JRG College of Pharmacy

JRG COLLEGE OF PHARMACY

UNIVERSITY SOLVED QUESTION WITH ANSWER

Year : 2021-2022

Subject : Physical Pharmaceutics - I

Subject Code : BP302T

Subject In-Charge : Ms. Monali Padhi

Registration No : | | | | | | | | | | |

Total Number of Pages: 01 **B.Pharm**
BP302T

3rd Semester Regular / Back Examination: 2021-22
PHYSICAL PHARMACEUTICS-I
BRANCH(S): B.Pharma
Time: 3 Hour
Max Marks : 75
Q.Code:OF612

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2×10)**

a) Expressthe term solubility.
b) Define glassy state.
c) Explain about sublimation.
d) What is boiling point and vapor pressure?
e) Express polymorphism with suitable example.
f) What do you understand the term glass transition temperature?
g) Differentiate between surface tension and interfacial tension.
h) What is Sorensen's pH scale?
i) What is tonicity? Mention its importance.
j) Mention the physiochemical properties of drug molecules.

Part-II

Q2 Focused-Short Answer Type Questions- (Answer Any Seven) **(5×7)**

a) Define solution? Mention the mechanism of solute and solvent interaction.
b) Write notes on spreading coefficient.
c) Narrate the basic principles of aerosol.
d) Explain critical solution temperature and its applications using suitable example.
e) Write a notes on HLB system
f) What is chelate, mention its application
g) What is buffer, mention how it is importance in pharmaceutical field?
h) Write a notes on Eutectic mixture
i) Mention how crystalline differ from amorphous

Part-III

Long Answer Type Questions (Answer Any Two)

Q3 What is Raoult`s law? Describe it briefly. **(10)**

Q4 What is universal gas law, derive it. **(10)**

Q5 What is surfactant? Classify it and discuss the pharmaceutical application. **(10)**

Q6 Discuss details about complexation, mention how drug-βcyclodextrin complexation occurs. **(10)**

PYQ - 2021 - 22

3rd Sem (physical pharmaceutics-1)

Part -1

Q1 a) Express the term solubility.

Ans- Solubility is a molecular level of interaction of 2 or more substance to form a homo-genous mixture.

→ Measurment of solubility :-

mg/ml, kg/mtr cube, moles/kg of solvent

b) Define glassy state ?

Ans- The glassy state is a physical state of matter in which a substance is rigid like a solid but lacks the long-range ordered structure of a crystal.

→ It is formed when a liquid is cooled rapidly and doesnot have enough time to crystallize.

c) Explain about sublimation ?

Ans- The process of conversion of any solid directly into gas without converting into liquid often increase in temp. is called sublimation.

Q) What is boilling point & vapor pressure ?

Ans:- boilling point

→ The boiling point is the specific temp at which a liquid converts into a vapour/gas

Vapour pressure -

→ The pressure exerted by a vapour that is in thermodynamic equilibrium with its liquid or solid phase at a specific temp in a closed system.

e// Express polymerphism with suitable Example.

Ans- polymerphism refers to the ability of a solid substance, particularly a drug to exist in 2 or more crystaline forms with different arrangements of the molecules within the crystalattice.

Example - Ritonavir.

f// What do you understand the term glass transition temperature?

Ans- The glass transition temp is the temp at which an amorphous polymer or material changes from a hard, brittle, glassy state to a soft, flexible, rubbery or molted state.

g// Differential betn surface tension & interfacial tension.

Ans (1) Surface tension-

→ It occurs at the interface betn a liquid and a gas.

→ measures the energy at the surface of a liquid that causes it to behave like an elastic sheet.

(2) Interfacial Tension-

→ It occurs at the interface betn 2 immiscible liquids or a liquid & a solid.

→ measures the energy at the interface betn 2 phases that causes them to minimize their contact area.

h) What is Sorensen's pH scale?

Ans→ It is a logarithmic scale used to measure the acidity or basicity of a soln, ranging from 0 to 14.
→ It defines pH as the -ve logarithm of the hydrogen ion concentration.

i) What is tonicity? Mention it's important?

Ans→ Tonicity refers to the relative concentration of solutes in a soln compared to another soln, typically a cells internal environment. It affects the movement of H_2O into or out of cells through osmosis.

Important→

(1) Maintains cell shape & fun^n.

(2) Regulates fluid balance & cell volm.

j) Mention the physiochemical properties of drug molecules?

Ans→ i) Solubility: Ability to dissolve in solvent, affecting absorption & bioavilability.

ii) Lipophillicity.

iii) Molecular size & shape

iv) Stability those are the physiochemical properties of drug molecules.

part - II

Q.1 a) Define solution ? Mention the mechanism of solute & solvent interaction ?

