2(g) \rightarrow 2HCL(g)$

C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

D) $CH_3COOH(L) + 2O_2(g) \rightarrow 2CO_2(g) + 2H_2O(L)$

E) $CL_2(g) \rightarrow 2CL(g)$

22. The enthalpy change (ΔH) for the reaction 92.38KJ at 298K. What is ΔE at 298K? (R=8.31KJ^{-1})

A) -2.0KJ   B) 4.95KJ   C) -87.43KJ

D) 8.314KJ   E) -168KJ

ANSWER TO THERMOCHEMISTRY

1. **Option C**

Q=-1625j, m+ 75g , c= 2.4J/g°C

Q=mc$\Delta \Theta$

$\Delta \Theta = Q/mc = -9°C$

2. **Option B**

At constant pressure, $\Delta H = Qp$ i.e the change in enthalpy of a system is equal to the heat given to the system

$\Delta H = \Delta E + \Delta PV$

$\Delta H = \Delta E + P \Delta V + V \Delta P$

If $\Delta P = 0$

I.e $\Delta H = \Delta E + \Delta PV$

$\Delta H = Qp$

3. Option A

$M=250g$, $c=4.184J/g\ c$

$\Delta T=45\ c$

$Q=mc\Delta T$

$Q=250\times4.184\times45$

$Q=47,070J$

4. Option B

$\Delta H=-10.5J$ (Exothermic)

$\Delta W=P\Delta V = -200J$

$\Delta H = \Delta U=\Delta w$

$-10.5=\Delta u-200J$

$\Delta u=-10.5=200J$

$\Delta u=+189.5J$

5. Option A

$V_1 = 20m^3$, $V_2 = 50m^3$, $P=20N/m^2$

$\Delta V = V_2-V_1 =(50-20) = 30m^3$

At constant pressure, workdone by Gas

$W = P\Delta V$

$W = -20\times30 = -600Nm$

6. Option C

Workdone by the system is negative
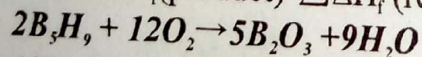
$V_1=25m^3$, $V_2=100m^3$, $P=50N/M^2$

At constant pressure

$W= -P\Delta V = -50(100-25)$

$W= -3750Nm$

7. Option D

USing Hess law of total heat summation

$\Delta H=\sum\Delta H_f(product)-\sum\Delta H_f (reactant)$

$2B_5H_9 + 12O_2\rightarrow5B_2O_3 +9H_2O$

$\Delta H = [5\times\Delta H^oF (B_2O_3) + 9\times \Delta HF^o(H_2O)] – [2\times \Delta H^oF(B_5H_9) + 12\Delta HF^o(O_2)]$

$= -8750-150 = -8900KJ$

8. Option D

4 Bond pair and 1 lone pair is a trigonal Bipyramidal molecule.

9. Option E

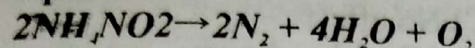Number of moles of HCL = cv/1000

$=0.01\times100/1000=0.001$moles

Number of mole of NaOH=Cv/1000

=0.01x50/1000

=0.0005moles

10. **Option C**

$2NH_4NO2 \rightarrow 2N_2 + 4H_2O + O_2$

$\Delta H = \sum Hf^o(\text{product}) - \sum Hf^o(\text{reactant})$

$\Delta H = [2 \times \Delta H^oF(N_2) + 4 \times \Delta HF^o(H_2O) + \Delta HF(O_2)] - [2 \times \Delta HF^o(NH_4NO_2]$

$\Delta H = -1144KJ/mol + 729.2KJmol$

$\Delta H = -414.8kj/mol$

11. Check Answer on our webpage

12. **Option B**

The presence of Impurity in solids will pass the melting point of solids

13. **Option A**

Using Born - Haber cycle

14. **Option E**
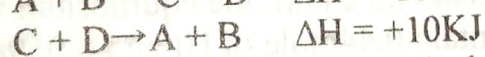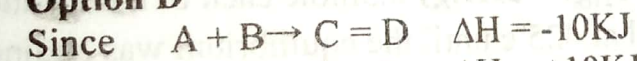
15. **Option A**

