OJEE M Pharm Sample Paper 02

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 60 minutes.
B) Total Questions: The exam contains 60 questions.
C) Marking Scheme & Rules:

- +4 marks for each correct answer; -1 mark for each incorrect answer.

Q1. In the manufacturing of solid dosage forms, the tablet defect characterized by the unequal or uneven distribution of color on the tablet surface is known as:

A. Capping

B. Picking

C. Mottling

D. Lamination

Q2. Which chemical kinetic equation is predominantly utilized in stability testing to mathematically predict the shelf-life or expiration date of a pharmaceutical product?

A. Noyes-Whitney equation

B. Arrhenius equation

C. Michaelis-Menten equation

D. Henderson-Hasselbalch equation

Q3. According to the standard pharmacopeial classification, Type I pharmaceutical packaging glass is chemically composed of:

A. Treated soda-lime glass

B. Regular soda-lime glass

C. Highly resistant borosilicate glass

D. General-purpose soda-lime glass

Q4. Which class of chemical compounds is most commonly utilized as the compressed liquefied propellant in topical pharmaceutical aerosol formulations?

A. Alcohols

B. Hydrocarbons

C. Fluorinated ethers

D. Silicones

Q5. The pharmaceutical process of freeze-drying (lyophilization) fundamentally relies on which precise physical phase transition?

A. Evaporation of liquid to gas

B. Melting of solid to liquid

C. Condensation of gas to liquid

D. Sublimation of solid to gas

Q6. According to the Noyes-Whitney equation, the dissolution rate of a drug is directly proportional to its:

A. Molecular weight

B. Surface area

C. Melting point

D. Viscosity

Q7. In an oil-in-water (o/w) emulsion, if the density of the dispersed oil phase is significantly lower than that of the continuous aqueous phase, the emulsion is prone to:

A. Cracking

B. Phase inversion

C. Creaming upward

D. Creaming downward

Q8. The synthetic pharmaceutical surfactants commercially known as 'Pluronics' or 'Poloxamers' are chemically classified as:

A. Anionic surfactants

B. Cationic surfactants

C. ABA block copolymers

D. Sorbitan esters

Q9. According to the Biopharmaceutics Classification System (BCS), the primary rate-limiting step for the oral absorption of a Class II drug is:

A. Gastric emptying

B. Membrane permeability

C. Hepatic first-pass metabolism

D. Dissolution

Q10. The widely used 'Eudragit' series of pharmaceutical coating polymers are primarily synthesized as copolymers of:

A. Acrylic and methacrylic acids

B. Polyvinyl alcohol and povidone

C. Cellulose and acetate

D. Starch and glycolate

Q11. Which of the following antihypertensive drugs is classified as a highly cardioselective Beta-1 (β_1) adrenergic receptor blocker?

A. Propranolol

B. Atenolol

C. Phentolamine

D. Carvedilol

Q12. The specific pharmacological antidote administered to reverse severe organophosphate (pesticide/nerve gas) poisoning is:

A. Flumazenil

B. Naloxone

C. Atropine (often with Pralidoxime)

D. Protamine sulfate

Q13. Which major class of cardiovascular drugs is well-known for causing a persistent, dry, hacking cough as a frequent adverse effect?

A. Calcium channel blockers

B. Beta blockers

C. Angiotensin-Converting Enzyme (ACE) inhibitors

D. Thiazide diuretics

Q14. In the pharmacological management of Parkinson's disease, Levodopa is formulated with Carbidopa primarily because Carbidopa:

A. Crosses the blood-brain barrier to act as an agonist

B. Inhibits peripheral DOPA decarboxylase

C. Directly stimulates dopamine D2 receptors

D. Inhibits Monoamine Oxidase B (MAO-B)

Q15. The fundamental mechanism of action of the triazole antifungal drug Fluconazole involves the direct inhibition of:

A. Ergosterol synthesis

B. Fungal cell wall peptidoglycan

C. Viral DNA polymerase

D. Bacterial protein synthesis

Q16. The highly effective antiemetic drug Ondansetron prevents chemotherapy-induced nausea and vomiting by specifically antagonizing which receptor?

