PHYSICAL CHEMISTRY

1. Composition & physical states of matter

Intermolecular forces & their impact on the state of the matter. Various physical properties of matter, dipole moment, dielectric constant, Van Der Waal's equation & critical phenomenon, liquefaction of gases, aerosols.

2. Colligative Properties

The liquid state, vapor pressure, ideal & real solutions. Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular weight based on colligative properties.

3. Thermodynamics

First, second & third law of thermodynamics. Thermochemical laws, isothermal & adiabatic processes, reversible processes, work of expansion, heat content, enthalpy, heat capacity. Gibb's & Helmholtz equation & chemical potential.

4. Refractive index

Refractive index, specific refractivity, molar refractivity, refractometers.

5. Solutions

Solubility, factors affecting solubility, solubility curves. Types of solutions, effect of co-solvency, pH & other factors on solubility. Solubility of gases in liquids, liquids in liquids, & solids in liquids, critical solution temperature, law of partitioning & its applications. Solute-solvent interactions. Expression of the concentration of pharmaceutical solutions

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& calculations. Molarity, molality, mole fraction & percentage expressions.

6. Electrochemistry

Properties of electrolyte solutions, electrolysis. Faraday's law of electrolysis, electron transport, electrical cell, single electrode potential, concentration cells, half-cells & half-cell potential, types of half cells, sign convention, Nernst equation, salt bridge, electromotive series, standard potential, SHE. Measuring the relative voltage of half cells, Calculation of standard potential. Reference & indicator electrodes. Standard oxidation-reduction potential.

7. Ionic equilibrium

Theory of conductivity, equivalent conductance, mobility of ions, specific conductance.

8. Kinetics

Order of reactions, derivation & internal form of rate laws, molarities of reaction, derivation of rate constants.

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PHYSICAL PHARMACY

1. Matter, properties of matter

States of matter, change in the state of matter, latent heat and vapor pressure, sublimation- critical point, eutectic mixtures, gases, aerosols- inhalers, relative humidity, liquid complexes, liquid crystals, glasses state, solid crystalline and amorphous polymorphism.

2. Micromeritics and powder rheology

Particle size and distribution, average particle size number and weight distribution, particle number, methods of determining particle size and volume, optical microscopy, sieving, sedimentation, determining surface areas, permeability, adsorption, derived properties of powders, porosity, packing arrangement densities, bulkiness and flow properties.

3. Surface and interfacial phenomenon

Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption and liquid interfaces, surface active agents, HLB classification, solubilization, detergency, absorption at solid interfaces, solid gas and solid-liquid interfaces, complex films, electrical properties of interfaces.

4. Viscosity and rheology

Newtonian systems, law of flow, kinematics viscosity, effect of temperature, non-Newtonian systems, pseudoplastics, dilatant, plastic, thixotropy in formulations,

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determination of viscosity and thixotropy by capillary, falling ball, rotational viscometer, application of theology in pharmacy

5. Dispersion systems

a. **Colloidal dispersions**: Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy.

b. **Suspensions and emulsions**: Interfacial properties of suspended particles settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, significance of electrical properties in dispersions, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsions: types, theories, physical stability.

6. Complexation

Classification of complexes, methods of preparations and analysis, applications.

7. Buffer

Buffer equations and buffer capacity in general. Buffers in pharmaceutical systems, preparations and stability, buffered isotonic solutions. Measurements of tonicity calculations and methods of adjusting isotonicity.

8. Solubility

a. Miscibility-influence of foreign substances

i. three component systems;

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ii. dielectric constant and

iii. solubility, solubility of solids in liquids

iv. ideal and non-ideal solutions

v. solvation and association in solutions solubility of salts in water

vi. solubility of slightly soluble and weak electrolyte, calculating solubility of weak electrolytes as influenced by pH, influence of solvents on the solubility of drugs

vii. effect of pH and solvents, distribution of solutes between immiscible solvents, effect of ionic dissociation and molecular association on partition, extraction, preservatives action of weak acids in emulsions, drug action and distribution coefficient.

b. Concepts of dissolution and diffusion.

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PHARMACEUTICAL ENGINEERING

1. Fluid flow

Type of flow, Reynold's number, viscosity, the concept of the boundary layer, basic equation of fluid flow, the study of valves, flow meters, manometers and measurement of flow and pressure including mathematical problems.