16. **Option A**

$\Delta HF(N_2) = 0$

17. **Option B**

If the heat of product is greater than the heat of reactant, the reaction is said to be endothermic

Hp>Hr (Endothermic)

Hr<Hp (Exothermic)

18. **Option D**

Since $A + B \rightarrow C = D$ $\Delta H = -10KJ$
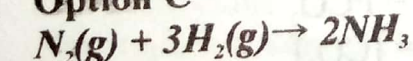
$C + D \rightarrow A + B$ $\Delta H = +10KJ$

The heat of reaction of the forward is the heat of reaction of the reverse.

19. **Option A**

20. **Option E**

21. **Option E**

22. **Option C**

$N_2(g) + 3H_2(g) \rightarrow 2NH_3$

$\Delta ngas = 2-4 = -2moles$

$\Delta H = \Delta E + \Delta nRT$

$\Delta E = \Delta H - \Delta nRT$

$\Delta E = -92380J - (-2)(8.314)(298)$

$\Delta E = -92380J + 4955.144$

$\Delta E = -87424.856J$

$\Delta E = -87.43KJ$

QUESTIONS ON CHEMICAL EQUILIBRIUM

1. For reaction $FeO(s) + O_2(g) \leftrightarrow Fe(s) + CO_2(g)$
   If at 298K the equilibrium amount present are 2.5mol FeO, 0.2molFe, 3.0mol CO_2 and 4.0mol CO. calculate the equilibrium constant for the

A)0.06   B) 0.6   C) 6.0   D) 2.1×10^{-2} E) 0.75

2. For the reaction in question 1 above. What would be the effect of increase in pressure on the position of equilibrium?
A) Equilibrium shift to the right   C) No effect
B) Equilibrium shift to the left   E) All of the above
D) None of the above

3. 2moles of HI are injected into a box of one dm3 volume at 490°C. If 0.228 mole of the HI disappeared. Calculate the concentration equilibrium constant.
A) 0.0166   B) 0.0179   C) 1.772   D) 0.228

4. The system $2NO(s) \leftrightarrow N_2 (g) + O_2(g)$ is considered to be at equilibrium when
A) The concentration of N_2 and O_2 are equal
B) The concentration of NO is twice that of either N_2 or O_2
C) The concentration of NO is equal to the combined concentration of N_2 and O_2
D) The rate of decomposition of NO is equal to its rate of formation

5. The relationship between the Kc and Kp is
[A] $K_c = Kp(RT)^{\Delta n}$ [B] $K_c = Kp(RT)$
[C] $K_c = Kp(d)$ [D] $K_c = Kp/(RT)^{\Delta n}$

6. Given that $P = 2.5 \times 10^4 \, Nm^{-2}$ and the % dissociation of NOBr is 34% the volume of kp for the reaction:
$2NOBr(g) \leftrightarrow NO(g) + Br_2(g)$ at 298K is
A) $938.5 Nm^{-2}$ B) $745 Nm^{-2}$ C) $1013 Nm^{-2}$ D) $11288 Nm^{-2}$

7. During the reaction $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$ 0.5mole each of the H_2 and I_2 were placed in the 4L vessel at 425°c until the equilibrium was attained. The vessel was found to contain 0.44mole of HI and 0.059mole each of H_2 and I_2, the value of Kc is
A) 54.9   B) 72.0   C) 10   D) 87.2

8. What is the kp for the reaction
$CaCO_3(aq) \leftrightarrow CaO(s) + CO_2(g)$ is
[A] $Kp = [CaO][CO_2]/[CaCO_3]$ [B] $Kp = PCO_2$
[C] $Kp = [CaCO_3]/[CaO][CO_2]$ [D] $kp = [CO_2]$

9. The value of Kp at 500°C for the reaction $3H_2 (g) + N_2(g) \leftrightarrow 2NH_3(g)$ is 1.50×10^{-5} the value of kc is
A) 6.02×10^{-2} B) 4.8×10^{-3} C) 8.01×10^{-2} D) 2.1×10^{-2}