A. Dopamine D2

B. Histamine H1

C. Serotonin 5-HT3

D. Muscarinic M1

Q17. The cornerstone oral antidiabetic drug Metformin belongs to which distinct chemical class of hypoglycemic agents?

A. Sulfonylureas

B. Thiazolidinediones

C. Biguanides

D. Alpha-glucosidase inhibitors

Q18. In the context of the clinical drug development process, Phase IV clinical trials are more commonly referred to as:

A. First-in-human microdosing

B. Pharmacokinetic profiling

C. Post-marketing surveillance

D. Preclinical toxicology

Q19. Local anesthetics block nerve conduction primarily by binding to and blocking which specific ion channels in the neuronal membrane?

A. Voltage-gated Calcium channels

B. Voltage-gated Sodium channels

C. Ligand-gated Potassium channels

D. Chloride ion channels

Q20. Heparin, a potent parenteral anticoagulant, exerts its pharmacological effect by binding to and accelerating the activity of:

A. Vitamin K epoxide reductase

B. Thrombin (Factor IIa) directly

C. Antithrombin III

D. Plasminogen

Q21. Which of the following broad-spectrum antibiotics exerts its bactericidal effect by specifically inhibiting the bacterial DNA gyrase (Topoisomerase II) enzyme?

A. Amoxicillin

B. Azithromycin

C. Ciprofloxacin

D. Tetracycline

Q22. In toxicology and pharmacology, the "Therapeutic Index" (TI) is a measure of drug safety mathematically defined as the ratio of:

A. ED50 to LD50

B. LD50 to ED50

C. Half-life to Clearance

D. Bioavailability to Volume of Distribution

Q23. Which of the following drugs is a highly potent loop diuretic commonly used in the management of severe edema and congestive heart failure?

A. Hydrochlorothiazide

B. Spironolactone

C. Acetazolamide

D. Furosemide

Q24. In the autonomic nervous system, the endogenous neurotransmitter released at all sympathetic preganglionic nerve terminals is:

A. Norepinephrine

B. Epinephrine

C. Acetylcholine

D. Dopamine

Q25. Which of the following opioid derivatives acts primarily as a centrally acting antitussive (cough suppressant) without significant analgesic properties?

A. Morphine

B. Fentanyl

C. Methadone

D. Dextromethorphan

Q26. The core heterocyclic ring system present in the chemical structure of the classic antimalarial drug Chloroquine is:

A. Isoquinoline

B. Quinoline

C. Phenothiazine

D. Acridine

Q27. In the fundamental chemical structure of all Penicillin antibiotics, the highly strained Beta-lactam ring is directly fused with a five-membered:

A. Thiazolidine ring

B. Dihydrothiazine ring

C. Pyrrolidine ring

D. Imidazole ring

Q28. Ascorbic acid is the exact IUPAC chemical designation for which essential water-soluble vitamin?

A. Vitamin A

B. Vitamin B12

C. Vitamin C

D. Vitamin K

Q29. Glycolysis is the central metabolic pathway in cellular biochemistry that enzymatically converts one molecule of glucose into two molecules of:

A. Lactic acid

B. Acetyl-CoA

C. Pyruvate

D. Oxaloacetate

Q30. The widely utilized analytical reagent Ninhydrin is specifically used in biochemistry to visually detect the presence of:

A. Reducing sugars

B. Lipids

C. Nucleic acids

D. Amino acids

Q31. The fundamental molecular building blocks that polymerize to form nucleic acids (DNA and RNA) are known as:

A. Nucleosides

B. Nucleotides

C. Polypeptides

D. Polysaccharides

Q32. The toxicity of heavy metals like Arsenic and Mercury is specifically and effectively treated using which of the following chelating agents?

A. EDTA

B. Penicillamine

C. Dimercaprol (BAL)

D. Deferoxamine

Q33. Barbiturates are a class of central nervous system depressants synthesized chemically via the condensation of urea with derivatives of:

A. Malonic acid (Diethyl malonate)

B. Acetic anhydride

C. Salicylic acid

D. Benzoic acid

Q34. The presence of an asymmetric or chiral carbon atom in a drug molecule gives rise to which specific type of stereoisomerism?