2. Heat transfer

Source of heat, mechanism of heat transfer, the laws of heat transfer, steam and electricity as heating media, determination of requirement of the amount of steam/electrical energy, steam pressure, boiler capacity, mathematical problems on heat transfer, steam traps and reducing valve, lagging etc.

3. Evaporation

The basic concept of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, mathematical problems on evaporation.

4. Distillation

Raoult's law, phase diagram, volatility: simple steam and flash distillation, principles of rectification, Mc-Cabe Thiele method for calculations of a number of theoretical plates, azeotropic and extractive distillation, mathematical problems on distillation.

5. Drying

Moisture content and mechanism of drying, the rate of drying and time of drying calculations, classifications and types of dryers, dryers used in pharmaceutical industries and special drying methods like freeze drying and lyophilization, mathematical problems in

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drying.

6. Size reduction and size separation

Definition, objectives of size reduction, factors affecting size reduction, laws governing in energy and power requirement of a mill, types of mills including ball mill, hammer mill, fluid energy mill, micronizer, Quadro co-mil, multi mill etc.

7. Extraction

Theory of extraction, extraction methods, equipment for various types of the extraction process.

8. Mixing

Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipment.

9. Crystallization

Characteristics of crystals like purity, size, shape, geometry, habit, forms, size and factors affecting them. Solubility curves and calculation curves and calculations of heat balance around S Swanson's Walker crystallizer , supersaturation theory and its limitations, Nucleation mechanism, crystal growth, study of various types of crystallizers, tanks, agitated batch, Swanson's Walker, single vacuums, circulating magma and crystal crystallizers, cracking of crystals and its prevention. Numerical problems on yields. Introduction to polymorphism.

10. Filtration and Centrifugation

Theory of filtrations, filter aids, filter media, industrial filters, including filter press, rotary filter, edge filters, filter leaf and laboratory filtration equipment etc., Factors affecting filtration, mathematical problems on filtrations, optimum cleaning cycle in

batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimentars.

11. Dehumidification and humidity control

Basic concept and definition, wet bulb and adiabatic saturation temperatures, psychometric count and measurement of humidity, application of humidity measurement in pharmacy, equipment for humidification and dehumidification operations

12. Refrigeration and air conditioning

Principles and applications of refrigeration and air conditioning.

13. Material of constructions

General study of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel, glass, ferrous metals, cast iron, non-ferrous metals, copper and alloys, aluminum and alloys, lead, tin, silver, nickel and alloys, chromium and non metals, stone, slate, brick, asbestos, plastics, rubber, timber, concrete. Corrosion and its prevention with reference to commonly used material in pharmaceutical plants.

14. Automated process control systems

A process variable, temperature, pressure, flow level and vacuum and their measurement. Elements of automatic process control and introduction to automatic process control. Elements of computer-aided manufacturing (CAM).

15. Industrial hazards & safety precautions

Mechanical, chemical, electrical, fire, dust, noise hazards, Industrial dermatitis, accident, records, safety requirements/equipment etc.

PHARMACEUTICS

1. Pharmacy Profession & Introduction to Pharmaceuticals Pharmacy as a career, evaluation of Pharmacy, earlier period middle to modern ages. Definition, importance of pharmaceuticals, areas concerned, scope of Pharmaceutics, history and development of the profession of Pharmacy and Pharmaceutical industry in India. A brief review of present Indian Pharma. Industry in global perspective.

2. Introduction to dosage form

Definition of the drug. New drug and dosage form. The desirable properties of a dosage form, the need of dosage form. Ideas about the available type of dosage forms and new drug delivery system.

3. Sources of drug information

Introduction to Pharmacopoeia with reference to IP, BP, USP and International Pharmacopeia. Study of structure/features (index) general notice and compartment of monographs of excipients, drug and drug product. Other sources. Textbooks, journals, internet (drug information system, online database, patient/ consumer information and non- print material. Classification of information, primary, secondary and tertiary. Nomenclature of the drug.

4. Allopathic dosage form

Merits/demerits, importance, formulation development - vehicles/excipients with examples for the dosage form: liquid dosage form: monophasic liquid dosage form. Aromatic waters, syrup, elixir, linctus, lotion, liniment, glycerites, solutions, spirits, ENT

preparations, mixtures, paints, mouthwash.

5. Crude extract

Infusion, decoction, maceration, percolation, tincture and extract. Methods of preparations of dry, soft and liquid extract.

6. Allergenic extract

Types of allergens, preparation of extract, testing and standardization of extracts.

