# NIPER JEE Pharmacy Subjects

## Sample Paper – 2

### M.S.(Pharm) / M.Pharm Joint Entrance Examination

**Duration: 96 Minutes** **Maximum Marks: 80**

## Instructions

- This paper contains **160 single-correct Multiple Choice Questions** drawn from the pharmaceutical-sciences syllabus of the **NIPER Joint Entrance Examination** (M.S.(Pharm) / M.Pharm).
- Each correct answer carries **+0.5 marks**. **0.125 mark is deducted** for every wrong answer, and an unattempted question gets **0 marks**. Maximum marks: **80**.
- The paper runs continuously from **Q1 to Q160** across six parts: Pharmaceutics; Pharmacology & Toxicology; Pharmaceutical & Medicinal Chemistry; Pharmaceutical Analysis & QA; Pharmacognosy; and Pharmaceutical Biotechnology & Microbiology.
- Only **one** option is correct. Personal calculators, mobile phones, and other electronic gadgets are strictly prohibited.

## Part A: Pharmaceutics

**Q1.** Barium sulphate ($BaSO_4$) has a solubility product $K_{sp} = 1.1 \times 10^{-10}$ at 25°C. Its molar solubility in pure water is approximately:

(A) $1.1 \times 10^{-10}$ mol/L

(B) $1.1 \times 10^{-5}$ mol/L

(C) $5.5 \times 10^{-11}$ mol/L

(D) $1.05 \times 10^{-5}$ mol/L

**Q2.** When 200 mg of a drug is shaken with 50 mL chloroform and 50 mL water, 160 mg is found in the chloroform layer at equilibrium. The chloroform/water partition coefficient (P) is:

(A) 0.25

(B) 0.80

(C) 4.0

(D) 8.0

**Q3.** A formulator must stabilise a water-in-oil (w/o) cream. Which required-HLB range should the chosen emulsifier blend target?

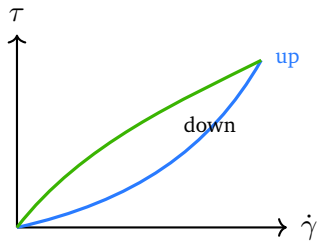
(A) 4 – 6 (w/o emulsifier)

(B) 8 – 10 (wetting agent)

(C) 12 – 16 (o/w emulsifier)

(D) 15 – 18 (solubiliser)

**Q4.** The flow curve below shows the up-curve and down-curve not coinciding, enclosing a hysteresis loop, with the structure rebuilding slowly when shear is removed. This time-dependent behaviour is termed:




(A) dilatancy

(B) thixotropy

(C) Newtonian flow

(D) rheopexy

**Q5.** During the mixing of two free-flowing powders, a tumbling (double-cone) blender is run for too long. The most likely undesirable consequence is:

(A) the powders cannot mix at all

(B) the mix becomes more uniform indefinitely

(C) segregation (demixing) of particles differing in size or density

(D) conversion of the solids into a liquid

**Q6.** A lyophobic colloidal dispersion is stabilised mainly by the electrical double layer around its particles. The potential measured at the plane of shear, which governs this stability, is the:

(A) Nernst potential

(B) streaming potential

(C) Donnan potential

(D) zeta potential

**Q7.** For the cold (filtration) sterilisation of a heat-labile parenteral solution, the nominal pore size of the sterilising-grade membrane filter that removes bacteria is:

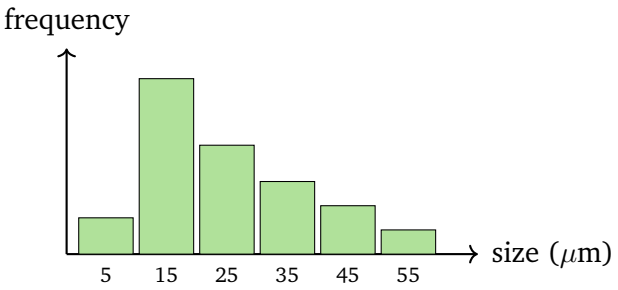
(A) 0.22 $\mu$m

(B) 5.0 $\mu$m

(C) 100 $\mu$m

(D) 1.2 $\mu$m

**Q8.** The histogram shows the number-frequency particle-size distribution of a milled powder. The modal size class (in $\mu$m) is:




(A) 5 – 15

(B) 10 – 20

(C) 25 – 35

(D) 45 – 55

**Q9.** A phosphate buffer is prepared with 0.2 M $Na_2HPO_4$ and 0.1 M $NaH_2PO_4$ ($pK_{a2}$ of phosphoric acid $= 7.2$). The pH of this buffer is approximately:

(A) 6.9

(B) 7.2

(C) 7.5

(D) 8.4

**Q10.** The sodium-chloride equivalent (E value) of a drug is defined as the:

(A) molecular weight of the drug divided by 58.5

(B) weight of drug equivalent to 1 g glucose osmotically

(C) freezing-point depression of a 1% drug solution

(D) weight of NaCl that produces the same osmotic effect as 1 g of the drug

**Q11.** Liposomes used as a novel drug-delivery carrier are best described as:

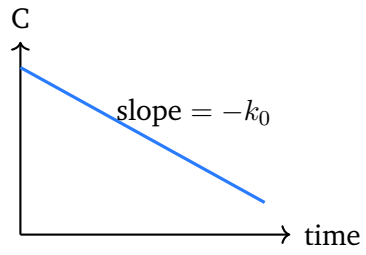
(A) concentric phospholipid bilayer vesicles that can entrap both hydrophilic and lipophilic drugs

(B) solid polymeric nanospheres with no aqueous core

(C) single-chain surfactant micelles only

(D) crosslinked hydrogel beads larger than 1 mm

**Q12.** For a degrading suspension, a plot of drug concentration (C) against time gives a straight line with a negative slope (figure). The degradation therefore follows:




(A) first-order kinetics

(B) zero-order kinetics

(C) second-order kinetics

(D) fractional-order kinetics

**Q13.** In an elementary osmotic pump (e.g. OROS) oral controlled-release tablet, the drug is released through the laser-drilled orifice at a rate governed primarily by:

(A) gastric pH alone

(B) the patient's chewing action

(C) the osmotic pressure gradient driving water across the semipermeable membrane

(D) disintegration of the tablet core

**Q14.** For a drug, the dose-normalised AUC after a 100 mg oral dose is 40 $\mu$g·h/mL and after a 100 mg intravenous dose is 50 $\mu$g·h/mL. The absolute oral bioavailability (F) is:

(A) 1.25

(B) 0.50

(C) 0.40

(D) 0.80

**Q15.** For the 1:1 complexation equilibrium D + L $\rightleftharpoons$ DL, the stability (formation) constant K is given by:

(A) $K = \dfrac{[\mathrm{DL}]}{[\mathrm{D}][\mathrm{L}]}$

(B) $K = \dfrac{[\mathrm{D}][\mathrm{L}]}{[\mathrm{DL}]}$

(C) $K = [\mathrm{D}][\mathrm{L}][\mathrm{DL}]$

(D) $K = \dfrac{[\mathrm{D}]}{[\mathrm{L}][\mathrm{DL}]}$

**Q16.** For passive diffusion of a drug across a membrane, the permeability coefficient (P) combines the diffusion coefficient (D), the partition coefficient (K) and the membrane thickness (h) as:

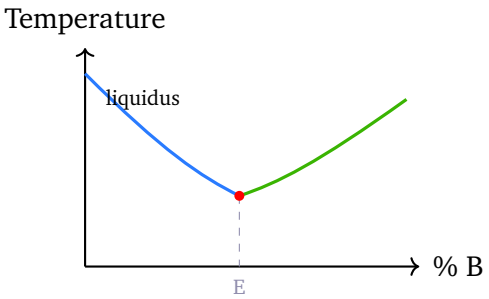
(A) $P = D\,h/K$

(B) $P = D\,K/h$

(C) $P = h/(D\,K)$

(D) $P = D/(K\,h)$

**Q17.** The binary phase diagram below for two components A and B shows a minimum melting point at composition E, where a single solid mixture melts/freezes at one temperature without separation. Point E is the:




(A) triple point

(B) glass-transition point

(C) eutectic point

(D) azeotropic point

**Q18.** In the Noyes-Whitney equation $dC/dt = \dfrac{DA}{h}(C_s - C)$, dissolution proceeds at its maximum constant rate (so-called sink conditions) when:

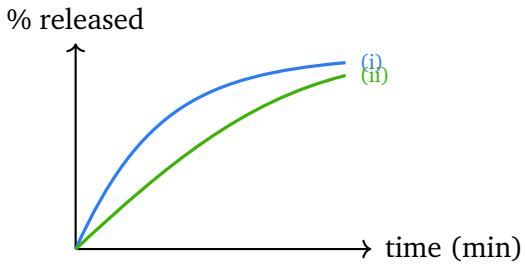
(A) C approaches $C_s$

(B) the surface area A is reduced

(C) the diffusion-layer thickness h is increased

(D) C is kept much smaller than $C_s$ ($C \ll C_s$)

**Q19.** Two dissolution profiles (cumulative % released vs time) are shown: profile (i) is a reference product and profile (ii) a test product, both reaching plateau. The model that linearises matrix release as $Q \propto \sqrt{t}$ is the:




(A) Higuchi model

(B) Hixson-Crowell model

(C) zero-order model

(D) Weibull model

**Q20.** In the Korsmeyer-Peppas model ($M_t/M_\infty = kt^n$) for drug release from a thin slab (film), a release exponent of $n = 0.89$ indicates the dominant mechanism is:

(A) pure Fickian diffusion

(B) Case-II (zero-order, polymer-relaxation) transport

(C) anomalous transport with $n$ between 0.45 and 0.89

(D) super Case-II transport

**Q21.** A poorly water-soluble but highly permeable drug, whose oral absorption is limited by its dissolution rate, is classified under the Biopharmaceutics Classification System as:

(A) Class I

(B) Class III

(C) Class II

(D) Class IV

**Q22.** Croscarmellose sodium is added to an immediate-release tablet formulation chiefly to function as a:

(A) glidant

(B) film-coating polymer

(C) sweetening agent

(D) superdisintegrant

**Q23.** An enteric (gastro-resistant) tablet coat must stay intact in the stomach and dissolve in the intestine. Which polymer is most suitable?