10. For the reaction
$FeO(s) + CO(g) \rightarrow Fe(s) + CO_2(g)$
What will be the effect of increase in pressure on the position of equilibrium?
A) Equilibrium shift to the right
B) Equilibrium shift to the left   C) No effect
D) More of CO_2 is produced

11. What is the PH of 0.10m of $NaOH$?
A) 1.0   B) 1.0×10^{-3} C) 3.0   D) 13

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12. The dissociation constant of ethanoic acid at 298k is 1.8×10^5. In a buffer solution the concentration of CH_3COO-and CH_3COOH are 0.05m and 0.1m respectively. What is the PH of the buffer solution?
   A) 11.28   B) 4.44   C) 3.15   D) 13

13. What is the PH of $10^{-3}M$ H_2SO_4?
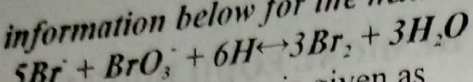   A) 3.0   B) 10   C) 2.70   D) 2.0

ANSWER TO CHEMICAL EQUILIBRUM

1. **Option D**
   At equilibrium $K= [Co_2]/[co]=3.0/4.0=0.75$

2. **Option C**
   Effect of increase in pressure on the position of equilibrium only act on homogenous gaseous system

3. **Question not complete**

4. **Option D**
   A system is said to be at equilibrium when the rate of forward reaction is equal to the rate of reverse reaction

5. **Option D**
   The relationship between Kp and Kc is given by $Kp=Kc(RT)^{\Delta ngas}$
   OR $Kc = Kp/(RT)^{\Delta n gas}$

6. **Option D**
   Check on website for complete solution

7. **Option D**
   $H_2(g) + I_2(g) \leftrightarrow 2NH_3$

	a	b	O
I			
C	-x	-x	+x
E	a-x	b-x	X

   At equilibrium
   [HI]= n/v = 0.44mol/1L = 0.44mL
   $[I_2] =[H_2] = n/v = 0.059/1L = 0.059m$
   $Kc= [HI]^2/[H_2][I_2]$
   $Kc = 87.2$

8. **Option B**
   Concentration of a solid sis expressed as unity 1

9. **Option A**

10. **Option C**

11. **Option D**

12. **Option B**
   Using Henderson-Hasselbalch equation

13. **Option C**

1. The half-life period for the decomposition of radium is 1,590years. Calculate the rate sec-1
   A) 5.83×10^{-10} sec^{-1} B) 2.58×10^{-1} sec^{-1}
   C) 1.382×10^{-11} sec^{-1} D) 5.83×10^{-11} sec^{-1}

Use the information below for the next two questions for the chemical reaction
$$5Br^- + BrO_3^- + 6H^+ \leftrightarrow 3Br_2 + 3H_2O$$
The rate expression is given as
Rate = $K[Br^-][BrO_3^-][H^+]^2$

What are the molecularity and the order of each reactant?

2. Reactant Br^-
   A) 5 and 1   B) 2 and 5   C) 3 and 1   D) 1 and 4

3. Reactant BrO_3^-
   A) 2 and 1   B) 1 and 3   C) 3 and 2   D) 1 and 1

4. Reactant H+
   A) 6 and 1   B) 6 and 2   C) 6 and 3   D) 4 and 2

5. A first order reaction has an initial volume of 1.71ml after 9minutes the volume become 4.49ml. Calculate the rate constant if the infinity reading is 15.98ml
   A) 1.41×10^{-2}min^{-1} B) 2.41×10^{-2}min^{-1} C) 3.41×10^{-2}min^{-1} D) 2.54×10^{-2}min^{-1}

6. A field order reaction is 40% complete at the end of 50mins. What is the value of the rate contact in sec^{-1}
   A) 1.82×10^{-4}sec^{-1} B) 1.90×10^{-4}sec^{-1} C) 1.70×10^{-4}sec^{-1} D) 1.63×10^{-4}sec^{-1}

7. What is the general form of a rate law?
   [A] Rate = $K[A]^n[B]$ [B] Rate = KA^nB^m
   [C] Rate = $[K/A]^n[K/B]^m$ [D] Rate = $R[A,B]^{nm}$