7. Biological products

Absorbable and non-absorbable material types, sutures and ligatures, processing, manufacturing, sterilization, packing, QC tests of materials like catgut and nylon.

8. Pharmaceutical Plant, location, layout

Plant location and layout of an industry. Various factors affecting locational aspects of chemical and pharmaceutical plants. The layout of plant building and importance of flow sheet, the difference between scientific process and technological process, the layout of various departments, equipment, and product layout v/s process layout.

9. Dosage Form Necessities and Additives

Antioxidants, preservatives, coloring agents, flavoring agents and diluting agents, emulsifying agents, suspending agents, ointment bases, solvents, and others.

10. Powders

Advantages and limitations as dosage form, manufacturing procedure and equipment,

special care and problems in manufacturing powders, powders of IP, effervescent granules and salts.

11. Capsules

Hard gelatin capsules, shell formulation and manufacturing, capsule sizes, storage, filing, cleaning process general formulation contents and evaluation. Soft gelatin capsules, shell formulation, formulation contents, filing, sealing and storage. Microencapsulation, advantages, encapsulation materials, methods of microencapsulation, I.P. formulations

12. Tablets

Types, ideal requirement, classification, granulation methods, general formulation, compression machines, different types of tooling's, difficulties in tableting, troubleshooting aspects, evaluation, sugar coating, compression coating, film coating, problems in tablet coatings and their troubleshooting aspects. IP formulations.

13. Parenterals - product requiring sterile packaging

Definition, types advantages and limitations, general formulation, vehicles, production procedure, production facilities, controls, tests, selected IP injections, sterile powders, implants, emulsions, suspensions.

14. Suspension

Formulation of deflocculated and flocculated suspension, manufacturing procedure, evaluation methods, IP suspensions.

15. Emulsions

Types, emulsifying agents, general formulation, manufacturing procedure, evaluation methods, IP emulsions.

16. Suppositories

Ideal requirements, bases, manufacturing procedure, evaluation methods, IP products.

17. Semisolids

Definitions, bases, general formulation, manufacturing procedure, evaluation methods, IP products.

18. Liquids (solutions, syrups, elixirs, spirits, aromatic water, liquid for external uses) Definition, types, general formulation, manufacturing procedure, evaluation methods, IP products.

19. Pharmaceutical Aerosols

Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. Impacts of propellants on the environment.

20. Ophthalmic preparations

Requirement, formulation, methods of preparation, containers, evaluation, IP products.

21. Preformulations

Consideration of Importance, physical properties, physical forms, particle size, crystal forms, bulk control, solubility, wetting, flow cohesiveness, compressibility, organoleptic properties and its effect on final product consideration of Chemical properties,

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hydrolysis, oxidation, recemization, polymerization, isomerization, decarboxylation, enzymatic decomposition, formulation additives, stabilizers, suspending and dispersing agents dyes, solid excipients etc. and its effect on quality of finished product.

22. Stability of formulated products

Requirements, drug regulatory aspects, pharmaceutical products stability, shelf life, overages, containers, closures.

Reaction rate and order, acid-base catalysis, destabilization and accelerated stability testing.

23. Prolonged Action Pharmaceuticals

Benefits, limitations, oral products, terminology, drug elimination rate, types and construction of implants products, product evaluation, parenteral products, absorption and evaluation.

24. Novel Drug delivery system

Critical fluid technology, transdermal drug delivery system, controlled drug delivery system, multiple emulsion, nanoparticles, targeted drug delivery system, aerosols, inhalation & new products reported etc.

25. GMP and Validation

Introduction to GMP, QC and QA. Concept and need of good manufacturing practice guidelines. Elements of GMP covering controls of area and processes and product. Regulations related to GMP. Introduction of the validation process. Types of validation. The brief methodology of process, equipment and instrument validation.

26. Packaging Materials

Role and features of pharmaceutical packing materials. Glass, plastic, rubber, metal and paper as pharmaceutical packaging material. General quality control of pharmaceutical packages. Primary, secondary and tertiary packaging materials. Child resistant and pilfer-proof packaging.

27. Cosmetics

Formulation and preparation of dentifrices, hair creams, lipsticks, face powders, shaving preparations, skin creams, shampoos, hair dyes, depilatories, manicure preparations etc.

28. Pilot plant scale-up techniques

Need, organization and layout, scale-up techniques for solid and liquid dosage forms. Technology transfer.

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