(A) cellulose acetate phthalate

(B) hydroxypropyl methylcellulose (immediate release)

(C) polyethylene glycol 6000

(D) povidone (PVP K-30)

**Q24.** In the USP friability test for uncoated tablets, a single, normally acceptable maximum weight loss after the test is:

(A) 5.0%

(B) 1.0%

(C) 10.0%

(D) 0.01%

**Q25.** For hard-gelatin capsules, the size designations and their fill volumes follow the rule that:

(A) size 5 is the largest commonly used oral size

(B) the larger the number, the larger the capsule

(C) size 000 holds the largest volume and size 5 the smallest

(D) all numbered sizes hold identical volumes

**Q26.** The Limulus Amebocyte Lysate (LAL) test used for parenteral products specifically detects:

(A) particulate matter

(B) residual ethylene oxide

(C) viable fungal spores

(D) bacterial endotoxins (Gram-negative)

**Q27.** Benzalkonium chloride is most commonly included in a multidose eye-drop formulation to act as a(n):

(A) antimicrobial preservative

(B) viscosity-building agent

(C) tonicity (osmotic) adjuster

(D) buffering agent

**Q28.** A suppository mould has a 2 g capacity (for the base). If a drug has a displacement value of 4 (4 parts of drug displace 1 part of base) and each suppository is to contain 0.4 g of drug, the mass of base required per suppository is:

(A) 2.0 g

(B) 1.9 g

(C) 1.6 g

(D) 0.4 g

**Q29.** In a pressurised metered-dose inhaler (pMDI), the modern propellant of choice that replaced ozone-depleting chlorofluorocarbons is:

(A) dimethyl ether only

(B) compressed nitrogen

(C) a hydrofluoroalkane (HFA, e.g. HFA-134a)

(D) liquid carbon dioxide

**Q30.** When the dispersed droplets of an emulsion coalesce irreversibly so that the two phases completely and permanently separate, the phenomenon is called:

(A) creaming

(B) flocculation

(C) phase inversion

(D) cracking (breaking)

**Q31.** Compared with a deflocculated suspension, a flocculated pharmaceutical suspension typically shows:

(A) rapid sedimentation but a loose, easily redispersible sediment

(B) a hard, caked sediment that is difficult to redisperse

(C) no sedimentation at all

(D) a clear supernatant only after several weeks

**Q32.** A ball mill achieves particle size reduction predominantly by the combined action of:

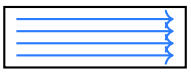
(A) cutting only

(B) impact and attrition

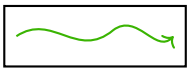
(C) compression between rollers only

(D) simple sieving

**Q33.** The two flow patterns in a pipe are sketched below: pattern (i) shows smooth parallel streamlines and pattern (ii) shows chaotic eddies. For Newtonian flow in a circular pipe, pattern (i) (laminar) is generally observed when the Reynolds number is:



(i) laminar



(ii) turbulent

(A) greater than 4000

(B) between 2100 and 4000

(C) less than about 2100

(D) exactly equal to 1.0

**Q34.** In freeze-drying (lyophilisation), the primary drying stage removes the bulk of the water by:

(A) melting the frozen ice and evaporating it

(B) desorbing bound moisture from the dried cake

(C) boiling the product under high pressure

(D) sublimation of ice directly to vapour under reduced pressure

## Part B: Pharmacology & Toxicology

**Q35.** A drug is given as a 200 mg IV bolus and its total area under the plasma concentration-time curve ($AUC_{0-\infty}$) is 40 mg·h/L. The total body clearance of the drug is:

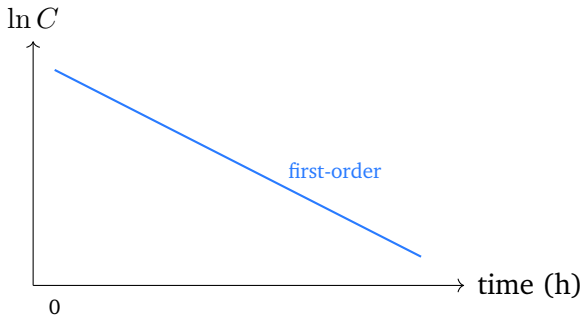
(A) 0.2 L/h

(B) 8000 L/h

(C) 5 L/h

(D) 0.5 L/h

**Q36.** The semi-log plot of plasma concentration against time below is a straight line for a drug eliminated by a single first-order process. If the slope of this line is $-0.10\,\mathrm{h}^{-1}$ (i.e. $\ln C$ vs $t$), the elimination rate constant $k_e$ and half-life are:




(A) $k_e = 0.10\,\text{h}^{-1}$, $t_{1/2} \approx 0.69$ h

(B) $k_e = 0.10\,\text{h}^{-1}$, $t_{1/2} \approx 6.93$ h

(C) $k_e = 0.69\,\text{h}^{-1}$, $t_{1/2} \approx 10$ h

(D) $k_e = 10\,\text{h}^{-1}$, $t_{1/2} \approx 0.069$ h

**Q37.** For a particular drug the AUC after a 100 mg oral dose is 30 mg·h/L, while the AUC after a 100 mg IV dose is 50 mg·h/L. The absolute oral bioavailability ($F$) is:

(A) 0.60 (60%)

(B) 1.67 (167%)

(C) 0.30 (30%)

(D) 0.50 (50%)

**Q38.** A drug has an apparent volume of distribution of 35 L and a target steady-state plasma concentration of 4 mg/L. Ignoring the small amount eliminated during loading and assuming complete IV bioavailability, the loading dose is approximately:

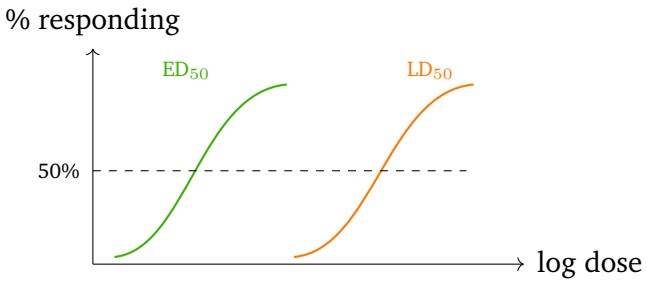
(A) 8.75 mg

(B) 39 mg

(C) 280 mg per hour

(D) 140 mg

**Q39.** The quantal dose-response curves below show the median effective dose and the median lethal dose of a drug. If $\text{ED}_{50}$ = 10 mg/kg and $\text{LD}_{50}$ = 250 mg/kg, the therapeutic index is:



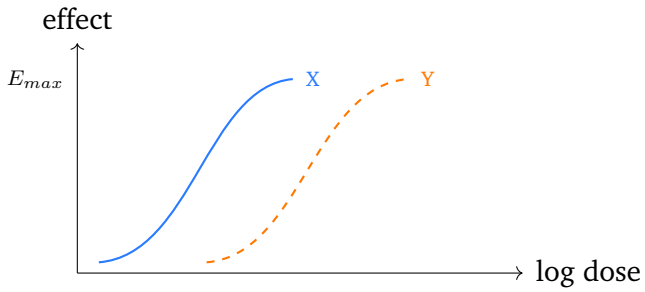

(A) 0.04

(B) 240

(C) 25

(D) 260

**Q40.** The two graded log dose-response curves below belong to drugs X and Y acting on the same receptor. Curve X lies to the left of curve Y but both reach the same plateau. The correct interpretation is:




(A) X has lower efficacy than Y

(B) X is more potent than Y but the two have equal efficacy

(C) Y is more potent than X

(D) X is a partial agonist and Y is a full agonist

**Q41.** The $\alpha_1$-adrenergic and $M_1/M_3$ muscarinic receptors couple through $G_q$. The immediate second-messenger consequence of $G_q$ activation of phospholipase C is generation of:

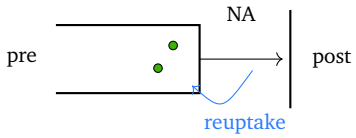
(A) Cyclic AMP, which activates protein kinase A

(B) Cyclic GMP, which activates protein kinase G

(C) A fall in intracellular cyclic AMP

(D) Inositol trisphosphate ($IP_3$) and diacylglycerol (DAG), raising cytosolic $Ca^{2+}$ and activating protein kinase C

**Q42.** At the postganglionic sympathetic nerve terminal depicted, noradrenaline release is terminated mainly by which process?




(A) Reuptake into the nerve terminal by the noradrenaline transporter (uptake-1)

(B) Enzymatic hydrolysis by acetylcholinesterase in the synaptic cleft

(C) Diffusion only, with no active transport involved

(D) Conversion to acetylcholine within the cleft

**Q43.** Tyramine and amphetamine raise blood pressure and cause other sympathetic effects largely because they:

(A) Are direct agonists at $\beta_2$-adrenergic receptors

(B) Block catechol-O-methyltransferase

(C) Are indirectly acting sympathomimetics that enter the nerve terminal and displace stored noradrenaline into the synapse

(D) Inhibit the noradrenaline-synthesising enzyme dopamine $\beta$-hydroxylase

**Q44.** Bethanechol is preferred over acetylcholine for stimulating the bladder and gut because bethanechol:

(A) Is selective for nicotinic receptors at the neuromuscular junction

(B) Is resistant to hydrolysis by acetylcholinesterase and acts selectively on muscarinic receptors

(C) Is a competitive muscarinic antagonist

(D) Crosses the blood-brain barrier to act centrally

**Q45.** Dexmedetomidine, used for sedation in intensive care, lowers sympathetic outflow and blood pressure chiefly by:

(A) Stimulating central presynaptic $\alpha_2$-adrenergic receptors, reducing noradrenaline release

(B) Blocking peripheral $\alpha_1$-adrenergic receptors

(C) Blocking $\beta_1$-adrenergic receptors in the heart

(D) Activating ganglionic nicotinic receptors

**Q46.** Trimethaphan produces a fall in blood pressure that affects both arteriolar and venous tone because it acts as a:

(A) Selective muscarinic $M_3$ antagonist

(B) Direct vasodilator opening potassium channels

(C) Selective $\beta_2$-agonist

(D) Nicotinic antagonist at autonomic ganglia (ganglion blocker), interrupting both sympathetic and parasympathetic transmission

**Q47.** Phenobarbital potentiates GABAergic inhibition in a way that differs from a benzodiazepine such as diazepam because phenobarbital:

(A) Increases only the frequency of chloride channel opening and is harmless in overdose

(B) Acts purely as a competitive GABA antagonist

(C) Increases the duration of chloride channel opening and at high concentration can open the channel directly without GABA, giving a lower margin of safety

(D) Has no effect on the GABA-A receptor at all

**Q48.** Compared with haloperidol, the atypical antipsychotic risperidone causes fewer extrapyramidal effects largely because it:

(A) Blocks 5-$HT_{2A}$ receptors in addition to $D_2$, with a higher 5-$HT_{2A}$:$D_2$ blocking ratio

(B) Is a pure $D_2$ agonist

(C) Selectively blocks only nigrostriatal $D_2$ receptors

(D) Has no affinity for dopamine receptors

**Q49.** Venlafaxine relieves depression by a mechanism best described as:

(A) Selective irreversible inhibition of monoamine oxidase-A

(B) Inhibition of reuptake of both serotonin and noradrenaline (an SNRI)

(C) Selective blockade of dopamine $D_2$ receptors

(D) Direct agonism at 5-$HT_{1A}$ receptors only

**Q50.** Buprenorphine is useful in opioid-dependence maintenance because its pharmacology is that of a:

(A) Full $\mu$-receptor agonist with a short duration of action

(B) Pure $\mu$-receptor antagonist with no agonist activity

(C) Selective $\delta$-receptor agonist devoid of $\mu$ activity

(D) Partial agonist at the $\mu$-opioid receptor with high affinity and a ceiling on respiratory depression

**Q51.** Levetiracetam controls partial and generalised seizures through a mechanism distinct from sodium-channel blockers, namely:

(A) Use-dependent block of voltage-gated sodium channels

(B) Enhancement of GABA transaminase activity

(C) Binding to the synaptic vesicle protein SV2A, modulating neurotransmitter release

(D) Antagonism at the AMPA glutamate receptor

**Q52.** Volatile general anaesthetics such as isoflurane and sevoflurane produce immobility and hypnosis largely by:

(A) Potentiating inhibitory GABA-A and glycine receptor currents while depressing excitatory NMDA and nicotinic transmission

(B) Acting as selective $\mu$-opioid receptor agonists

(C) Blocking voltage-gated calcium channels in the SA node

(D) Stimulating dopaminergic neurons in the mesolimbic pathway

**Q53.** Entacapone is added to levodopa/carbidopa therapy to reduce wearing-off because entacapone:

(A) Is a central dopamine $D_2$ agonist

(B) Inhibits catechol-O-methyltransferase, reducing peripheral metabolism of levodopa and prolonging its plasma half-life