8. What is the relationship between the specific rate constant and half-life?
   [A] $T_{1/2} = 8.314/k$ [B] $T_{1/2} = 9500/k$
   [C] $T_{1/2} = 0.693/k$ [D] $k = 2.303/T_{1/2}$

Use the information to answer the next two questions

The decomposition of acetaldehyde and acetine dicarboxylic acid yielded results whose plot is log T against 1/T gave straight lines with slopes
   A) -9920   and   B) -5070 respectively

9. Calculate the activation energy at first
   A) 54,294kcalmol^{-1} B) 45,394kcalmol^{-1}
   C) 54,382kcalmol^{-1} D) 63,200kcalmol^{-1}

10. What is the activation energy of the second?
    A) 15,000Calmol^{-1} B) 17,000Calmol^{-1}
    C) 1,000Calmol^{-1} D) 23,200Calmol^{-1}

11. The rate law of a chemical reaction was found to be $R = K(A)^{2x-1}[B]$
    What is the overall order of equation if x=1
    A) 3/2   B) 2   C) 2x-1+x   D) 3x-1   E) 3

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12. In a first order chemical reaction, after ups, 6moles from the initial concentration of 16moles of the reactant disappeared. Calculate the rate constant

A) $2.303S^{-1}$ B) $Log (16/10)S^{-1}$ C) $0.0470s^{-1}$ D) $20s$ E) $14.74s^{-1}$

Use the information below to answer the next two questions. At 25°c the half-life period for the decomposition of N_2O_5 is 5.7hrs and is independent of the initial pressure of N_2O_5.

13. Calculate the specific rate constant?

A) $0.015hr^{-1}$ B) $0.15hr^{-1}$ C) $0.013hr^{-1}$ D) $0.12hr^{-1}$ E) $0.14hr^{-1}$

14. Calculate the time required for the reaction to go 90% completion

A) 19.19hrs   B) 19.18hrs   C) 19.17hrs   D) 19.20hrs

19. The half-life of a radioactive isotope A is 1997years. How long does it take for a sample of A to decay to 20% of its original radioactivity

A) 2638years   B) 3638years   C) 4638years

D) 1638years   E) 5000years

20. The rate law of a chemical reaction was found to be $R=K(A)^{3/2}B^2$ What is the overall order of this reaction?

A) 3/2   B) 2   C) 7/2   D) 7   E) 1

21. In a zero order of reaction

A) The rate reaction is independent of the concentration of all the reactant

B) the rate of reaction is dependent of the concentration of all the reactants

C) The rate of reaction is doubled

D) None of the above   E) All of the above

22. A first order of reaction 25% complete in 30s. Calculate the rate constant k

A) $9.956 \times 10^{-3}s^{-1}$ B) 72.25^{-1} C) $144.4s^{-1}$ D) $20s^{-1}$ E) $22s^{-1}$

23. Given the molecularity of the elementary reaction below

$2NO + O_2 \rightarrow 2NO_2$

A) Unimolecular   B) Bimolecular

C) Termolecular   D) Second Order   E) First Order

24. The ideal of surface area becomes insignificant in

A) An homogenous system   B) Heterogeneous system

C) Particles with small size   D) Particle with large size

E) All of the above

25. How can the rate of reaction be reactant as well as each product of this reaction?

$2N_2O_5 \rightarrow 4NO_2 + O_2$

[A] $R = -\frac{1}{2}d[N_2O_5]/dt = \frac{1}{4}d[NO_2]/dt = d[O_2]/dt$

[B] $R = -2d[N_2O_5]/dt = 4d[NO_2]/dt = d[O_2]/dt$

[C] $R = -2d[N_2O_5]/dt = d[NO_2]/dt = d[O_2]/dt$

[D] $R = -\frac{1}{2}d[N_2O_5]/dt = 4d[NO_2]/dt = d[O_2]/dt$

[E] None of the above

26. A second order reaction is $2A \rightarrow product$, what is the rate equation?

A) $R = K_2(A)^2$ B) $R = K_2(2A)$ C) $R = K_2(\frac{1}{2}A)$

D) $R = K_2(A_2)$ E) None of the above

27. A reaction follows the rate expression R=K[A]. If the rate is expressed in terms of $Mol^{-1} S^{-1}$ and the concentration of A is in $Mol L^{-1}$. What is the unit of first order rate constant?
A) $Mol L^{-1}$ B) $K mol L^{-1}$ C) S   D) S^{-1} E) S^{-2}