A. Geometrical isomerism

B. Optical isomerism

C. Conformational isomerism

D. Tautomerism

Q35. The principal mechanism of action of alkylating agents (e.g., Cyclophosphamide) in cancer chemotherapy involves:

A. Inhibiting microtubule formation

B. Cross-linking DNA strands

C. Antagonizing folic acid

D. Blocking hormone receptors

Q36. The therapeutically crucial active chemical constituents isolated from the leaves of the plant *Digitalis purpurea* belong to which specific class of secondary metabolites?

A. Anthraquinone glycosides

B. Tropane alkaloids

C. Cardiac glycosides

D. Triterpenoid saponins

Q37. According to the biogenetic isoprene rule, the fundamental building block of all terpenoid compounds is a repeating unit containing how many carbon atoms?

A. 3 Carbon atoms

B. 5 Carbon atoms

C. 10 Carbon atoms

D. 15 Carbon atoms

Q38. The 'Goldbeater's skin test' is a specific and classic pharmacognostic identification test used exclusively for the detection of:

A. Volatile oils

B. Resins

C. Alkaloids

D. Tannins

Q39. The potent muscarinic antagonist Scopolamine (Hyoscine) is a tropane alkaloid predominantly extracted from which of the following medicinal plants?

A. *Datura stramonium*

B. *Cinchona officinalis*

C. *Papaver somniferum*

D. *Rauwolfia serpentina*

Q40. Opium, a highly addictive narcotic containing morphine and codeine, is pharmacognostically defined as the dried latex obtained from the unripe seed capsules of:

A. *Erythroxylum coca*

B. *Papaver somniferum*

C. *Cannabis sativa*

D. *Claviceps purpurea*

Q41. The 'Borntrager's test' is a classic chemical color test specifically utilized in pharmacognosy to identify the presence of:

A. Cyanogenic glycosides

B. Flavonoids

C. Anthraquinone glycosides

D. Saponins

Q42. The prominent antineoplastic drug Paclitaxel (commercially known as Taxol) was originally discovered and isolated from the bark of which plant?

A. Madagascar periwinkle

B. Pacific yew (*Taxus brevifolia*)

C. Autumn crocus

D. Mayapple

Q43. The vinca alkaloids, Vincristine and Vinblastine, are complex dimeric compounds containing which specific nitrogenous heterocyclic core?

A. Indole

B. Quinoline

C. Isoquinoline

D. Tropane

Q44. In plant anatomy, 'Stomata' are specialized microscopic pore structures found primarily on the epidermis of leaves, utilized mainly for:

A. Photosynthesis

B. Water storage

C. Gas exchange and transpiration

D. Nutrient absorption

Q45. In pharmacognostic classification, which of the following is considered a classic example of an "unorganized" crude drug?

A. Senna leaves

B. Clove buds

C. Nux vomica seeds

D. Acacia gum

Q46. In Gas Chromatography (GC), the mobile phase is strictly required to be:

A. A highly polar liquid

B. An inert gas (e.g., Helium or Nitrogen)

C. A supercritical fluid

D. A buffered aqueous solution

Q47. In UV-Visible spectroscopy, the term "Chromophore" specifically refers to:

A. A functional group that shifts absorption to a shorter wavelength

B. An atom that emits fluorescence

C. The specific part of a molecule responsible for the absorption of light

D. The solvent used to dissolve the sample

Q48. In Mass Spectrometry (MS), ionized molecules and their fragments are separated and detected precisely based on their:

A. Boiling point

B. Polarity

C. Mass-to-charge ratio (m/z)

D. Optical rotation

Q49. The "Chemical Shift" observed in Nuclear Magnetic Resonance (NMR) spectroscopy is universally expressed in which standard units?