(C) Inhibits central acetylcholinesterase

(D) Blocks NMDA receptors to control dyskinesia

**Q54.** Losartan lowers blood pressure and, unlike enalapril, rarely causes a dry cough because losartan:

(A) Inhibits angiotensin-converting enzyme and raises bradykinin

(B) Blocks L-type calcium channels in vascular smooth muscle

(C) Is a $\beta_1$-selective adrenergic antagonist

(D) Selectively blocks the angiotensin II $AT_1$ receptor without affecting bradykinin metabolism

**Q55.** Amlodipine lowers blood pressure predominantly by:

(A) Blocking L-type calcium channels preferentially in arteriolar smooth muscle, causing vasodilation

(B) Blocking $\beta_1$-adrenergic receptors in the heart

(C) Inhibiting the renin-angiotensin system

(D) Acting as a thiazide-type diuretic on the distal tubule

**Q56.** Furosemide produces a brisk diuresis in pulmonary oedema by inhibiting:

(A) The $Na^+/Cl^-$ symporter in the distal convoluted tubule

(B) Carbonic anhydrase in the proximal tubule

(C) The $Na^+/K^+/2Cl^-$ cotransporter in the thick ascending limb of the loop of Henle

(D) Aldosterone receptors in the collecting duct

**Q57.** Atorvastatin lowers LDL cholesterol mainly by:

(A) Binding bile acids in the gut lumen

(B) Competitively inhibiting HMG-CoA reductase, which upregulates hepatic LDL receptors

(C) Activating peroxisome-proliferator-activated receptor-$\alpha$ (PPAR-$\alpha$)

(D) Inhibiting intestinal cholesterol absorption at NPC1L1

**Q58.** Clopidogrel prevents arterial thrombosis by a mechanism different from aspirin, namely:

(A) Irreversible acetylation of platelet cyclooxygenase

(B) Blockade of the glycoprotein IIb/IIIa receptor

(C) Direct inhibition of thrombin (factor IIa)

(D) Irreversible blockade of the platelet $P2Y_{12}$ ADP receptor, reducing ADP-induced aggregation

**Q59.** Montelukast benefits chronic asthma because it acts as a:

(A) Cysteinyl-leukotriene ($CysLT_1$) receptor antagonist, blocking bronchoconstriction and inflammation

(B) 5-lipoxygenase inhibitor preventing leukotriene synthesis

(C) Selective $\beta_2$-adrenergic agonist

(D) Phosphodiesterase-4 inhibitor

**Q60.** Celecoxib offers a lower risk of gastrointestinal ulceration than non-selective NSAIDs because it:

(A) Irreversibly acetylates both COX-1 and COX-2

(B) Is a leukotriene receptor antagonist

(C) Selectively inhibits COX-2 while largely sparing the gastroprotective COX-1 isoform

(D) Inhibits lipoxygenase and so spares prostaglandins entirely

**Q61.** Ondansetron controls chemotherapy-induced nausea and vomiting by:

(A) Blocking dopamine $D_2$ receptors in the chemoreceptor trigger zone

(B) Antagonising 5-$HT_3$ serotonin receptors on vagal afferents and in the chemoreceptor trigger zone

(C) Stimulating gastric motility as a prokinetic

(D) Blocking histamine $H_1$ receptors in the vestibular pathway

**Q62.** The broad anti-inflammatory action of dexamethasone is best explained by its ability to:

(A) Directly block COX-2 at the active site

(B) Antagonise histamine $H_1$ receptors

(C) Stabilise mast-cell membranes only

(D) Bind cytosolic glucocorticoid receptors and alter transcription, inducing annexin-1/lipocortin and suppressing cytokines, with net reduced phospholipase $A_2$ activity

**Q63.** Azithromycin inhibits bacterial growth by binding which target?

(A) The 50S ribosomal subunit, blocking translocation during protein synthesis

(B) The 30S ribosomal subunit, causing mRNA misreading

(C) DNA gyrase (topoisomerase II)

(D) Dihydropteroate synthase in folate synthesis

**Q64.** Fluconazole is fungistatic against Candida because it inhibits:

(A) Synthesis of the fungal cell wall $\beta$-glucan

(B) The fungal cytochrome-P450 enzyme 14-$\alpha$-demethylase, blocking ergosterol synthesis

(C) Fungal DNA-dependent RNA polymerase

(D) Microtubule assembly in the fungal mitotic spindle

**Q65.** 5-Fluorouracil exerts its anticancer effect chiefly by:

(A) Cross-linking DNA strands as an alkylating agent

(B) Intercalating DNA and inhibiting topoisomerase II

(C) Stabilising microtubules and arresting mitosis

(D) Forming a complex that inhibits thymidylate synthase, blocking dTMP and DNA synthesis

**Q66.** Zidovudine (AZT) suppresses HIV replication because, after intracellular phosphorylation, it:

(A) Inhibits the viral protease that cleaves polyprotein precursors

(B) Blocks viral entry by antagonising the CCR5 co-receptor

(C) Acts as a chain-terminating inhibitor of HIV reverse transcriptase

(D) Inhibits the viral integrase enzyme

**Q67.** Glimepiride lowers blood glucose in type 2 diabetes by:

(A) Closing ATP-sensitive $K^+$ channels in pancreatic $\beta$-cells, depolarising them and stimulating insulin secretion

(B) Activating AMP-kinase and reducing hepatic gluconeogenesis (the biguanide action)

(C) Inhibiting intestinal $\alpha$-glucosidase

(D) Antagonising the glucagon receptor

**Q68.** Which antidote-poison pairing for heavy-metal poisoning is CORRECT?

(A) Iron (acute) poisoning is treated with dimercaprol (BAL)

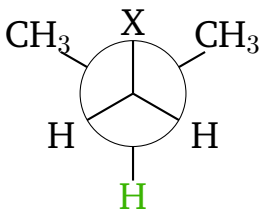
(B) Lead poisoning is treated with calcium disodium EDTA (and dimercaprol/DMSA), which chelate the metal for renal excretion

(C) Cyanide poisoning is treated with deferoxamine

(D) Methanol poisoning is treated with penicillamine

## Part C: Pharmaceutical & Medicinal Chemistry

**Q69.** The Newman projection below (sighting along the C–C bond of a 2-halobutane) shows the leaving group X and the abstracted $\beta$-hydrogen in the geometry required for bimolecular elimination.




The relationship between the leaving group X and the $\beta$-hydrogen that maximises the rate of E2 elimination is:

(A) syn-periplanar (dihedral 0°)

(B) gauche (dihedral 60°)

(C) anti-periplanar (dihedral 180°)

(D) eclipsed (dihedral 120°)

**Q70.** For the solvolysis of *tert*-butyl bromide in aqueous ethanol, the rate is found to be first order overall and independent of nucleophile concentration. This is consistent with an $S_N1$ mechanism whose rate-determining step is:

(A) ionisation to form the *tert*-butyl carbocation

(B) backside attack of water on carbon

(C) proton transfer from the solvent

(D) concerted departure and attack in one step

**Q71.** Benzene reacts with acetyl chloride in the presence of anhydrous $AlCl_3$. Identify the reaction and its major product.

(A) Friedel–Crafts alkylation giving ethylbenzene

(B) nucleophilic substitution giving chlorobenzene

(C) sulfonation giving benzenesulfonic acid

(D) Friedel–Crafts acylation giving acetophenone

**Q72.** An oxime, on treatment with a strong acid (e.g. concentrated $H_2SO_4$ or $PCl_5$), rearranges to an amide. This acid-catalysed conversion of a ketoxime to an amide is the:

(A) Hofmann rearrangement

(B) Beckmann rearrangement

(C) Claisen rearrangement

(D) pinacol rearrangement

**Q73.** Reaction of a phosphorus ylide ($R_3P{=}CR'_2$) with an aldehyde or ketone, forming a carbon–carbon double bond with loss of triphenylphosphine oxide, is the:

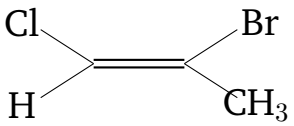
(A) Reformatsky reaction

(B) Grignard reaction

(C) Wittig reaction

(D) Cannizzaro reaction

**Q74.** Assign the configuration of the disubstituted alkene drawn below, where Cl and Br are on one carbon and $CH_3$ and H on the other.




On the left carbon Cl outranks H; on the right carbon Br outranks $CH_3$. The two higher-priority groups (Cl and Br) lie on the same side. The configuration is:

(A) *Z* (zusammen, higher-priority groups on the same side)

(B) *E* (entgegen, higher-priority groups on opposite sides)

(C) neither, the molecule is achiral

(D) it shows optical, not geometric, isomerism

**Q75.** The cycloheptatrienyl (tropylium) cation, $C_7H_7^+$, is unusually stable. According to Hückel's rule this is because it possesses:

(A) 4 $\pi$ electrons and is antiaromatic

(B) 8 $\pi$ electrons in a planar ring

(C) no conjugation at all

(D) 6 $\pi$ electrons ($4n+2$, $n=1$) and is aromatic

**Q76.** Arrange the following nitrogen bases in order of *increasing* basicity in aqueous solution: (i) aniline ($C_6H_5NH_2$), (ii) ammonia ($NH_3$), (iii) ethylamine ($C_2H_5NH_2$).

(A) (iii) $<$ (ii) $<$ (i)

(B) (i) $<$ (ii) $<$ (iii)

(C) (ii) $<$ (iii) $<$ (i)

(D) all three are equally basic

**Q77.** The reaction of an $\alpha$-halo ester with a carbonyl compound in the presence of zinc metal, giving a $\beta$-hydroxy ester via an organozinc intermediate, is the:

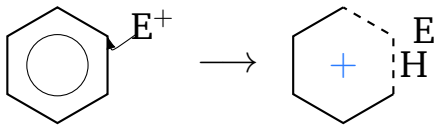
(A) Diels–Alder reaction

(B) aldol condensation

(C) Claisen condensation

(D) Reformatsky reaction

**Q78.** The scheme below shows the first step of electrophilic aromatic substitution: addition of an electrophile $E^+$ to the aromatic ring to form a resonance-stabilised intermediate.




The cationic intermediate formed in this step is called the:

(A) arenium ion ($\sigma$-complex / Wheland intermediate)

(B) carbanion

(C) free radical

(D) benzyne

**Q79.** Two molecules of ethyl acetate, in the presence of sodium ethoxide, condense to give ethyl acetoacetate (a $\beta$-keto ester). This base-catalysed self-condensation of an ester is the:

(A) aldol condensation

(B) Claisen condensation

(C) Cannizzaro reaction

(D) Perkin reaction

**Q80.** A molecule contains two non-equivalent stereocentres and possesses no internal symmetry. The maximum number of distinct stereoisomers it can have is:

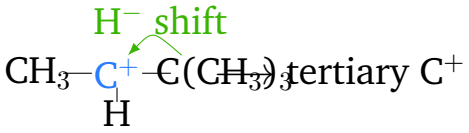
(A) 2 (one pair of enantiomers only)

(B) 3

(C) 4 (two pairs of enantiomers / four diastereomeric relationships)

(D) 8

**Q81.** The reaction below shows an initially formed secondary carbocation converting to a more stable tertiary carbocation before the nucleophile attacks.