Ans- Solution is the mixture of 2 or more components that forms a homogenous mixture. The components are referred to solute / solvent & solvent / solvents.

Mechanism of solute solvent interaction-

→ It is a process which results in the stabilisation of solute species in the solvent molecules.
→ This interaction influences various properties of solute like reactivity colour, stability & physical properties of solvents like density & viscosity.
→ The interactn depends on various factors like attractive & repulsive force, ion-dipole interaction, H bonding, wander force etc.

condition for solubility-

If A is the solvent & B is the solute then there are mainly 3 types of intraction involved in solute - solvent interactn:

(1) A - A interactn
(2) A - B interactn
(3) B - B interactn.

Principle of solute - solvent interaction-

→ solute - solvent interaction based on principle of "like dissolves like"
→ Polar solute from bulk foam.
→ Non-polar solute dissolves in Non-polar solvents.

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→ Polar solute from bulk form.
→ Non-polar solute dissolves in Non-polar solvents.

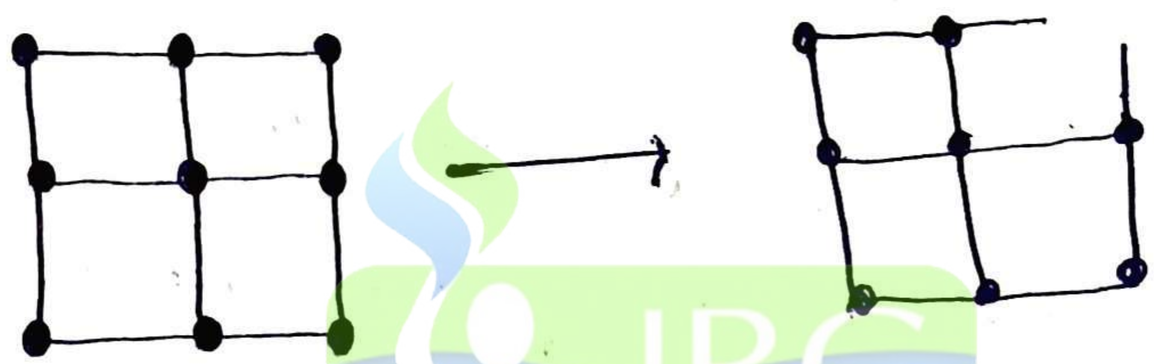
Mechanism-

The mechanism of solute solvent interaction involved 3 setps -

(1) Detachment of solute from bulk form
(2) Formatn of vacant site in solvent
(3) Insertion of solute molecules in the vacant site of solvent.

(1) Detachment of solute from bulk form -

In this step one molecules of solute get detached from solute bulk crystals & this further used in solute-solvent interaction.



(2) formatn of vacant site in solvent -

In this step from the solvent bulk one molecule get free and created a vacant site

→ It is further used in the solute solvent interaction.

3) Insertion of solute molecule in the vacant site of solvent -

In the final step the detached solute molecule inserted inside the vacant site of solvent & this is how we get solvent with embedded solute molecule.

b// Write notes on spreading coefficient.

Ans- On a immiscible liquid, when we placed first's liquid drop on the surface of other it will spread as a filter

And the ability of one liquid to spread over another liquid is calculated as spreading coefficient.

eg:- Emulsion, oil in H_2O etc.

And it occurs, when adhesive force is more than cohesive force.

i.e $\boxed{S = W_A - W_C}$ —— (1)

where,

S = Spreading coefficient.

W_A = Work done on adhesive force

W_C = Work done of cohesive force.

Derivation-

1st case → For Cohesive force

$W_C = \gamma_L \Delta A + \gamma_L \Delta A$ [∵ γ_2 = surface tension of H_2O ; ΔA = Area of drop]

$W_C = 2\gamma_L \Delta A$

If $\Delta A = 1\ cm^2$ then

$\boxed{W_C = 2\gamma_L}$ —— (ii)

2nd case :- For different nature liquid (Adhesive force)

$W_A = \gamma_2 \cdot \Delta A + \gamma_S \cdot \Delta A - \gamma_{LS} \Delta A$

If $\Delta A = 1\ cm^2$

$\boxed{W_A = \gamma_L + \gamma_S - \gamma_{LS}}$ —— (iii)

Now, put value of eqn (ii) & (iii) into (i)

$S = W_A - W_C$

$S = \gamma_L + \gamma_S - \gamma_{LS} - 2\gamma_L$

$\boxed{S = \gamma_S - (\gamma_L + \gamma_{LS})}$

$gf, V_S > (V_L + V_{LS})$, then spreading occurs.