A. Nanometers (nm)

B. Reciprocal centimeters (cm^{-1})

C. Parts per million (ppm)

D. Hertz per Tesla (Hz/T)

Q50. Which distinct chromatographic technique separates macromolecules (like proteins or polymers) primarily based on their physical size or molecular weight?

A. Ion-exchange chromatography

B. Affinity chromatography

C. Size-exclusion chromatography

D. Thin-layer chromatography

Q51. In standard acid-base titrimetry, Phenolphthalein acts as a chemical indicator that visually changes color over which approximate pH range?

A. 1.2 - 2.8

B. 3.1 - 4.4

C. 6.0 - 7.6

D. 8.2 - 10.0

Q52. The specialized analytical technique used to determine the concentration or purity of chiral drug samples by measuring the angle of rotation of plane-polarized light is called:

A. Refractometry

B. Polarimetry

C. Fluorimetry

D. Nephelometry

Q53. In Thin Layer Chromatography (TLC), the calculated Retention factor (Rf) value of any compound must mathematically always lie between:

A. -1 and +1

B. 0 and 1

C. 1 and 10

D. 0 and 100

Q54. In the context of quantitative volumetric analysis, a reagent solution of known, exactly determined concentration is formally referred to as a:

A. Buffer solution

B. Test solution

C. Standard solution

D. Indicator solution

Q55. Flame photometry (Flame Atomic Emission Spectrometry) is an analytical technique utilized primarily for the rapid quantitative determination of:

A. Halogens

B. Alkali and alkaline earth metals (e.g., Na, K, Ca)

C. Heavy transition metals

D. Organic functional groups

Q56. According to the stringent regulations of the Indian Drugs and Cosmetics Act of 1940, Schedule M is strictly concerned with outlining the requirements for:

A. Clinical trials

B. Good Manufacturing Practices (GMP)

C. Labeling and packaging

D. Biological products

Q57. According to the Drugs and Cosmetics Act and Rules, Schedule G encompasses a list of specific drugs that:

A. Require a prescription from a registered medical practitioner (Schedule H)

B. Are considered highly addictive narcotics (Schedule X)

C. Are mostly hormonal preparations that must be taken only under medical supervision

D. Are exempt from all manufacturing regulations

Q58. In pharmaceutical microbiology, the standard, most accurate in-vitro method for determining the Minimum Inhibitory Concentration (MIC) of a novel antibiotic is the:

A. Disk diffusion (Kirby-Bauer) method

B. Streak plate method

C. Broth dilution method

D. Pour plate method

Q59. The fundamental biological process by which living bacteria transfer genetic material (plasmids) to one another through direct cell-to-cell contact is known as:

A. Transformation

B. Transduction

C. Conjugation

D. Mutation

Q60. Which specific class of immunoglobulins (antibodies) is unique in its ability to cross the human placenta, thereby providing crucial passive immunity to the developing fetus?

A. IgA

B. IgE

C. IgM

D. IgG

Solutions

1. C
Explanation: Mottling refers to the unequal or uneven distribution of color on a tablet, causing light and dark patches. It often results from the migration of water-soluble dyes during the drying of granules.

2. B
Explanation: The Arrhenius equation ($k = Ae^{-E_a/RT}$) models the temperature dependence of reaction rates. It is used in accelerated stability studies to extrapolate degradation rates at higher temperatures to predict shelf-life at room temperature.

3. C
Explanation: Type I glass is highly resistant borosilicate glass. It has the highest chemical resistance and is suitable for all types of parenteral preparations, regardless of pH.

4. B
Explanation: Hydrocarbons (like propane, butane, and isobutane) are widely used as propellants in topical pharmaceutical aerosols because they are inexpensive, environmentally friendly (unlike CFCs), and excellent solvents.

5. D
Explanation: Lyophilization, or freeze-drying, works by freezing the material and then reducing the surrounding pressure to allow the frozen water in the material to sublimate directly from the solid phase to the gas phase.

6. B
Explanation: The Noyes-Whitney equation ($\frac{dC}{dt} = \frac{DA(C_s - C)}{h}$) demonstrates that the rate of dissolution ($\frac{dC}{dt}$) is directly proportional to the surface area (A) of the dissolving drug particles.