28. The ideal of surface area becomes insignificant in
A) An homogenous system   B) Heterogenous system
C) Particles with small size   D) Particles with large size
E) All of the above

29. For the chemical reaction $A \rightarrow G$, it is formed that the rate of the factor of 2.25 when the concentration of A is increased by a factor of 1.5. What is the order of A of this reaction?
A) 0   B) 1   C) 2   D) 3   E) 4

30. After five half-life periods for a first order reaction what is fraction of reactant remains
A) 1/6   B) 1/5   C) 1/25   D)1/32   E) 2

31. In general, what happens to the rate of reaction as the reaction progress?
A) The rate of reaction also increases
B) The rate of reaction is quenched
C) Concentration increases
D) The rate of reaction decreases
E) All of the above

32. The slowest step in an elementary reaction is
A) Molecularity of a reaction
B) Order of a reaction
C) Rate determining step
D) Elementary step

33. Which one of the following statement is a complete false description of the rate determining step of a reaction?
A) It governs the rate of the overall reaction
B) It usually corresponds to the height activation peak in the reaction profile
C) It correspond to the slowest stage of the reaction
D) It necessarily involves the breaking of bonds in the reactant molecules

34. The rate constant of azoisopropane is $2.06 \times 10^{-3} sec^{-1}$ at $27°C$
Calculate the time required for the reaction to go to95% completion
A) 1454.50secs   B) 1680.50secs   C) 1983.50secs   D) 1382.50secs

ANSWER TO CHEMICAL KINETICS

1. Option C
$T_{1/2}$= 1590 years, Since 1 year is 31,536,000 secs then 1590 years=5.01422×10^{10}secs
$T_{1/2}=0.693/\lambda$ where λ is the rate constant
Substituting the parameters we have
$\lambda=1.382 \times 10^{-11} sec^{-1}$

2. Option A
Br=First order and molecularity is 5

3. **Option D**
The reaction is first order to the concentration of BrO_3 and hence unimolecular

4. **Option B**
The reaction is second order with respect to the concentration of H+ and hence its molecularity is 6

5. **Incomplete question**

6. **Option C**
T=5mins=3000secs, k=?
A=100, a-x=100-40=60
$In[a/a-x]=kt$
Inputting the parameters in the above equation $k= 1.70x10^{-1}sec^{-1}$

7. **Option A**
The general form of rate low is given by rate = $K(A)^n(B)^m$ where n and m are exponents of the reaction and can only be determined experimentally

8. **Option C**
The relationship between rate constant k and half life, $T_{1/2}$ is given by:
$T_{1/2}= 0.693/k$

9. **Option B**
Since Arrhenius equation is given by
In K=-Ea/RT + In A…equ 1
LogK=-Ea/Rt+ Log A….equ 2
Comparing with the equation of a straight line
Y=mx+c
Y=Log T, m=-Ea/2.303R, x=1/T, c= log A
M=slope=-Ea/R
-Ea=9920x2.303 x 1.987Cal
$-Ea=45.394Kcal/mol$

10. **Option D**
M=-Ea/2.303R
$Ea=23200cal/mol$

11. **Option B**
Overall Order=Sum of order of reaction
$R=K(A)^{2x-1}[B]^x$
Overall order=2x-1+x=3x-1
$If x=1, overall order =3[1]-1=2$

12. **Option C**
A=16moles, a-x=16-6=10moles
In[a/a-x]=kt
In[16/10]=k x 10
$K= 0.0470s^{-1}$