$V_S < (V_L + V_{LS})$, the spreading is not occurs.

C// Narrate the basic principle of Aerosol?

Ans When any gassious substance is Could under pressure & low temp°, then Convert into liquid gram, when the Pres. is reduce the molecules expand & the liquid convert into gaseous state.

→ Aerosol are based on the principle of reversible change of state on the application of release of pressure.

→ In pharmaceutical aerosol a drug is dissolve in a propellent at high pressure.

→ propellent is a substance which ↑es the pressure & convert gaseous during into liquid.

→ The Container is design in such a manner that on pressing a valve, some of the drug propellent mixture is release out due to the excess pressure inside the container.

→ Nitrogen & CO_2 gas is generally used as propellen.

(d) Explain Critical solution temperature and it's application using suitable example ?

Ans - Critical solution Temperature :-

The critical solution tempr is the temperature at which the miscibility of two partially miscible liquid becomes complete.

→ It is also known as consulate temperature.

→ There are two types of critical solution temperature (CST).

1- Upper critical solution Temperature (UCST)

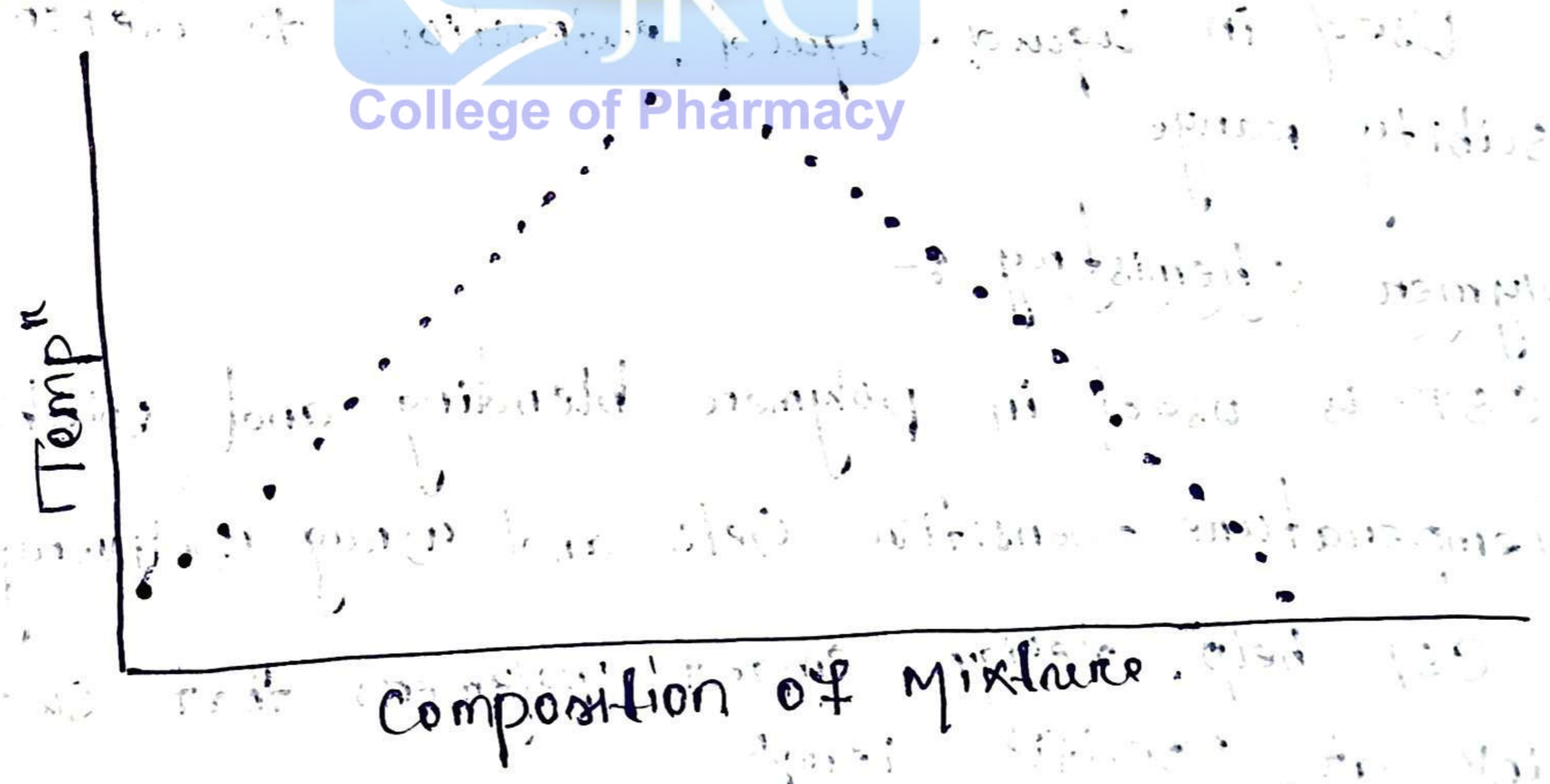
2- Lower Critical solution Temperature (LCST)

1 - Upper citrical sol^n temp^r (UCST) :-

The highest temperature at which phase separation occurs. Above this temp^r, the liquid become completely miscible.