7. C
Explanation: According to Stokes' Law, if the dispersed oil droplets are less dense than the continuous water phase, they will experience an upward buoyant force, causing them to rise to the top of the emulsion, a reversible process known as creaming upward.

8. C
Explanation: Pluronics (or Poloxamers) are non-ionic triblock copolymers composed of a central hydrophobic chain of polyoxypropylene flanked by two hydrophilic chains of polyoxyethylene (an ABA structure).

9. D
Explanation: The Biopharmaceutics Classification System (BCS) categorizes Class II drugs as having high permeability but low solubility. Therefore, the rate at which they dissolve in gastrointestinal fluids (dissolution) is the rate-limiting step for their absorption.

10. A
Explanation: Eudragit polymers are a diverse range of polymethacrylates. They are synthetic copolymers derived from esters of acrylic and methacrylic acid, engineered for specific enteric, sustained, or targeted release profiles.

11. B
Explanation: Atenolol is a second-generation, cardioselective β_1-adrenergic receptor antagonist. Propranolol is non-selective, blocking both β_1 and β_2 receptors.

12. C
Explanation: Organophosphates irreversibly inhibit acetylcholinesterase, leading to a lethal buildup of acetylcholine. Atropine acts as a competitive antagonist at muscarinic receptors to block this excess acetylcholine, often paired with Pralidoxime to reactivate the enzyme.

13. C
Explanation: ACE inhibitors (like Lisinopril, Enalapril) block the degradation of bradykinin. The accumulation of bradykinin in the respiratory tract leads to a characteristic persistent, dry cough in a significant percentage of patients.

14. B
Explanation: Levodopa crosses the blood-brain barrier to convert into dopamine. Carbidopa is a peripheral DOPA decarboxylase inhibitor that cannot cross the BBB; it prevents Levodopa from being prematurely converted to dopamine in the periphery, reducing systemic side effects.

15. A
Explanation: Fluconazole and other azole antifungals inhibit the fungal cytochrome P450 enzyme 14α-demethylase. This halts the conversion of lanosterol to ergosterol, a vital component of the fungal cell membrane.

16. C
Explanation: Ondansetron is a highly specific and selective antagonist of the serotonin 5-HT3 receptor, located both peripherally on vagal nerve terminals and centrally in the chemoreceptor trigger zone (CTZ).

17. C
Explanation: Metformin is the only clinically significant drug in the Biguanide class. It lowers blood glucose primarily by decreasing hepatic gluconeogenesis and increasing peripheral insulin sensitivity.

18. C
Explanation: Phase IV trials are post-marketing surveillance studies conducted after a drug has received regulatory approval. They monitor the long-term safety, real-world effectiveness, and rare adverse effects in the general population.

19. B
Explanation: Local anesthetics (like Lidocaine) act by reversibly binding to the intracellular portion of voltage-gated sodium channels, preventing the influx of sodium required for the generation and propagation of action potentials.

20. C
Explanation: Heparin is an indirect anticoagulant. It binds tightly to the endogenous enzyme inhibitor antithrombin III (ATIII), causing a conformational change that massively accelerates ATIII's ability to inactivate thrombin and factor Xa.

21. C
Explanation: Ciprofloxacin belongs to the fluoroquinolone class. It is bactericidal, acting by targeting and inhibiting bacterial DNA gyrase (Topoisomerase II)

and Topoisomerase IV, enzymes critical for DNA unwinding and replication.

22. B

Explanation: The Therapeutic Index is the mathematical ratio of the dose that is lethal in 50% of the population (LD50) divided by the dose that is therapeutically effective in 50% of the population (ED50). A higher TI indicates a safer drug.

23. D

Explanation: Furosemide is a potent high-ceiling loop diuretic that acts on the thick ascending limb of the Loop of Henle. Hydrochlorothiazide is a thiazide, Spironolactone is potassium-sparing, and Acetazolamide is a carbonic anhydrase inhibitor.