This conversion of a less stable to a more stable carbocation is best described as a:

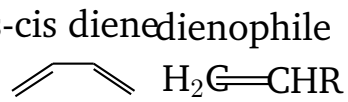
(A) Markovnikov addition

(B) nucleophilic acyl substitution

(C) radical chain initiation

(D) 1,2-hydride shift (carbocation rearrangement)

**Q82.** In the Diels–Alder cycloaddition sketched below, the s-cis diene reacts with the two-carbon component. Reactivity is greatly enhanced when the dienophile bears an electron-withdrawing group.




Which substituent R on the dienophile would make it the **most** reactive towards a normal-demand Diels–Alder reaction?

(A) –CHO (an electron-withdrawing aldehyde)

(B) $-CH_3$ (an electron-donating alkyl)

(C) $-OCH_3$ (an electron-donating alkoxy)

(D) $-N(CH_3)_2$ (a strong electron donor)

**Q83.** Acetaldehyde, treated with dilute NaOH, gives 3-hydroxybutanal (aldol), which on heating dehydrates to but-2-enal. The C–C bond-forming step occurs between an enolate and a carbonyl carbon. This reaction is the:

(A) Cannizzaro reaction

(B) aldol condensation

(C) Wittig reaction

(D) Hofmann elimination

**Q84.** In the design of 5-fluorouracil from uracil, a hydrogen atom is replaced by a fluorine atom of similar size. This single-atom swap that preserves steric demand while altering metabolism is an example of:

(A) a prodrug strategy

(B) ring expansion

(C) classical (monovalent) bioisosterism

(D) racemic switching

**Q85.** Phenobarbital and thiopental are sedative-hypnotic drugs built on a common heterocyclic nucleus formed by condensing a malonic ester derivative with urea (or thiourea). This nucleus is:

(A) the imidazole ring

(B) the phenothiazine tricycle

(C) the 1,4-benzodiazepine ring

(D) the barbituric acid (pyrimidine-2,4,6-trione) ring

**Q86.** The antipsychotic chlorpromazine is a phenothiazine. Maximal antipsychotic (dopamine-blocking) activity is associated with a side chain of a particular length linking the ring nitrogen to the terminal amine. The optimal carbon chain length is:

(A) three carbon atoms separating the two nitrogens

(B) one carbon atom

(C) two carbon atoms

(D) six carbon atoms

**Q87.** Bacampicillin is administered orally and is cleaved by esterases to release the active antibiotic ampicillin. The rationale for this ester prodrug is primarily to:

(A) increase the molecule's metabolic toxicity

(B) improve oral absorption (lipophilicity/bioavailability) of the polar parent drug

(C) make the drug active only after injection

(D) convert it into a different therapeutic class

**Q88.** In a Hammett study of a reaction, a **positive** reaction constant $\rho$ is obtained. This indicates that the rate-determining step is:

(A) insensitive to substituent electronic effects

(B) favoured by electron-donating substituents (builds positive charge)

(C) favoured by electron-withdrawing substituents (negative charge develops in the transition state)

(D) governed only by lipophilicity

**Q89.** Which of the following is a Phase I **reductive** biotransformation, as opposed to an oxidation?

(A) aromatic ring hydroxylation

(B) O-dealkylation

(C) sulfoxidation

(D) nitro-group reduction to an amine

**Q90.** Local anaesthetics are weak bases with $pK_a$ values around 8–9. At physiological pH 7.4 they exist as an equilibrium of the un-ionised free base and the ionised cation. Which form crosses the nerve membrane, and which form blocks the sodium channel from inside?

(A) the cation crosses; the free base blocks the channel

(B) both processes use the cation only

(C) both processes use the free base only

(D) the un-ionised free base crosses the membrane; the ionised cation blocks the sodium channel

**Q91.** For the $\beta$-blocker propranolol, the (*S*)-enantiomer is about 100 times more potent at $\beta$-adrenoceptors than the (*R*)-enantiomer. The ratio of the activity of the eutomer to that of the distomer is termed the:

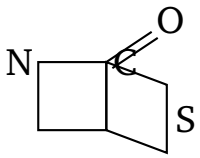
(A) eudismic ratio

(B) partition coefficient

(C) therapeutic index

(D) Hammett constant

**Q92.** The core of penicillins is a $\beta$-lactam ring fused to a thiazolidine ring, drawn schematically below. The carbonyl of the four-membered ring is unusually reactive towards nucleophiles.




The principal reason the $\beta$-lactam carbonyl is so reactive (and the ring opens readily) is:

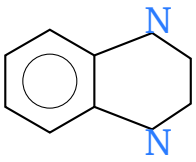
(A) the carbonyl is aromatic and very stable

(B) ring strain in the four-membered ring prevents the usual amide resonance, leaving the carbonyl electrophilic

(C) the nitrogen donates its lone pair fully into the carbonyl

(D) the sulfur atom makes the ring inert

**Q93.** The anxiolytic class drawn schematically below consists of a benzene ring fused to a seven-membered ring containing two nitrogen atoms.




This bicyclic system, the pharmacophore of diazepam-type drugs, is the:

(A) barbituric acid ring

(B) phenothiazine ring

(C) 1,4-benzodiazepine ring system

(D) $\beta$-lactam ring

**Q94.** A weakly acidic drug has $pK_a = 4.4$. In blood plasma at pH 7.4, the ratio of ionised to un-ionised drug, from the Henderson–Hasselbalch equation, is approximately:

(A) 1 : 1

(B) 1 : 1000 (mostly un-ionised)

(C) 3 : 1

(D) 1000 : 1 (mostly ionised)

**Q95.** In radiographic examination of the gastrointestinal tract, an insoluble inorganic suspension is given orally as a contrast (radio-opaque) medium because it is opaque to X-rays yet not absorbed. This pharmaceutical aid is:

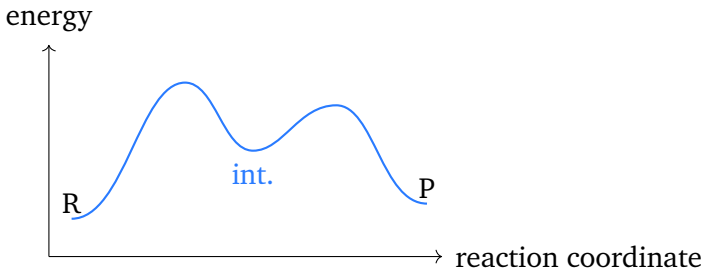
(A) sodium chloride solution

(B) calcium carbonate

(C) magnesium trisilicate

(D) barium sulfate

**Q96.** The reaction-coordinate diagram below shows a two-step process with a discrete high-energy intermediate sitting in an energy well between two transition states.




The presence of a discrete carbocation **intermediate** (energy minimum) between two transition states is the signature of which mechanism?

(A) $S_N1$ (stepwise via a carbocation)

(B) $S_N2$ (concerted, one transition state, no intermediate)

(C) a pericyclic concerted reaction

(D) a radical chain reaction with no intermediate

**Q97.** In phenylethylamine sympathomimetics, increasing the size of the N-substituent changes receptor selectivity. Replacing the N–H of noradrenaline with an N-*tert*-butyl group (as in some $\beta_2$ agonists) generally:

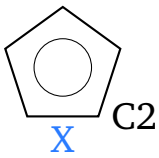
(A) increases $\alpha$-adrenergic selectivity

(B) increases $\beta$-adrenergic (especially $\beta_2$) selectivity over $\alpha$

(C) abolishes all adrenergic activity

(D) converts the drug into an antagonist of acetylcholine

**Q98.** The five-membered aromatic heterocycle drawn below has the heteroatom contributing a lone pair to the aromatic sextet, making the ring $\pi$-electron-rich and strongly activated towards electrophilic substitution (preferentially at C2).




If the heteroatom X is oxygen, this electron-rich, oxygen-containing aromatic heterocycle is:

(A) pyridine

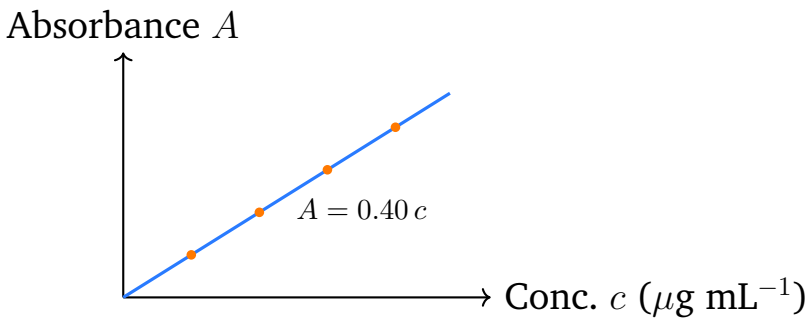
(B) benzene

(C) furan

(D) piperidine (a non-aromatic saturated ring)

## Part D: Pharmaceutical Analysis & Quality Assurance

**Q99.** The Beer–Lambert calibration line below was constructed for a drug at its $\lambda_{max}$. The line obeys $A = 0.40\,c$ with $c$ in $\mu$g mL$^{-1}$. A sample solution gives an absorbance of $A = 0.60$ under identical conditions. What is the concentration of the drug in the sample?




(A) 0.24 $\mu$g mL$^{-1}$

(B) 0.67 $\mu$g mL$^{-1}$

(C) 1.5 $\mu$g mL$^{-1}$

(D) 2.4 $\mu$g mL$^{-1}$

**Q100.** For the non-aqueous titration of a weakly acidic drug (e.g. a barbiturate) dissolved in dimethylformamide, the most appropriate standard titrant is:

(A) Perchloric acid in glacial acetic acid

(B) Sodium methoxide in methanol–benzene

(C) 0.1 M aqueous hydrochloric acid

(D) Standard iodine solution

**Q101.** The Karl Fischer titration is the pharmacopoeial method of choice for determining which quantity in a drug substance?

(A) Total ash value

(B) Free acidity

(C) Water (moisture) content

(D) Heavy-metal impurities

**Q102.** In a complexometric assay, a known excess of EDTA is added to the metal-ion sample and the unreacted EDTA is then titrated with a standard zinc solution. This procedure is best described as a:

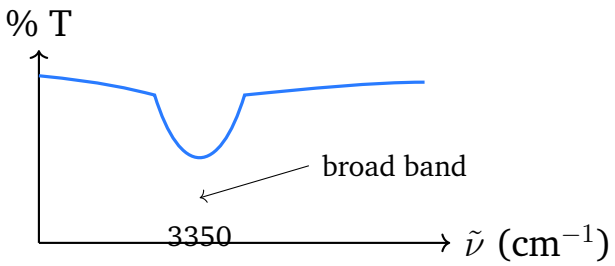
(A) Direct titration

(B) Displacement titration

(C) Masking titration

(D) Back (residual) titration

**Q103.** The schematic IR spectrum below shows a broad, intense absorption centred near **3350 cm$^{-1}$**. A band of this shape and position is most characteristic of which functional group?