Ex :- hexane & nitro benzene (UCST ≈ 66°C)

Graph :-



Above the curve (above UCST) :- complete miscibility

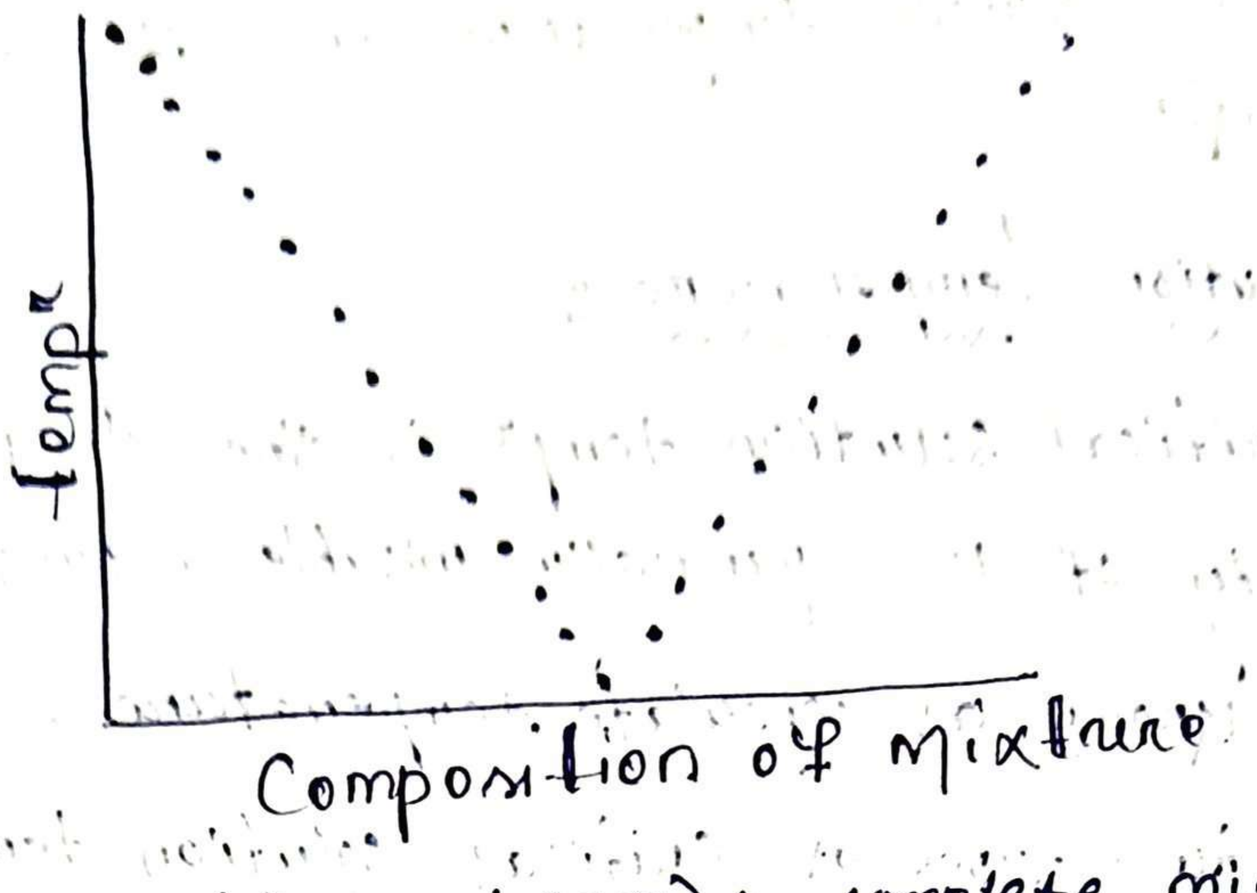
Below the curve (below UCST) :- partial miscibility (two layers)

2. Lower Critical sol^n temp^r (LCST) :-

The lowest temperature at which phase separation occur. Below this temp^r, the liquid become completely miscible

→ Ex :- Triethyl amine and water (LCST ≈ 18°C)

Graph :-



Below the curve (Below LCST) :- complete miscibility

Above the curve (Above LCST) :- partial miscibility (two layer)

Application :-

1- Pharmaceutical Formulation :-

CST helps in selecting compatible solvent for drug solubilisation

2- Extraction and separation process :-

Used in liquid - liquid extraction to determine miscibity range.