13. **Option D**
T½=5.7hrs
T½=0.693/k=0.693/5.7
$K=0.12hrs^{-1}$

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14. **Option A**

$A=100, a-x=100-90=10$

$2.303\log[a/a-x]=kt$

Since $k=0.12hr^{-1}$

$T=2.303/k\log[a/a-x]$

$T=2.303/0.12\log[100/10]$

T=19.19hrs

15. **Option B**

Since $In[a/a-x]=kt$

$2.303Log[a/a-x]=kt$

K=2.303/tLog[a/a-x]

16. **Option B**

Given srante Arrhenius equation

$dInK/dt=Ea/RT2.......equ\ 1$

integrating equation 1

$In\ K = -Ea/Rt +constant$

$In\ K = -Ea/Rt + In\ A.........equ\ 2$

$2.303LogK=-Ea/Rt+2.303LogA$

$LogK=-Ea/2.303Rt+LogA..equ\ 3$

Combining equation 3 with equation of a straight line $y=mx+c$

$Y=LogK, m=-Ea/2.303R, x=1/T, c=logA$

Slope m=-Ea/2.303R

17. **Option C**

Given slope $m=-5070$

$M=-Ea/2.303R$

Ea=23200Calmol

18. **Option C**

Second order $k= R/[A]2$

$K= \dfrac{mol/dm3/s}{[Mol/dm3]2}$

=Mol/dm3/s

19. **Option C**

$T\frac{1}{2}=0.693/1997=0.000347yr^{-1}$

If $[A]_t=20/100\ x\ [A]_o=0.2[A]_o$

$In[A]_o/[A]_t=kt$

$1/0.000347\ x\ In[A]o/0.2[A]o$

T=4638yrs

20. Option C

21. Option A

22. **Option A**

Using $k=2.303/t\ Log[a/a-x]$

K=0.00959s^{-1}

23. Option C

24. Option B

25. Option A

26. Option A
27. Option D
28. Option B
29. Option C
$[1.5^{ln}=[2.25]$
$[1.5]^n=[1.5]2$
$N=2$
30. *Try hands on this or check our web platform for solutions*
31. Option A
32. Option C
The rate determining or limiting step is the slowest step in an elementary reaction
33. Option B
34. Option A

Question on Electrochemistry

Use the question below in answer

The next two question.

Find the Masses of product formed when a dilute Sulphuric acid solution is electrolyzed with a current of 0.6A for 90 min ($H= 1.0$, $O=16$, $S=32$)

1. Cathode
   (A) 0.0226g   (B) 0.0336g   (C) 0.0446g   (D) 0.0446g   (E) 0.0116g

2. At the Anode
   (A) 0.2686g   (B) 0.1686g   (C) 0.3686g   (D) 0.4686g   (E) 0.0686g

3. Find the Masses of products formed when a dilute Sulphuric acid solution is electrolyzed with a current of 0.6A for 90 minutes
   (A) Mass of H_2 formed is 0.0336g   (B) Mass of Cu formed is 0.0336g
   (C) Mass of S formed is 0.0333336g
   (D) Mass of Fe formed is 0.0336g   (E) Mass of Zn formed is 0.0336g.

4. Using Question three above
   (A) Mass of Au formed is 0.2686g   (B) Mass of H_2O formed is 6.2686g
   (C) Mass of O_2 formed is 0.2686g   (D) Mass of Cl_2 formed is 0.2686g
   (E) Mass of Br_2 formed is 0.2686g.

5. What is the Mass of Copper formed at the cathode when a current of 0.25A is passed through a Copper(ii) Sulphate solution for 1 hour (R.A.M Cu=63.5)
   (A) 0.296g   (B) 0.358g   (C) 0.581g   (D) 159g   (E) 0.578g.

6. During the electrolysis of Copper(ii) tetraoxosulphate (VI) solution using platinum electrode 0.16g of copper was deposited on the cathode. Calculate

the volume of oxygen gas liberated at S.T.P ($Cu=64$, faraday constant$=96500Cmol^{-1}$, Molar Volume$= 22.4dm^3$ step)
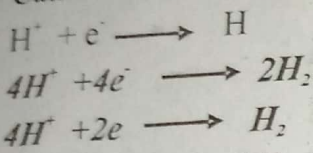
(A) $0.028dm^3$ (B) $0.28dm^3$ (C) $2.9dm^3$ (D) $280dm^3$.