(A) C≡N stretch of a nitrile

(B) C=O stretch of an ester

(C) C–Cl stretch of a chloride

(D) O–H stretch of a hydrogen-bonded alcohol

**Q104.** In cerimetric titrations using ceric ammonium sulphate as the oxidising titrant, the redox indicator most commonly employed to mark the end point is:

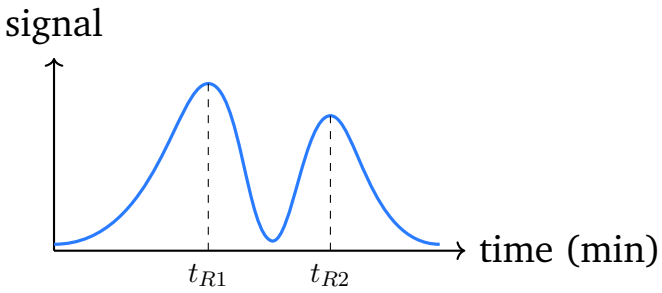
(A) Ferroin (1,10-phenanthroline iron(II))

(B) Starch

(C) Potassium chromate

(D) Eriochrome Black T

**Q105.** Two peaks in the chromatogram below elute at $t_{R1} = 4.0$ min and $t_{R2} = 5.0$ min with baseline widths $w_1 = 0.8$ min and $w_2 = 1.2$ min. Using $R_s = 2(t_{R2} - t_{R1})/(w_1 + w_2)$, the resolution is:




(A) 0.50

(B) 1.0

(C) 1.5

(D) 2.0

**Q106.** In size-exclusion (gel-permeation) chromatography of a protein mixture, the order in which the components leave the column is:

(A) Smallest molecules elute first

(B) Most charged molecules elute first

(C) Largest molecules elute first

(D) Most hydrophobic molecules elute first

**Q107.** In the Volhard method for chloride, an excess of standard silver nitrate is added and the unreacted $Ag^{+}$ is back-titrated with standard ammonium thiocyanate. The indicator that produces a red colour at the end point is:

(A) Potassium chromate

(B) Fluorescein

(C) Starch

(D) Ferric alum (ferric ammonium sulphate)

**Q108.** In $^{1}H$ NMR spectroscopy, protons attached to or near strongly electronegative atoms (such as the CH proton of chloroform, $CHCl_3$) appear:

(A) Downfield (higher $\delta$, deshielded) relative to TMS

(B) Upfield (lower $\delta$, shielded) relative to TMS

(C) Exactly at the TMS reference, $\delta = 0$

(D) At negative chemical shift values only

**Q109.** A solute elutes from an HPLC column with a retention time $t_R = 5.0$ min and a peak width at half-height $w_{1/2} = 0.20$ min. Using $N = 5.54\,(t_R/w_{1/2})^2$, the number of theoretical plates is approximately:

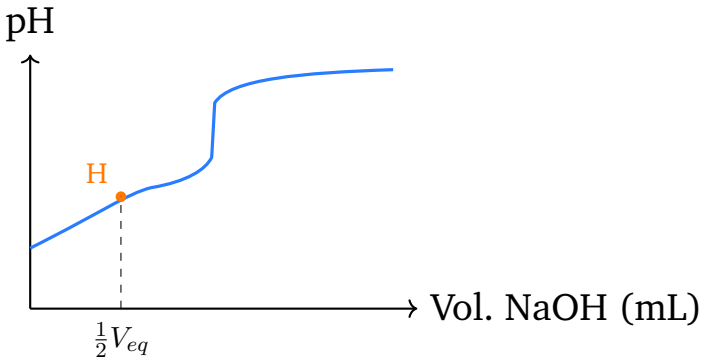
(A) 1390

(B) 3460

(C) 138

(D) 25

**Q110.** The curve below is for the titration of a *weak* acid (HA, $pK_a$) with a strong base. At the half-equivalence point marked **H**, the pH of the solution equals:




(A) 7.0 (neutral) regardless of the acid

(B) $pK_a + 1$

(C) $pK_a$ of the weak acid

(D) $pK_w - pK_a$

**Q111.** According to the nitrogen rule in mass spectrometry, an organic compound that shows an *odd*-mass molecular ion ($M^{+\bullet}$) must contain:

(A) No nitrogen atoms

(B) An even number of nitrogen atoms

(C) Only oxygen atoms

(D) An odd number of nitrogen atoms

**Q112.** Atomic absorption spectroscopy (AAS) quantifies a metal by measuring the:

(A) Light emitted by excited atoms returning to the ground state

(B) Mass-to-charge ratio of metal ions

(C) Absorption of resonance-line radiation by ground-state free atoms

(D) Fluorescence emitted after UV excitation

**Q113.** During the conductometric titration of a strong acid (HCl) with a strong base (NaOH), the conductance of the solution before the equivalence point:

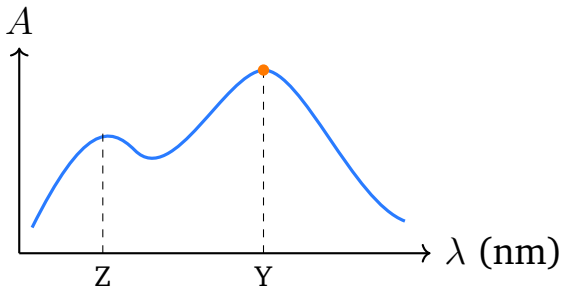
(A) Decreases, as fast-moving $H^+$ ions are replaced by slower $Na^+$ ions

(B) Increases steadily throughout

(C) Remains exactly constant

(D) Rises sharply because $Cl^-$ is removed

**Q114.** The UV absorption curve below shows two maxima. For a quantitative assay of this drug, the analyst should select the wavelength marked **Y** (the more intense, longer-wavelength band at 278 nm) rather than Z because:




(A) It gives the lowest possible absorbance reading

(B) Higher absorptivity at $\lambda_{max}$ gives greater sensitivity and a flatter, more reproducible response

(C) Transmittance is maximal there

(D) The molar absorptivity is zero at that wavelength

**Q115.** A cation-exchange resin used in chromatography separates analytes on the basis of their:

(A) Molecular size only

(B) Volatility and boiling point

(C) Affinity for the negatively charged functional groups on the resin (i.e. their cationic charge)

(D) Refractive index

**Q116.** Compared with conventional UV-visible absorption spectrophotometry, fluorimetry (fluorescence spectrometry) is generally:

(A) Less sensitive and applicable to all compounds

(B) Useful only for inorganic salts

(C) Independent of the excitation wavelength

(D) More sensitive and more selective, but limited to fluorescent (rigid, conjugated) molecules

**Q117.** The assay of ascorbic acid (vitamin C) by direct titration with a standard iodine solution, using starch as indicator near the end point, is an example of:

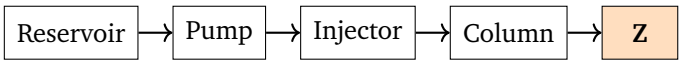
(A) Iodimetry (direct titration with iodine)

(B) Iodometry (indirect, via liberated iodine)

(C) Permanganometry

(D) Argentometry

**Q118.** In the HPLC flow diagram below, identify the component labelled **Z**, which is positioned immediately after the column and generates the chromatographic signal:




(A) Solvent reservoir

(B) Detector (e.g. a UV-Vis detector)

(C) High-pressure pump

(D) Sample injector

**Q119.** In gas chromatography, which of the following is used as the mobile phase (carrier gas)?

(A) Methanol

(B) Acetonitrile–water mixture

(C) An inert gas such as nitrogen, helium, or hydrogen

(D) Liquid carbon dioxide

**Q120.** Potassium permanganate solutions cannot be used as a primary standard and must be standardised before use, commonly against:

(A) Sodium chloride

(B) Potassium hydrogen phthalate

(C) Silver nitrate

(D) Sodium oxalate (or oxalic acid)

**Q121.** During validation of an analytical method, linearity is demonstrated by plotting response against concentration and reporting the correlation coefficient. A value of $r$ regarded as acceptable evidence of a good linear relationship is typically:

(A) $r \geq 0.999$

(B) $r \leq 0.50$

(C) $r = 0$

(D) Any negative value of $r$

**Q122.** Which set of abbreviations correctly denotes the Indian, British, and United States official pharmacopoeias, respectively?

(A) NF, EP, JP

(B) IP, BP, USP

(C) ChP, IP, BP

(D) BP, USP, IP

## Part E: Pharmacognosy & Natural Products

**Q123.** A pharmacognosist arranges crude drugs into leaves, barks, roots, rhizomes, seeds, flowers and fruits, purely on the basis of the plant part employed, without reference to their constituents or therapeutic use. This basis of grouping is called:

(A) Chemical classification

(B) Morphological (organoleptic) classification

(C) Pharmacological classification

(D) Taxonomical classification

**Q124.** Organized crude drugs possess a definite cellular structure, whereas unorganized drugs are cell-free direct products of plant or animal metabolism. Which of the following sets contains **only unorganized** crude drugs?

(A) Cinnamon bark, Fennel fruit, Liquorice root

(B) Coriander fruit, Vasaka leaf, Ginger rhizome

(C) Tragacanth, Benzoin, Beeswax

(D) Ergot sclerotium, Ipecacuanha root, Cardamom seed

**Q125.** Grouping the crude drugs that yield diterpene taxanes, indole alkaloids and tropane alkaloids strictly by the chemical nature of their chief constituents, and disregarding their botanical family, is an example of:

(A) Chemical classification

(B) Morphological classification

(C) Serotaxonomic classification

(D) Pharmacological classification

**Q126.** Ephedrine, a sympathomimetic protoalkaloid in which the nitrogen lies in a side chain rather than in a ring, is obtained from the dried aerial stems of which plant?

(A) *Catharanthus roseus*

(B) *Physostigma venenosum*

(C) *Ephedra gerardiana*

(D) *Colchicum autumnale*

**Q127.** Pilocarpine, an imidazole alkaloid used as a miotic in glaucoma, is obtained from the dried leaflets of which plant?

(A) *Pilocarpus jaborandi*

(B) *Hyoscyamus niger*

(C) *Lobelia inflata*

(D) *Erythroxylum coca*

**Q128.** Colchicine, the antimitotic principle of *Colchicum autumnale*, is biosynthesised from phenylalanine and tyrosine but its nitrogen atom enters as an amide (acetamido) group and lies outside any heterocyclic ring. It is therefore most correctly classified as a:

(A) True (heterocyclic) alkaloid

(B) Purine pseudo-alkaloid

(C) Steroidal pseudo-alkaloid

(D) Protoalkaloid (amino-alkaloid)

**Q129.** An aqueous acidic plant extract is treated with potassium mercuric iodide solution and yields a cream-coloured to white precipitate, confirming the presence of alkaloids. This precipitating reagent and test are:

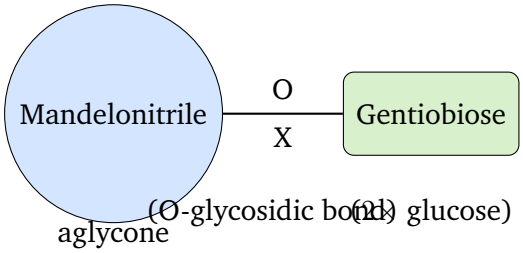
(A) Wagner's reagent giving a reddish-brown precipitate

(B) Mayer's reagent giving a cream/white precipitate

(C) Hager's reagent giving a yellow precipitate

(D) Dragendorff's reagent giving an orange precipitate

**Q130.** The schematic below represents amygdalin, the cyanogenetic glycoside of bitter almond. On enzymatic hydrolysis the linkage "X" is cleaved to liberate the disaccharide and the aglycone, which then breaks down further.




The gas finally released on complete hydrolysis of the mandelonitrile aglycone, detected by the sodium picrate (Guignard) test, is:

(A) Carbon dioxide

(B) Ammonia

(C) Hydrogen sulphide

(D) Hydrocyanic acid (HCN)

**Q131.** The seeds of *Strophanthus kombe* contain cardiac glycosides whose sugar chain carries 2-deoxysugars. The presence of these deoxysugars is confirmed by a reddish-brown ring at the junction of acetic acid (with ferric chloride) and concentrated sulphuric acid layers in which test?