3- polymer chemistry :-

CST is useef in polymer blending and solubility testing.

4- Temperature - sensitive Gels and Drug Delivery :-

CST help design smart polymers that swell or Shrink at specific temp".

5 - Industrial Application :-

Useef in detergent, cosmetic and chemical syntheis to ensure phase stability.

(e) write a Notes on HLB system.

ANS → HLB Stands for Hydrophilic - Lipophilic balance.

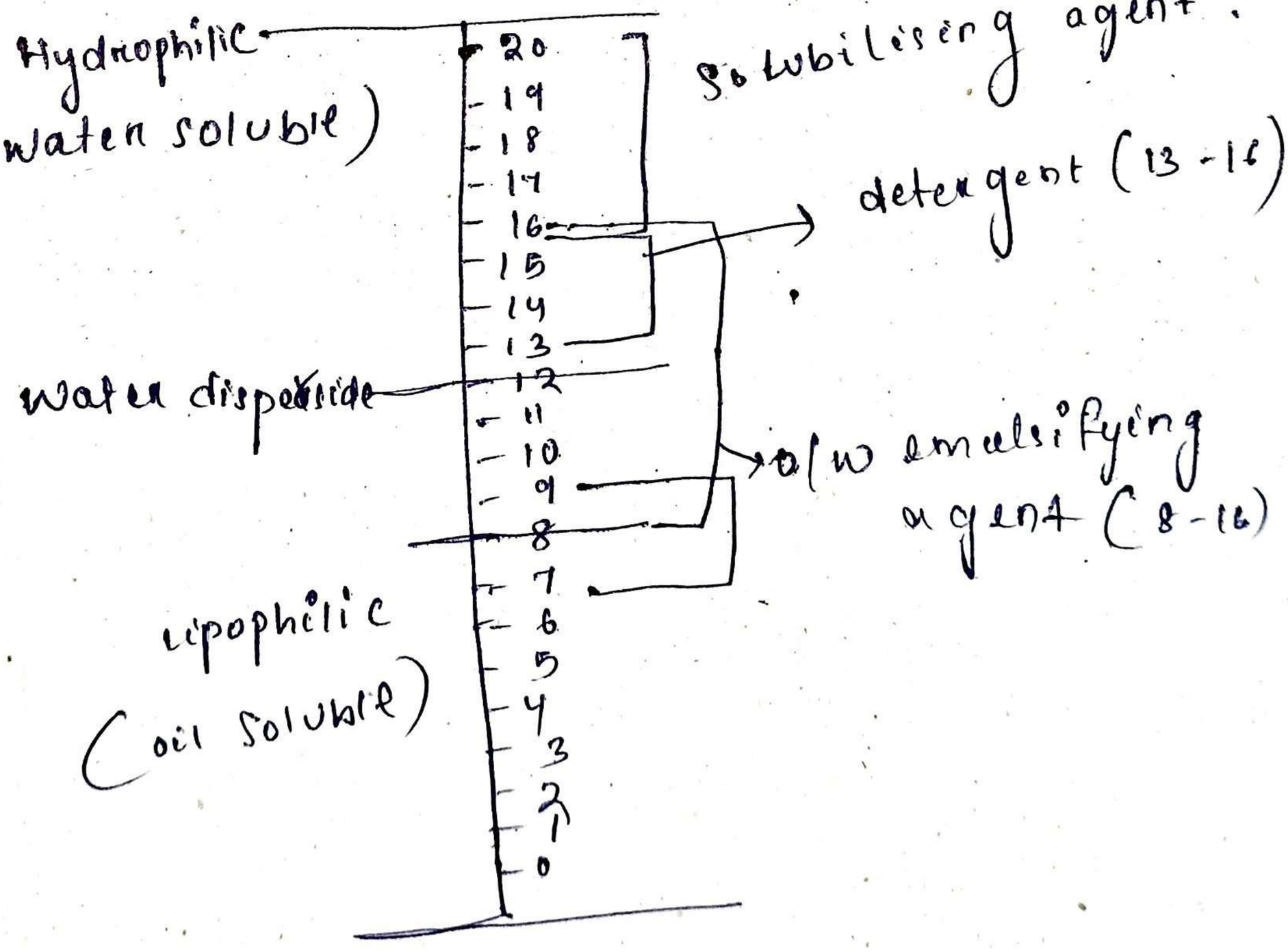
→ This system consisting of an binatory scale in which values are assigned to different Surfectants according to their Nature.