24. C

Explanation: Regardless of whether the pathway is sympathetic or parasympathetic, the neurotransmitter released by all preganglionic neurons at the autonomic ganglia is Acetylcholine, which acts on nicotinic receptors.

25. D

Explanation: Dextromethorphan is the d-isomer of the codeine analog levorphanol. It acts centrally on the cough center in the medulla to elevate the threshold for coughing, possessing no significant analgesic or addictive properties.

26. B

Explanation: Chloroquine belongs to the 4-aminoquinoline class of antimalarials. Its core structure is a quinoline ring, which is a fused bicyclic compound consisting of a benzene ring and a pyridine ring.

27. A

Explanation: The core structure of Penicillin is the penam nucleus, consisting of a highly reactive four-membered β-lactam ring fused to a five-membered, sulfur-containing thiazolidine ring. (Cephalosporins fuse it to a six-membered dihydrothiazine ring).

28. C

Explanation: Ascorbic acid is the chemical name for Vitamin C. It is a powerful water-soluble antioxidant and a critical coenzyme for collagen synthesis, the deficiency of which causes scurvy.

29. C

Explanation: Glycolysis is a 10-step enzymatic pathway that oxidizes one 6-carbon molecule of glucose into two 3-carbon molecules of Pyruvate, generating a net gain of 2 ATP and 2 NADH.

30. D

Explanation: Ninhydrin is a classic chemical reagent used to detect primary amino acids. When reacted with an amino acid, it produces a deep blue or purple compound known as Ruhemann's purple.

31. B

Explanation: Nucleotides are the fundamental monomers of nucleic acids. A nucleotide consists of three parts: a nitrogenous base (purine or pyrimidine), a 5-carbon sugar (ribose or deoxyribose), and a phosphate group.

32. C

Explanation: Dimercaprol, also known as British Anti-Lewisite (BAL), is a heavy metal chelating agent equipped with two sulfhydryl groups. It binds firmly to highly toxic metals like Arsenic, Mercury, and Gold, forming a water-soluble complex that is renally excreted.

33. A
Explanation: The classical chemical synthesis of barbituric acid and its derivatives involves the condensation reaction between urea and diethyl malonate (or its substituted derivatives) in the presence of a strong base like sodium ethoxide.

34. B
Explanation: A chiral carbon atom is bonded to four completely different groups. This asymmetry means the molecule cannot be superimposed on its mirror image, resulting in optical isomerism (enantiomers).

35. B
Explanation: Alkylating agents are highly reactive chemicals that transfer alkyl groups to DNA bases (most commonly at the N7 position of guanine). This forms intra- and inter-strand cross-links, severely disrupting DNA replication and triggering cell death.

36. C
Explanation: *Digitalis purpurea* (Foxglove) leaves contain potent cardiac glycosides like Digoxin and Digitoxin. These secondary metabolites exert profound positive inotropic effects on the heart by inhibiting the Na+/K+ ATPase pump.

37. B
Explanation: The isoprene rule dictates that all terpenoid frameworks are constructed by the head-to-tail linkage of multiple isoprene units. Isoprene is a distinct 5-carbon compound (2-methyl-1,3-butadiene).

38. D
Explanation: The Goldbeater's skin test assesses the ability of a compound to physically tan animal hides. It is a highly specific, definitive identification test for true tannins, distinguishing them from pseudo-tannins.

39. A
Explanation: *Datura stramonium* (Jimsonweed), along with *Atropa belladonna* and *Hyoscyamus niger*, are classic Solanaceous plants exceptionally rich in the tropane alkaloids scopolamine and atropine.

40. B
Explanation: Pharmacognostically, raw opium is strictly defined as the air-dried milky exudate (latex) obtained by incising the unripe seed capsules of the opium poppy, *Papaver somniferum*.

41. C
Explanation: The Borntrager's test identifies anthraquinone glycosides (like those found in Senna, Aloe, and Cascara). Boiling with acid releases the aglycone, which then partitions into an organic solvent and produces a rose-pink to red color when shaken with ammonia.