Answers to Electrochemistry

1) **OPTION A**

$$H_2SO_{4(aq)} \rightleftharpoons 2H^+_{(aq)} + SO^{2-}_{4(aq)}$$
$$H_2O \rightleftharpoons /H/ + OH^-$$
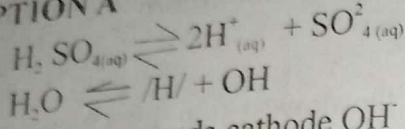
H^+ migrate towards cathode OH^- shows a greater tendency to be preferentially discharge at Anode

Catholic half Reaction.

$$H^+ + e^- \longrightarrow H$$
$$4H^+ + 4e^- \longrightarrow 2H_2$$
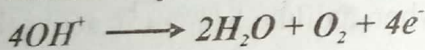$$4H^+ + 2e \longrightarrow H_2$$

2 F liberates 4g of H_2

193000c liberates of H_2

$(0.6 \times 70 \times 60)$ liberates $\dfrac{(0.6 \times 90 \times 60 \times 4)}{193000}$

$$=0.0226g.$$

OPTION A

Anodic half Reaction.

$$4OH^+ \longrightarrow 2H_2O + O_2 + 4e^-$$

4f liberates 32g of O_2
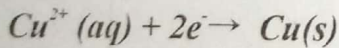
(4×96500) c berates $\dfrac{(0.6 \times 90 + 60}{7 \times 96500}$

$$=0.2686g.$$

3. Check our website for solutions

Option A

$I = 0.25A$, t$=$ hour $= 3600$ se

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$$

63.5g of 63 5g

(2×96500)C liberates 63. 5g Cu

(0.25×3600)C liberates $\dfrac{(0.25 \times 3600}{(2 \times 96500}$

$$= 0.29\ 6g$$

6. **Option B**

a= 100, a-X =100 – 40 =60 t=3000sec

$$\ln \frac{\{a\}}{\{a-x\}} = Kt$$

$$2.303 \log \frac{a}{a-x} = Kt$$

$$K = \frac{2.303}{3000} \log \frac{\{100\}}{\{60\}}$$

$$K = 1.7 \times 10^{-4} sec^{-1}$$

Question on Intermolecular Forces

1. _____ has Intermolecular forces called _____

    (A) KCl/ Vander waal   (B) Co_2, Vander waal

    (C) 0_2/ electrostatic forces   (D) Cl_2 cohensive (E) None

Answer to intermolecular forces

1. **OPTIONA**

    KCl has Intermolecular forces called Vander Waal forces

QUESTION ON CHEMICAL BONDING

1. The type of Inter molecular Interaction including KCL is:

    (A). Dipole –Dipole   (B). Hydrogen bonding

    (C). Inter atomic forces   (D) Ion- dipole.

2. Which of the following does not obey octet rule?

    a) CH_4 (b) Nh_3 (C) SO_2 (d) BF_3

3. The following arise as a result of permanent dipole in a molecule except

    A) Inter atomic force   (B) Dipole Dipole Interactions

    C) Ion dipole Interaction (D) Hydrogen bonding

4) In which of the following repulsion is greatest

    A) Lone pair, bond pair B) Lone pair, Lone pair

    C) Bond pair, Bond pair D) None.

5. Which of the following contains coordinate covalent bond?

    (A) Nh_4^+ (B) $Na^+ CL^-$ (C) CH_4 (D) HCL (E) all of the above

6. _____ and _____ are examples of ionic crystals and layer crystal respectively

    (A) Diamond and graphite   (b) HCL and diamond

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(C) NACL and graphite   (D) NACL and diamond

7. The following are the properties of ionic compounds except.

(A) Good conductors of heart and electricity

(B) Mostly solids   (C) Low melting and boiling point

(D) Soluble in water   (E) None

8. Nitrogen gas has_____ Covalent bond

(A) Triple bond   (B) No bond

(C) Dative bond   (D) Double bond (E) All of the above

9. The ammonia molecule NH_3 can from NH^{4+} because

(A) Nitrogen has vacant p – orbitals to accept elections

(B) Hydrogen can donate electrons to nitrogen

(C) The nitrogen a to m has a lone pair of election

(D) All of the above

10. H_2O is a liquid at room temperature while H_2S is a gas at the same temperature; the difference is a result of _____