→ HLB value of 1 indicators → Surfectant is lipophilic & Soluble in oil.

→ HLB value of 20 indicators → surfectant is hydrophilic & Soluble in water.

$$HLB = \frac{\text{Hydrophilic}}{\text{Lypophilic}}$$

→ HLB scale :-



(f) what is chelate, mention its application?

Ans:- → A chelate is a Complex Compound formed when a metal ion binds with an organic molecule through two or more donor atoms

→ A ring like str. around the metal ion.

Example:-

(1) EDTA (Ethylene diamine tetra acetic acid) forms Stable chelates with Ca^{2+}, Mg^{2+}, Fe^{3+} etc.

(2) ~~H~~emoglobin is a natural chelate of iron with the porphyrin ring.

(3) Chlorophyll is a magnesium chelate with a porphyrin ring.

Application:-

① Medicine:-

→ EDTA is used in chelation therapy to remove heavy metals (like Lead, mercury) from the body.

→ Iron chelates are used to treat iron deficiency Anemia.

② Agriculture:-

→ Micro nutrient fertilizers often contain Chelated forms of Fe, Zn, Cu, Mn to improve plant uptake.

③ Food Industry:-

→ Chelating agents like Citric acid and EDTA are added to food to prevent oxidn & spoilage.

④ Water Treatment :-

→ chelates help remove hardness-causing ions (Ca^{2+}, mg^{2+}) from water.

⑤ Analytical chemistry :-

→ chelating agents are used in complexometric titⁿ.

(g) what is buffer. mention how it's importance in pharmaceutical field?

Ans :- Buffer :-

→ A buffer is a solⁿ that resists changes in pH when small amounts of an acid or a base are added.

→ It is usuary made of a weak acid and it's conjugate base or a weak base and it's conjugate acid.

Importance of buffer in pharmaceutical field :-

(1) Stability of durgs :-

→ many drugs are stable only within a certain pH range. buffers maintain that pH & prevent degradⁿ.

Ex :- vitamin C is stabilized in slightly acidic buff

② Drug formulation :-

→ Buffers are used in tablets, injections & syrup to keep the product effective & safe.

Ex :- opthamic & injectable drugs must be buffered near physiological pH (~7.4).

③ Drug Absorption:-

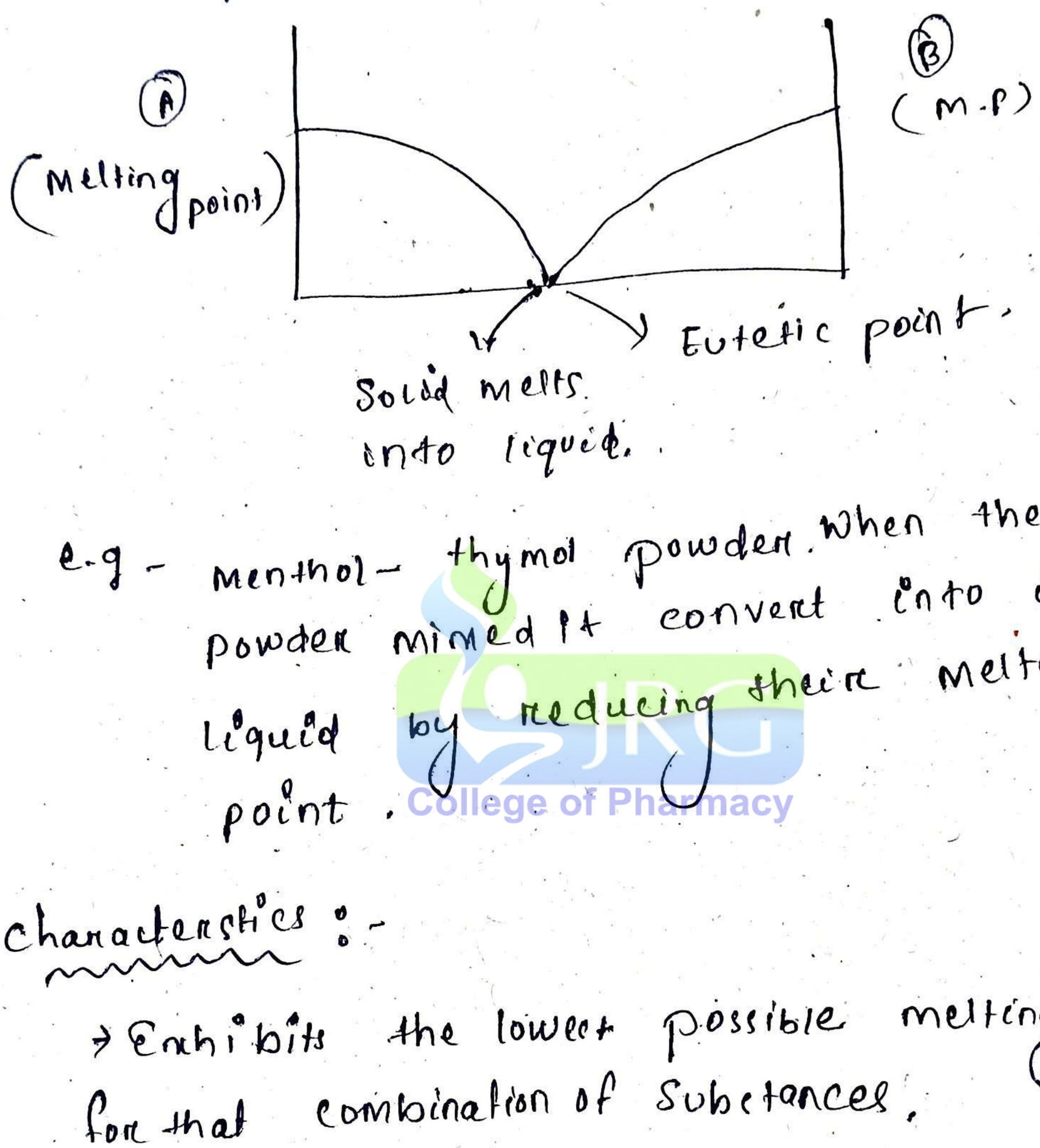
→ The rate and extent of drug absorption in the body depend on p^H.