42. B
Explanation: Paclitaxel is a highly complex diterpenoid originally extracted in

minute quantities from the bark of the Pacific yew tree (*Taxus brevifolia*). It is a powerful microtubule-stabilizing anticancer agent.

43. A
Explanation: Vincristine and Vinblastine are classified structurally as dimeric indole-indoline alkaloids. They contain two linked multi-ring systems (vindoline and catharanthine), both of which feature an indole nucleus.

44. C
Explanation: Stomata are specialized biological pores regulated by guard cells. They allow plants to take in carbon dioxide for photosynthesis and release oxygen, while simultaneously controlling water loss through transpiration.

45. D
Explanation: "Unorganized" drugs lack a defined cellular structure. They are solid or liquid exudates, extracts, or resins derived from plants or animals. Acacia gum (an exudate) is unorganized, whereas leaves and seeds are "organized" cellular structures.

46. B
Explanation: In Gas Chromatography, the mobile phase is explicitly required to be a completely unreactive, high-purity carrier gas (like Helium, Nitrogen, or Argon) that simply transports the vaporized sample through the column.

47. C
Explanation: A chromophore is an isolated, covalently bonded group of atoms that exhibit characteristic absorption of electromagnetic radiation in the UV or visible range (e.g., conjugated double bonds, carbonyl groups).

48. C
Explanation: Mass Spectrometry (MS) fundamentally operates by ionizing chemical species and sorting those ions inside high-vacuum electric/magnetic fields based precisely on their mass-to-charge ratio (m/z).

49. C
Explanation: The chemical shift (δ) in NMR is a dimensionless value mathematically expressed in parts per million (ppm). It denotes the resonant frequency of a nucleus relative to a standard, independent of the operating magnetic field strength.

50. C
Explanation: Size-exclusion chromatography (SEC), or gel permeation chromatography, employs porous beads. Smaller molecules enter the pores and are delayed, while larger molecules bypass the pores and elute first, separating them strictly by physical size.

51. D
Explanation: Phenolphthalein is a weak acid indicator. It is colorless in highly acidic solutions but undergoes a structural change to display a vibrant pink/fuchsia color across a pH range of roughly 8.2 to 10.0.

52. B
Explanation: Polarimetry is an instrumental technique that measures the precise degree of rotation of plane-polarized light caused by an optically active (chiral) substance in a solution tube.

53. B
Explanation: The Rf value is the ratio of the distance traveled by the compound to the distance traveled by the solvent front. Since a compound cannot physically travel further than the solvent, the Rf value is strictly bounded between 0 and 1.

54. C
Explanation: In titrimetry, a standard solution is a highly purified reagent of exactly known concentration, which is slowly added from a burette to the analyte until the chemical reaction reaches its equivalence point.

55. B
Explanation: Flame photometry relies on the fact that alkali metals (Sodium, Potassium, Lithium) and alkaline earth metals (Calcium) emit highly characteristic wavelengths of light when thermally excited in a flame, making it ideal for their quantification.

56. B
Explanation: Schedule M of the Drugs and Cosmetics Act comprehensively outlines the stringent Good Manufacturing Practices (GMP) and detailed requirements for premises, plant, and equipment for manufacturing pharmaceutical products in India.

57. C
Explanation: Schedule G contains a specific list of drugs (mostly hormones, antineoplastics, and antihistamines) whose packaging must bear the mandatory warning: "Caution: It is dangerous to take this preparation except under medical supervision."

58. C
Explanation: While disk diffusion measures zones of inhibition qualitatively, the broth dilution method is the gold standard for strictly quantifying the MIC—the lowest exact concentration of an antimicrobial that completely inhibits visible bacterial growth.

59. C
Explanation: Conjugation is a primary mechanism of horizontal gene transfer. It involves the direct physical connection between two bacteria via a pilus, allowing the unidirectional transfer of genetic material, most commonly a plasmid containing antibiotic resistance genes.

60. D
Explanation: Immunoglobulin G (IgG) is the most abundant antibody isotype in blood plasma. It is the only class of antibody equipped with specific receptor mechanisms allowing it to cross the placental barrier, giving the fetus critical passive immunity.