(A) Keller–Kiliani test

(B) Bornträger's test

(C) Molisch's test

(D) Liebermann–Burchard test

**Q132.** Rhubarb (the rhizome of *Rheum emodi*) is a purgative owing to anthraquinone glycosides such as the rhein and emodin derivatives. To which therapeutic class do these anthraquinone derivatives belong?

(A) Cardiotonic glycosides

(B) Stimulant (anthraquinone) laxatives

(C) Bitter (iridoid) tonics

(D) Cyanogenetic glycosides

**Q133.** Saponin glycosides are characterised by their ability to froth in water and to haemolyse red blood cells. The steroidal saponin diosgenin, an important precursor for corticosteroid semisynthesis, is obtained chiefly from which crude drug?

(A) Bark of *Cinchona officinalis*

(B) Leaf of *Digitalis lanata*

(C) Rhizome/tuber of *Dioscorea deltoidea*

(D) Latex of *Papaver somniferum*

**Q134.** Rutin (from *Sophora japonica* buds) and umbelliferone differ in their basic carbon skeleton. Which statement correctly distinguishes a flavonoid glycoside such as rutin from a coumarin?

(A) A flavonoid is built on a C6–C3–C6 (phenyl-benzopyran) skeleton, whereas a coumarin is a C6–C3 benzo-$\alpha$-pyrone lactone

(B) Both are simple C6–C1 phenolic acids

(C) A coumarin has the C6–C3–C6 skeleton and a flavonoid is the lactone

(D) Both are nitrogen-containing alkaloidal glycosides

**Q135.** Cinnamon bark (*Cinnamomum zeylanicum*) yields a volatile oil whose chief aldehydic constituent (about 60–75%) gives the spice its characteristic odour and flavour. This constituent is:

(A) Eugenol

(B) Carvone

(C) Citral

(D) Cinnamaldehyde

**Q136.** Lemongrass oil, distilled from *Cymbopogon flexuosus*, is valued as a starting material for the synthesis of ionones (vitamin A and perfumery). The acyclic monoterpene aldehyde that makes up the bulk of this oil is:

(A) Anethole

(B) Citral (a mixture of geranial and neral)

(C) Menthol

(D) Thymol

**Q137.** Asafoetida is the oleo-gum-resin obtained from the rhizome and root of *Ferula asafoetida*. Its disagreeable garlic-like odour and carminative action are attributed mainly to the volatile sulphur compounds present in which fraction of the drug?

(A) The gum fraction only

(B) The resin (ferulic acid ester) fraction only

(C) The volatile oil fraction (organic sulphides)

(D) The mineral (ash) fraction

**Q138.** Tragacanth, the dried gummy exudate of *Astragalus gummifer*, in cold water swells to a stiff translucent gel rather than dissolving. The water-soluble fraction of tragacanth responsible for the small dissolved portion is called:

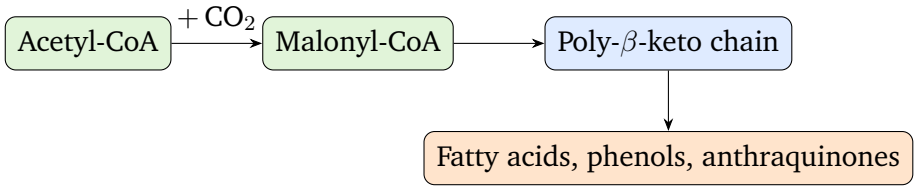
(A) Tragacanthin (water-soluble), the swelling part being bassorin

(B) Arabin, the swelling part being inulin

(C) Agarose, the swelling part being pectin

(D) Glycyrrhizin, the swelling part being saponin

**Q139.** The biosynthetic scheme below outlines a route that repeatedly condenses two-carbon units derived from acetyl-CoA via its activated thioester. Identify the pathway and the class of products it primarily yields.




(A) Shikimic acid pathway giving aromatic amino acids

(B) Acetate–malonate (polyketide) pathway giving fatty acids and phenolic compounds

(C) Acetate–mevalonate pathway giving terpenoids

(D) Pentose phosphate pathway giving nucleotides

**Q140.** Hydrolysable gallotannins are esters of glucose with gallic acid. Gallic acid itself is derived from an intermediate of which biosynthetic pathway?

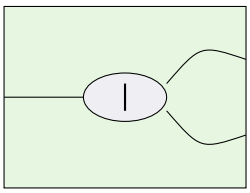
(A) Acetate–mevalonate pathway

(B) Acetate–malonate pathway

(C) Pentose phosphate pathway

(D) Shikimic acid pathway (via 3-dehydroshikimate)

**Q141.** The microscopical sketch shows the arrangement of subsidiary cells around a stoma, a diagnostic leaf character. Here the stoma is surrounded by **three** subsidiary cells, one of which is distinctly smaller than the other two.



stoma with 3 subsidiary cells

This type of stomatal apparatus is:

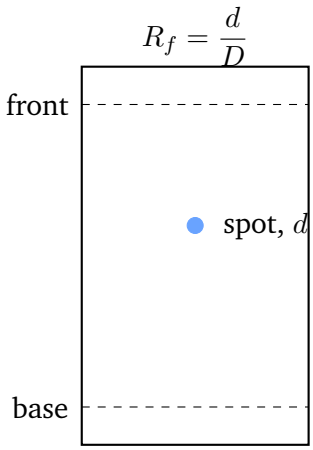
(A) Diacytic

(B) Paracytic

(C) Anisocytic (cruciferous type)

(D) Anomocytic (ranunculaceous type)

**Q142.** The TLC plate below is a fingerprint of a herbal extract, showing the spotting line (base), a resolved spot, and the solvent front.




If the spot travels $d = 2.4$ cm and the solvent front $D$ moves $6.0$ cm from the baseline, the $R_f$ value of the spot is:

(A) 0.40

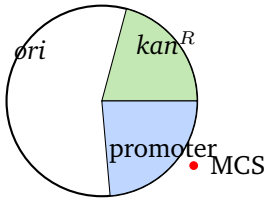
(B) 2.50

(C) 0.60

(D) 0.24

## Part F: Pharmaceutical Biotechnology & Microbiology

**Q143.** The circular expression vector shown below carries an *ori*, a kanamycin-resistance marker, a strong promoter, and a multiple-cloning site (MCS) placed downstream of the promoter. A foreign gene cloned into the MCS will be transcribed efficiently mainly because the:




(A) Kanamycin-resistance gene drives its transcription

(B) Insert lies just downstream of the strong promoter that recruits RNA polymerase

(C) Origin of replication acts as the transcription start site

(D) Foreign gene supplies its own bacterial promoter automatically

**Q144.** Which one of the following restriction endonucleases cleaves its recognition sequence at the centre to leave **blunt ends** (no single-stranded overhang)?

(A) *Bam*HI, which cuts G↓GATCC

(B) *Hind*III, which cuts A↓AGCTT

(C) *Eco*RV, which cuts GAT↓ATC at the centre

(D) *Pst*I, which cuts CTGCA↓G leaving a 3′ overhang

**Q145.** To clone a eukaryotic protein in bacteria, the intron-free coding sequence is obtained by copying mature mRNA into complementary DNA. The enzyme that synthesises this cDNA from an RNA template is:

(A) Reverse transcriptase (RNA-dependent DNA polymerase)

(B) Terminal deoxynucleotidyl transferase

(C) DNA ligase

(D) RNA polymerase II

**Q146.** A researcher wishes to measure the size and abundance of a specific **messenger RNA** transcript. The transcripts are separated by electrophoresis, transferred to a membrane, and probed with a labelled complementary nucleic-acid probe. This technique is:

(A) Western blotting

(B) Southern blotting

(C) Dot blotting of protein

(D) Northern blotting

**Q147.** Recombinant human erythropoietin (EPO) produced in mammalian cell culture is used clinically chiefly to:

(A) Lower blood glucose by promoting glucose uptake

(B) Stimulate red-blood-cell production to treat anaemia (e.g. in chronic renal failure)

(C) Dissolve fibrin clots as a thrombolytic

(D) Promote longitudinal bone growth in children

**Q148.** Streptomycin, an aminoglycoside antibiotic, is obtained industrially by submerged fermentation of which group of microorganisms?

(A) A filamentous mould of the genus *Penicillium*

(B) A Gram-negative enteric bacterium

(C) An actinomycete, *Streptomyces griseus*

(D) A budding yeast, *Saccharomyces cerevisiae*

**Q149.** During an aerobic fed-batch fermentation the dissolved-oxygen level drops sharply as cell density rises. Which combination of operating changes most directly raises the oxygen-transfer rate to the broth?

(A) Increasing the agitation (impeller) speed and the aeration rate

(B) Lowering the temperature and reducing stirring

(C) Adding more antifoam and closing the air inlet

(D) Reducing the working volume only, with no aeration

**Q150.** In which method of enzyme immobilisation is the enzyme attached to an activated insoluble support through stable covalent bonds formed between functional groups (e.g. $-NH_2$) of the protein and the carrier?

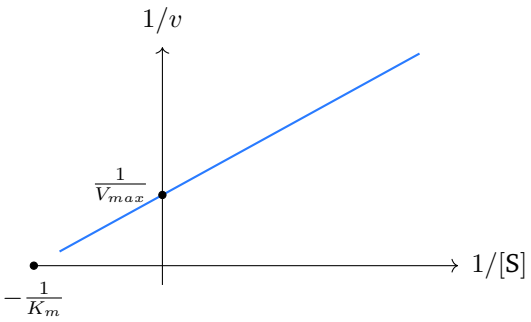
(A) Entrapment within agar gel beads

(B) Physical adsorption on activated charcoal

(C) Encapsulation inside semipermeable microcapsules

(D) Covalent coupling to a chemically activated matrix

**Q151.** The double-reciprocal (Lineweaver–Burk) plot of $1/v$ against $1/[S]$ is shown. The intercept on the $1/v$ axis and the intercept on the $1/[S]$ axis give, respectively:




(A) $1/K_m$ and $1/V_{max}$

(B) $1/V_{max}$ and $-1/K_m$

(C) $V_{max}$ and $K_m$ directly

(D) $K_m/V_{max}$ and $V_{max}$

**Q152.** A reversible **non-competitive** inhibitor binds equally to the free enzyme and the enzyme–substrate complex at a site other than the active site. Compared with the uninhibited reaction, its effect on the kinetic parameters is:

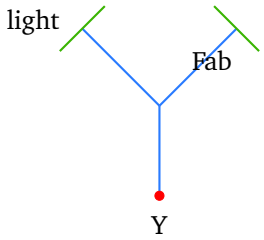
(A) $K_m$ increases, $V_{max}$ unchanged

(B) $K_m$ decreases, $V_{max}$ increases

(C) $K_m$ unchanged, $V_{max}$ decreases

(D) Both $K_m$ and $V_{max}$ increase

**Q153.** The IgG monomer is drawn below as a Y. The stem region labelled Y (the paired constant domains of the two heavy chains) is responsible for effector functions such as complement fixation and binding to phagocyte receptors. This region is the:




(A) Fc region of the heavy chains

(B) Variable region of the light chain

(C) Antigen-binding paratope

(D) Hypervariable CDR loop

**Q154.** The diphtheria and tetanus vaccines are prepared by treating the bacterial exotoxin with formaldehyde so that it loses toxicity but keeps its antigenicity. Such a preparation is best classified as a:

(A) Live attenuated vaccine

(B) Conjugate polysaccharide vaccine

(C) Whole killed (inactivated) vaccine

(D) Toxoid vaccine

**Q155.** In a sandwich ELISA used to quantify an antigen, the signal that is finally measured is produced by:

(A) Agglutination of red cells visible to the eye

(B) An enzyme conjugated to the detection antibody acting on a chromogenic substrate

(C) Radioactive decay of an iodine-125 label

(D) Precipitation of antigen–antibody complexes in agar gel

**Q156.** An immediate anaphylactic reaction to penicillin, mediated by IgE bound to mast cells and basophils that release histamine on antigen re-exposure, is classified as:

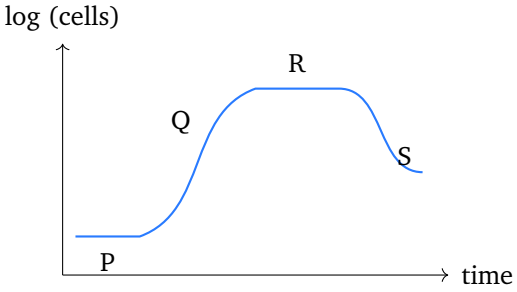
(A) Type II (antibody-mediated cytotoxic) hypersensitivity

(B) Type III (immune-complex) hypersensitivity

(C) Type I (immediate, IgE-mediated) hypersensitivity

(D) Type IV (delayed, cell-mediated) hypersensitivity

**Q157.** The bacterial batch-culture growth curve below plots log(viable cells) against time. In which labelled phase has nutrient depletion and accumulation of toxic products balanced cell division against death, so that the viable count stays roughly constant and many secondary metabolites are produced?