④ Analytical App^n's:-

→ Buffers are used in assays titⁿ & quality control tests for accurate measurment of drug conc.

(h) Write a Note on Eutetic Mixture.

Ans → It is a mixture of two solid particles mix together & reduced their melting point & converted into liquid at Normal (Room) temp.



e.g - Menthol - thymol powder. When these powder mixed it convert into in liquid by reducing their melting point.

Characteristics :-

→ Exhibits the lowest possible melting point for that combination of substances.

→ Both Components Crystalise simultaneously without Forming a New Compound.

Applications :-

Pharmacy :- To improve drug Solubility. dissolution etc.

metallurgy :- To preparing alloys with desirable melting properties.

ii) Mention how crystalline differ from Amorphus.

Ans-

Crystaline vs Amorphous Solid :-

1→ Structure :-
crystaline Solid have an ordered, reapeting structure while amorphous Solid have a disorder, random structure.

2→ Melting point :- crystaline Solids have a sharp Meting point where as amarphas Solids Soften gradually.

3→ X-Ray differaction :- Crystaline Solid produce sharp x-ray differaction patterns while amorphous Solids

4→ physical properties :- crystaline Solids often exhibit anisotropy, while amorphous Solids are isotropic.

5→ Long-Range Order :-
crystaline Solids have long-range order where as amorphous Solids lack it.

Part - III
Long Question

Q. // What is Raoult's law ? Describe it briefly ?

→ Raoult's law states that the partial vapour pressure of a component in a soln is directly proportional to the mole fraction of that component in the soln.

→ In other words it can also be defined as the partial vapour pressure of any component in a solution is equal to the vapour pressure of pure components multiplied by mole fraction of that component in the soln.

$$P \propto x \quad \text{or} \quad P = P_0 x$$

→ Here, P = partial vapour pressure.
P_0 = Pure vapour pressure.
x = mole fraction.

Let us consider A soln of a volatile liquid A & B :-

→ Here, we have a soln of a volatile and completely miscible liquid A & B

→ Now according to Raoult's law :

$$P_A = P^0_A x_A$$
$$P_B = P^0_B x_B$$

→ Now, According to Dalton's law the total vapour pressure exerted by the soln is equal to the sum of individual partial pressure exerted by all the components in the soln.

$$P_{total} = P_A + P_B$$

Now, after combining Raoult's law & Dalton's law. Finally we get :

$$P_{total} = P^{o}_{A} x_A + P^{o}_{B} x_B$$

Now Here,

P_{total} = Total vapour pressure of the sol^n.

P^{o}_{A} = vapour pressure of pure A

x_A = Mole fraction of A

P^{o}_{B} = vapour pressure of pure B

x_B = Mole fraction of B

Q4) What is universal gas law. derive it?

Ans:- The Universal Gas law is a fundamental relation in chemistry & physics that Connects the pressure, volm, temp & number of moles of an ideal gas.

→ It is also called the ideal gas law.

Derivation -

The universal gas law is a fundamental relation that described the behavior of an ideal gas in terms of pressure, volm, temp & the no. of moles of gas.