(A) Weaker hydrogen band in H_2O then H_2S

(B) Stronger hydrogen band in H_2O then H_2S

© Difference In atomic mass

(D) Difference In size forms 0and 5,

11. An element Y, has 5 valence electrons and forms a molecule Y_2 the what as the band owner of the Y_2 molecule.

(A) 1   (B) 3   (C) 2   (D) 4

12. In which of the following compounds is hydrogen bonding most likely to be least?

(A) HF   (B) H_2O (C) NH_3 (D) PH_3

13. All chemical bands Indeed ·

(A) Centrifugal fore   (B) Electrostatic attraction

(C) Centripetal force   (D) Gravitational force

14. Metallic bond is an attractive force between

(A) Cation and anion   (B) Metal ions and delocalized election cloud

(C) Two dipoles   (D) Electropositive and electronegative elements

15. The type of dipole that exists in HCL molecule is known as

(A) Instantaneous   (B) Permanent

(C) Induced   (D) Temporary

16. In a molecule, there is _____ type of electrons

(a) 3   (C) 2   (d) 5

17. In which of the following is repulsion lowest?
   (A) Bond pair – Lone pair
   (B) Bond pair – Bond pair
   (C) Lone pair – Lone pair
   (D) All of the above

18. For a molecule to have trigonal planar shape there must be _____
   (a) 2 bond pairs alone around the central atom
   (b) 3 bonds pairs alone around the central atom.
   (c) 2 bond pairs and 1 lone pair around the central atom
   (d) 3 lone pairs alone around the central atom

19. An element x has 5 valence elections and forms a homo nuclear diatomic macular x_2.
   What is the bond order of x_2?
   (a) 2   (b) 3   (c) 1   (d) 5

20. Which of the following molecular violate octet rule?
   (a) HF   (b) H_2O (c) NH_3 (d) BF_3.

21. The type of bonding fond in NH_3 is known as
   (a) Covalent (b) ionic (c) metallic (d) denture

22. The following are that affect the Strength of metallic bond
   (a) Size of metal atoms
   (b) No of valence electrons metals atom   (c) a an d b   (d) none

23. In which of the following is hydrogen bond is most likely to be strongest
   (a) NH_3 (b) H_2O (c) HF (d) HCL

24. Molecules with permanent dipole are said to be
   (a) non polar   (b) bipolar   (c) polar   (d) aprotic

Answer to chemical bonding.

1. Option D
2. Option D
   BF₃ violates Octet rule because it has fewer number of bond pair of electrons

1. Option A
2. Option B
   $$\frac{Lone}{Pair} \_ \frac{Lone}{Pair} \frac{Lone}{Pair} - \frac{Bond}{Pair} > \frac{Bond}{Pair} \_ \frac{Bond}{Pair}$$

   Decrease in Repulsion

5. OPTION A.

NH_4^+ exhibit coordinate / Dative Bond which is a type of covalent bond in which the shared pair of electrons is supplied by only one of the bonded atoms.

6. **OPTION D**

NaCl is ionic crystals and diamond is a covalent compound with layer crystal.

7. **OPTION C**

Ionic compound exhibit the following properties

    1)   They are three dimension solid structures at temperature.

    2)   They have high meting and being point.

    3)   They are Good conductors of electricity.

    4)   They are soluble in water.

8. **OPTION A**

$:N=N:$

Nitrogen gas has three covalent Bond pair

9.   **OPTION C**

10.   **OPTION B**

11.   **OPTION B**

12.   **OPTION D**

13.   **OPTION B**

14.   **OPTION B**

15.   **OPTION B**

16.   **OPTION C**

17.   **OPTION C**

18.   **OPTION B**

19.   **OPTION D**

20.   **OPTION B**

21.   **OPTION D**

22.   **OPTION C**

23.   **OPTION C**

24.   **OPTION C**