(A) Phase R (stationary phase)

(B) Phase P (lag phase)

(C) Phase Q (log / exponential phase)

(D) Phase S (death / decline phase)

**Q158.** Glass Petri dishes, metal instruments, and non-aqueous oils are best sterilised by a method that destroys microbes mainly by oxidation. The standard reference condition for this dry-heat method is:

(A) Saturated steam at 121°C, 15 psi, for 15 min

(B) Filtration through a 0.22 $\mu$m membrane

(C) Exposure to ethylene oxide gas at room temperature

(D) Hot air oven at 160°C for about 2 hours

**Q159.** The phenol coefficient of a disinfectant is used to express its:

(A) Solubility in water relative to phenol

(B) Boiling point compared with that of phenol

(C) Toxicity to human tissue relative to phenol

(D) Germicidal activity relative to that of phenol under standard test conditions

**Q160.** According to the pharmacopoeial sterility test, the preferred method for testing a filterable antibiotic injection (especially one with antimicrobial activity) for sterility is the:

(A) Membrane-filtration method, which traps organisms and washes away the inhibitory drug before incubation

(B) Direct-inoculation method only, with no rinsing step

(C) Phenol-coefficient assay against *Salmonella*

(D) Optical-density turbidity reading taken immediately, without incubation

## Detailed Solutions

**Q1.**

**Solution**

**Concept — Solubility product of a 1:1 salt:** For $BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$, $K_{sp} = [Ba^{2+}][SO_4^{2-}] = s^2$, so $s = \sqrt{K_{sp}}$. **Reasoning:** $s = \sqrt{1.1 \times 10^{-10}} = 1.05 \times 10^{-5}$ mol/L. **Why the other options are wrong:**

- (A) $1.1 \times 10^{-10}$ is $K_{sp}$ itself, not the solubility.
- (B) $1.1 \times 10^{-5}$ drops the square-root scaling of the coefficient.
- (C) $5.5 \times 10^{-11}$ wrongly halves $K_{sp}$ instead of taking its root.

**Final Answer:** $s = \sqrt{K_{sp}} = 1.05 \times 10^{-5}$ mol/L $\Rightarrow$ D

**Answer: (D)** Go Back to Q1

**Q2.**

**Solution**

**Concept — Partition coefficient:** $P = C_{oil}/C_{water}$; with equal phase volumes the concentration ratio equals the mass ratio. **Reasoning:** Mass in chloroform $= 160$ mg, in water $= 200 - 160 = 40$ mg. $P = 160/40 = 4.0$. **Why the other options are wrong:**

- (A) 0.25 is the inverted water/chloroform ratio.
- (B) 0.80 is the fraction in chloroform, not the partition coefficient.
- (D) 8.0 wrongly uses 160 over 20 mg.

**Final Answer:** $P = 160/40 = 4.0 \Rightarrow$ C

**Answer: (C)** Go Back to Q2

**Q3.**

**Solution**

**Concept — HLB scale:** A w/o emulsifier must be lipophilic, so it sits low on the Griffin scale. **Reasoning:** w/o emulsifiers fall in the HLB band 4–6 (e.g. sorbitan monooleate, Span 80, HLB $\approx 4.3$); they keep oil as the continuous phase. **Why the other options are wrong:**

- (B) 8–10 is the wetting-agent range.

- (C) 12–16 is an o/w emulsifier band, the opposite of what is needed.
- (D) 15–18 is the solubiliser range.

**Final Answer:** w/o emulsifier ⇒ HLB 4–6 ⇒ A

**Answer: (A)** Go Back to Q3

## Q4.

### Solution

**Concept — Time-dependent rheology:** A hysteresis loop between the up- and down-curves means the apparent viscosity depends on the duration and history of shearing. **Reasoning:** Structure breaks down on shearing and rebuilds (gel–sol–gel) when shear is removed; this isothermal, reversible breakdown is thixotropy, desirable in shake-before-use suspensions and gels. **Why the other options are wrong:**

- (A) Dilatancy is shear-thickening, not time-dependent loop behaviour.
- (C) Newtonian flow gives a single straight line with no loop.
- (D) Rheopexy is the rarer build-up under gentle shear; the figure shows structure breakdown (thixotropy).

**Final Answer:** hysteresis loop with structure recovery ⇒ thixotropy ⇒ B

**Answer: (B)** Go Back to Q4

## Q5.

### Solution

**Concept — Solids mixing and segregation:** A random mix has a maximum attainable homogeneity; running a tumbling blender beyond the optimum time induces demixing. **Reasoning:** Free-flowing particles that differ in size, shape or density separate under continued tumbling (percolation and trajectory segregation), so over-mixing reduces uniformity. **Why the other options are wrong:**

- (A) Free-flowing powders do mix readily; the problem is over-mixing, not failure to mix.
- (B) Homogeneity does not improve indefinitely; it peaks then falls.
- (D) Mixing is a physical process and does not liquefy solids.

**Final Answer:** over-mixing ⇒ segregation (demixing) ⇒ C

**Answer: (C)** Go Back to Q5

## Q6.

### Solution

**Concept — Electrokinetics of colloids:** The electrical double layer has a fixed Stern layer and a diffuse layer; the boundary between bound and mobile fluid is the shear (slipping) plane. **Reasoning:** The potential at the plane of shear is the zeta potential; a high magnitude (typically $> \pm 30$ mV) gives strong electrostatic repulsion and physical stability of a lyophobic sol. **Why the other options are wrong:**

- (A) The Nernst potential is measured at the actual particle surface, not the shear plane.
- (B) Streaming potential is generated by forcing liquid through a plug, a different phenomenon.
- (C) The Donnan potential arises across a semipermeable membrane with non-diffusible ions.

**Final Answer:** potential at the shear plane $\Rightarrow$ zeta potential $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q6

## Q7.

### Solution

**Concept — Sterile filtration:** A heat-labile solution is sterilised by passing it through a membrane whose pores are small enough to retain bacteria. **Reasoning:** The accepted sterilising-grade rating is 0.22 $\mu$m (0.2 $\mu$m), which retains organisms such as *Pseudomonas* and *Brevundimonas diminuta*. **Why the other options are wrong:**

- (B) 5.0 $\mu$m is a coarse clarifying/prefilter rating, far too large.
- (C) 100 $\mu$m removes only gross particulates.
- (D) 1.2 $\mu$m is a bioburden-reduction prefilter, not sterilising-grade.

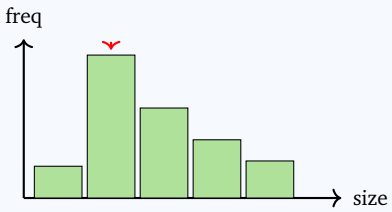
**Final Answer:** sterilising membrane $\Rightarrow$ 0.22 $\mu$m $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q7

## Q8.

**Solution**

**Concept — Particle-size distribution:** The mode is the size class with the greatest frequency, read directly as the tallest bar of the histogram. **Reasoning:** The tallest bar spans the 5–15 $\mu$m interval (centred near 15 on the axis labels of the histogram), so the modal class is 5–15 $\mu$m.




**Why the other options are wrong:**

- (B) 10–20 is not a labelled class on the axis.
- (C) 25–35 and (D) 45–55 are shorter (lower-frequency) bars.

**Final Answer:** tallest bar $\Rightarrow$ 5–15 $\mu$m $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q8

## Q9.

**Solution**

**Concept — Henderson-Hasselbalch:** $\text{pH} = \text{pK}_a + \log \dfrac{[\text{salt/base}]}{[\text{acid}]}$. **Reasoning:** $\text{pH} = 7.2 + \log \dfrac{0.2}{0.1} = 7.2 + \log 2 = 7.2 + 0.30 = 7.5$. **Why the other options are wrong:**

- (A) 6.9 subtracts the log term instead of adding it.
- (B) 7.2 ignores the 2:1 salt/acid ratio.
- (D) 8.4 over-counts the log term.

**Final Answer:** $\text{pH} = 7.2 + \log 2 = 7.5 \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q9

## Q10.

**Solution**

**Concept — Sodium-chloride equivalent:** The E value lets any tonicity-contributing solute be expressed in terms of NaCl. **Reasoning:** E is defined as the weight (g) of NaCl that produces the same osmotic effect as 1 g of the drug; it is used in the NaCl-equivalent method of isotonicity adjustment. **Why the other options are wrong:**

- (A) Dividing molecular weight by 58.5 is not how E is defined.
- (B) The reference for E is sodium chloride, not glucose.
- (C) Freezing-point depression underlies a separate (cryoscopic) method.

**Final Answer:** mass of NaCl with equal osmotic effect to 1 g drug $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q10

## Q11.

**Solution**

**Concept — Liposomes:** Liposomes are vesicular carriers formed when phospholipids self-assemble into one or more concentric bilayers enclosing aqueous compartments. **Reasoning:** The aqueous core can entrap hydrophilic drugs while the lipid bilayer accommodates lipophilic drugs, allowing dual loading and controlled/targeted delivery. **Why the other options are wrong:**

- (B) Solid polymeric nanospheres are nanoparticles, not phospholipid vesicles.
- (C) Single-chain surfactant micelles have no enclosed aqueous core.
- (D) Crosslinked beads $> 1$ mm are macroscopic, not vesicular nanocarriers.

**Final Answer:** concentric bilayer vesicles entrapping both drug types $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q11

## Q12.

**Solution**

**Concept — Order from a concentration-time plot:** A straight line of C vs t (constant slope) means $dC/dt = -k_0$, independent of concentration. **Reasoning:** A rate that does not depend on the remaining concentration is zero-order; de-

grading suspensions commonly show apparent zero-order loss while excess solid maintains saturation. **Why the other options are wrong:**

- (A) First-order gives a straight line only on a $\ln$ C vs t plot.
- (C) Second-order linearises as $1/C$ vs t.
- (D) A simple straight C vs t line is not fractional order.