→ It is expressed as:

$$PV = nRT$$

where,

P = pressure of the gas

V = volm of the gas

n = no. of moles

R = universal gas const.

T = absolute temp in kelvin.

Derivation from the Combination of gas laws:-

The universal gas law is obtained by combining (1) Boyel's law
(2) Charl's law
& (3) Avogadro's law.

(1) Boyel's law:-

At const. temp^{r} & no. of moles the volm of a given mass of gas is inversly proportional to it's pressure.

$$P \propto \frac{1}{V}$$

$$\Rightarrow PV = \text{Const.}$$

(2) Charl's law:-

At Const pressure & no. of moles, the volm of a gas is directly proportional to its absolute temp^{r}.

$$V \propto T$$

$$\Rightarrow \frac{V}{T} = \text{Const.}$$

(3) Avogardro's law:-

At Const temp^{r} & pressure, the volm of a gas is directly proportional to the no. of moles.

$$V \propto n$$

$$\Rightarrow \frac{V}{n} = \text{Const.}$$

Combining the 3 laws:-

From Boyle's, charles & Avogardo's laws

$$V \propto \frac{nT}{P}$$

Introducing a Const. of proportionality, R:

$$V = \frac{nRT}{P}$$

Rearranging:,

$$PV = nRT$$

Value of the Gas const(R):-

$R = 8.314\ J\ mol^{-1}\ K^{-1}$

$R = 0.0821\ L\ atm\ mol^{-1}\ K^{-1}$

Ans// What is surfactant? classify it & Discuss the pharmaceutical application:

Ans:- Surfactant:-

These are those agents which reduce- -ed the surface tension and interfacial tension blw two liquids.

eg- Detergents, soaps, emulsifier etc

Type of surfactant:-

1// Anionic
2// Cationic
3// Ampholytic
4// Non-ionic.

1// Anionic :-

→ It contain organic tail with -ve charge head & small +ve molecules like ammonia.

→ These are unpleasant taste.

→ eg:- Alkali metal & ammonium soaps.

II/ Cationic surfactants:-

→ It contain organic tail with +ve charge head & small -ve molecules like chloride.

→ There are sometimes used on the skin for cleaning of wounds.

→ Eg:- Benzalkonium chloride.

III/ Amphoteric surfactant:-

Ampholytic & Amphoteric surfactants sometimes referred to as

Zwitter ionic molecules:- surfactants that posses both cationic & anionic groups in the some molecules.

→ They depends on the pH of the system.

→ eg:- Lecithin, Amino acetic acid.

IV/ Non ionic surfactants:-

They are nonionic, so they doesnot ionize in H2O, because their hydrophilic part consist of non-dissociable molecules.

→ They are resistant to pH change.

→ eg:- Glycerol

Application:-

1/ surfactant are widely used in pharmaceuticals because they can reduce surface tension.

2/ Solubilizing agent:-

→ surfactant increase the solubility of poorly H2O soluble drugs by forming micelles.

5) Wetting agents:-

→ They reduce surface tension betn solid drug particles & liquids, allowing powders to disperse in liquid vehicles.

4) Emulsifying Agents:-

Surfactants stabilize oil in water or water in oil emulsions by forming a protective film at the oil-H2O interface.

3) Suspending & Dispersing Agents:-

→ Help disperse insoluble drugs uniformly in liquid media, preventing sedimentation or caking.

Q6) Discuss details about complexation, mention how drug-β cyclodextrin complexation occurs.

Ans:- Complexation is defined as an association of 2 or more chemical species, resulting a formation of complexes.

→ complexes generally results from a donor acceptor mechanism.

→ classification of complexation:

(1) Metal ion complexes
- inorganic ~~agen~~type.
- chillates
- olefin types
- Aromatic types.

(2) organic molecular complexes
- quinhydrone type
- Picric acid
- Caffine
- polymer type.

5// Inclusion/occlusion complexes

- cathrate
- channel lattice type
- layer type.
- monomolecular type
- macromolecular type.

Application of complexation :-

1// physical state :-
To convert liquid substances to solid complexes and improve its procesing characteristics.

2// stability of drugs -
stability of drugs can be enhance by complexation.

3// solubility -
Enhancement of solubility by useing solid complexes.

4// Dissolution -
complexatn enhances the solubility, thus enhancing the dissolution of drugs.

5// Absorption & bioavailibility :-
complexation helps in increasing the absorption & bioavailibility of drug in the body.

→ β-cyclodextrin forms inclusion complexes with drugs by trapping the hydrophobic part of the drug inside its hydrophobic cavity, stability by hydrophobic interactns, vander waals forces & H-bonding. This improves solubility & bioavailility of the drug.