**Final Answer:** linear C vs t $\Rightarrow$ zero-order $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q12

## Q13.

### Solution

**Concept — Elementary osmotic pump:** A drug core is surrounded by a rigid semipermeable membrane with a small orifice; water is imbibed osmotically and drug solution is pumped out. **Reasoning:** Delivery is controlled by the osmotic pressure gradient driving water across the membrane, giving near zero-order release that is largely independent of GI pH and motility. **Why the other options are wrong:**

- (A) The design is deliberately pH-independent.
- (B) Release does not depend on chewing; the tablet is swallowed whole.
- (D) The core does not disintegrate; the membrane stays intact and is excreted.

**Final Answer:** osmotic gradient across the semipermeable membrane $\Rightarrow$ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q13

## Q14.

### Solution

**Concept — Absolute bioavailability:** $F = \dfrac{AUC_{oral}/Dose_{oral}}{AUC_{iv}/Dose_{iv}}$; with equal doses it reduces to the AUC ratio. **Reasoning:** $F = 40/50 = 0.80$ (80%). **Why the other options are wrong:**

- (A) 1.25 is the inverted ratio; F for an oral dose cannot exceed 1 relative to IV.
- (B) 0.50 mishandles the AUC values.
- (C) 0.40 reports the oral AUC value rather than the ratio.

**Final Answer:** $F = 40/50 = 0.80 \Rightarrow$ D

**Answer: (D)** Go Back to Q14

## Q15.

### Solution

**Concept — Stability (formation) constant:** For D + L $\rightleftharpoons$ DL, the equilibrium constant places the product (complex) over the reactants. **Reasoning:** $K = \dfrac{[\text{DL}]}{[\text{D}][\text{L}]}$; a large K means a strong, favourable complex (e.g. drug-cyclodextrin inclusion).
**Why the other options are wrong:**

- (B) This is the inverse (instability/dissociation constant).
- (C) A product of all three species is dimensionally and conceptually wrong.
- (D) This expression has no thermodynamic meaning for the equilibrium.

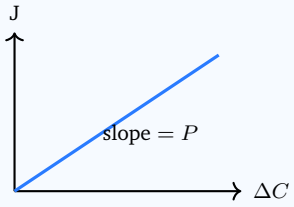
**Final Answer:** $K = [\text{DL}]/([\text{D}][\text{L}]) \Rightarrow$ A

**Answer: (A)** Go Back to Q15

## Q16.

### Solution

**Concept — Permeability from Fick's law:** Steady-state flux $J = \dfrac{DK}{h}\Delta C = P\,\Delta C$, so the lumped permeability coefficient is $P = DK/h$. **Reasoning:** A high diffusion coefficient (D) and partition coefficient (K) raise P, whereas a thicker membrane (h) lowers it. A linear flux-vs-gradient plot has slope $P$.




**Why the other options are wrong:**

- (A) $Dh/K$ inverts the roles of K and h.
- (C) $h/(DK)$ is the resistance (reciprocal of P).
- (D) $D/(Kh)$ wrongly divides by K.

**Final Answer:** $P = DK/h \Rightarrow$ B

**Answer: (B)** Go Back to Q16

## Q17.

### Solution

**Concept — Binary phase diagram:** Two descending liquidus lines meet at the lowest melting composition, where solid and liquid of fixed composition coexist and freeze/melt together. **Reasoning:** Point E is the eutectic point; eutectic mixtures (e.g. lidocaine-prilocaine, camphor-menthol) are exploited in topical and melt-based formulations. **Why the other options are wrong:**

- (A) A triple point is a P–T condition for three phases of one substance, not a binary composition minimum.
- (B) The glass-transition point concerns amorphous softening, not this phase minimum.
- (D) Azeotropic points apply to vapour-liquid (distillation) equilibria.

**Final Answer:** minimum-melting composition where liquidus lines meet $\Rightarrow$ eutectic point $\Rightarrow$ C

**Answer: (C)** Go Back to Q17

## Q18.

### Solution

**Concept — Sink conditions:** In $dC/dt = \frac{DA}{h}(C_s - C)$, the driving force is $(C_s - C)$. **Reasoning:** When C $\ll$ $C_s$ the term $(C_s - C) \approx C_s$ stays maximal and constant, so dissolution proceeds at its fastest, steady rate. *In vitro* this is achieved with a large dissolution-medium volume. **Why the other options are wrong:**

- (A) As C $\rightarrow$ $C_s$ the gradient vanishes and dissolution stops.
- (B) Reducing A slows dissolution.
- (C) A thicker diffusion layer h lowers the rate.

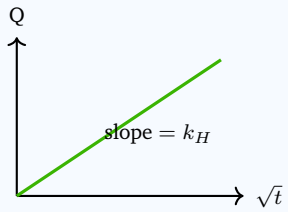
**Final Answer:** sink conditions hold when C $\ll$ $C_s$ $\Rightarrow$ D

**Answer: (D)** Go Back to Q18

## Q19.

**Solution**

**Concept — Higuchi model:** For drug release from a homogeneous matrix, the cumulative amount released is proportional to the square root of time, $Q = k_H\sqrt{t}$. **Reasoning:** Plotting Q against $\sqrt{t}$ linearises the data through the origin (slope $k_H$), regardless of the curved appearance of the Q-vs-time profiles shown.




**Why the other options are wrong:**

- (B) Hixson-Crowell linearises as the cube root of remaining mass.
- (C) Zero-order plots amount against time directly, not $\sqrt{t}$.
- (D) The Weibull function is empirical and does not give the $\sqrt{t}$ law.

**Final Answer:** $Q \propto \sqrt{t} \Rightarrow$ Higuchi model $\Rightarrow$ A

**Answer: (A)** Go Back to Q19

## Q20.

**Solution**

**Concept — Korsmeyer-Peppas exponent for a slab:** For a thin film/slab, $n = 0.5$ is Fickian and $n = 1.0$ is Case-II (zero-order, polymer-relaxation controlled); intermediate values are anomalous. **Reasoning:** $n = 0.89$ for a slab is the upper boundary indicating Case-II (relaxation/swelling-controlled) transport, giving essentially zero-order release. (For cylinders the corresponding upper value is 0.89 and for spheres 0.85.) **Why the other options are wrong:**

- (A) Pure Fickian for a slab is $n = 0.5$, not 0.89.
- (C) Anomalous transport spans $0.5 < n < 0.89$; 0.89 itself marks the Case-II limit.
- (D) Super Case-II requires $n > 0.89$.

**Final Answer:** slab with $n = 0.89 \Rightarrow$ Case-II transport $\Rightarrow$ B

**Answer: (B)** Go Back to Q20

## Q21.

**Solution**

**Concept — BCS classes:** Class I (high solubility, high permeability), II (low solubility, high permeability), III (high solubility, low permeability), IV (low–low). **Reasoning:** A poorly soluble but highly permeable drug whose absorption is dissolution-rate limited is Class II (e.g. many weak acids/bases formulated as solubility-enhanced products). **Why the other options are wrong:**

- (A) Class I is highly soluble.
- (B) Class III has low permeability.
- (D) Class IV has both low solubility and low permeability.

**Final Answer:** low solubility, high permeability $\Rightarrow$ Class II $\Rightarrow$ $\boxed{C}$

**Answer: (C)** Go Back to Q21

## Q22.

**Solution**

**Concept — Superdisintegrants:** These swell or wick rapidly to break a tablet apart at low use levels (2–5%). **Reasoning:** Croscarmellose sodium (crosslinked carboxymethylcellulose) is a classic superdisintegrant that promotes rapid water uptake and tablet break-up, speeding dissolution. **Why the other options are wrong:**

- (A) Glidants (e.g. colloidal silica) improve flow, not disintegration.
- (B) Film-coating polymers (e.g. HPMC) form the coat, not the disintegrant.
- (C) Sweeteners are taste agents.

**Final Answer:** croscarmellose sodium $\Rightarrow$ superdisintegrant $\Rightarrow$ $\boxed{D}$

**Answer: (D)** Go Back to Q22

## Q23.

**Solution**

**Concept — Enteric coating:** An enteric polymer is insoluble at acidic gastric pH but ionises and dissolves at the higher pH of the small intestine. **Reasoning:** Cellulose acetate phthalate (CAP) has free phthalic acid groups that stay un-ionised (insoluble) at pH 1–3 and dissolve above pH $\approx 6$, giving gastro-resistant release.

**Why the other options are wrong:**

- (B) Immediate-release HPMC dissolves in the stomach.
- (C) PEG 6000 is a water-soluble plasticiser/base, not pH-dependent.
- (D) Povidone is a freely soluble binder, not enteric.

**Final Answer:** cellulose acetate phthalate $\Rightarrow$ A

**Answer: (A)** Go Back to Q23

## Q24.

### Solution

**Concept — Friability test:** Friability measures the weight lost when tablets are tumbled in a rotating drum, reflecting mechanical strength. **Reasoning:** A maximum mean weight loss of 1.0% is generally regarded as acceptable for uncoated tablets per the USP. **Why the other options are wrong:**

- (A) 5.0% is far too high and would indicate fragile tablets.
- (C) 10.0% is grossly excessive.
- (D) 0.01% is unrealistically strict and not the stated limit.

**Final Answer:** acceptable friability $\leq 1.0\% \Rightarrow$ B

**Answer: (B)** Go Back to Q24

## Q25.

### Solution

**Concept — Hard-gelatin capsule sizes:** Sizes run 000 (largest) down to 5 (smallest) for human use; the higher the number, the smaller the shell. **Reasoning:** Size 000 holds the largest fill volume ($\approx 1.37$ mL) and size 5 the smallest ($\approx 0.13$ mL); this inverse numbering must be memorised. **Why the other options are wrong:**

- (A) Size 5 is the smallest, not the largest.
- (B) The relationship is inverse: larger number means smaller capsule.
- (D) Different sizes hold clearly different volumes.

**Final Answer:** 000 largest, 5 smallest $\Rightarrow$ C

**Answer: (C)** Go Back to Q25

## Q26.

**Solution**

**Concept — LAL (bacterial endotoxin) test:** Amebocyte lysate from the horseshoe crab gels in the presence of lipopolysaccharide endotoxin. **Reasoning:** The LAL test specifically and sensitively detects Gram-negative bacterial endotoxins (pyrogens) in parenteral products and devices, replacing the rabbit pyrogen test in many cases. **Why the other options are wrong:**

- (A) Particulate matter is assessed by light-obscuration/microscopy.
- (B) Residual ethylene oxide is measured by chromatography.
- (C) Fungal sterility is judged by culture-based sterility tests.

**Final Answer:** LAL detects Gram-negative endotoxins $\Rightarrow$ D

**Answer: (D)** Go Back to Q26

## Q27.

**Solution**

**Concept — Eye-drop preservatives:** Multidose ophthalmics need an antimicrobial preservative to prevent contamination between uses. **Reasoning:** Benzalkonium chloride, a quaternary-ammonium cationic surfactant, is the most widely used ophthalmic preservative (typically 0.004–0.02%). **Why the other options are wrong:**

- (B) Viscosity is raised by polymers such as HPMC.
- (C) Tonicity is adjusted with NaCl or boric acid.
- (D) Buffering uses borate or phosphate systems.

**Final Answer:** benzalkonium chloride $\Rightarrow$ preservative $\Rightarrow$ A

**Answer: (A)** Go Back to Q27

## Q28.

**Solution**

**Concept — Displacement value (DV):** DV is the number of parts of drug that displace 1 part of base by volume; base to weigh = (mould capacity) − (drug weight ÷ DV). **Reasoning:** Base displaced by drug $= 0.4/4 = 0.1$ g. Base required $= 2.0 - 0.1 = 1.9$ g per suppository. **Why the other options are wrong:**

- (A) 2.0 g ignores the volume occupied by the drug.
- (C) 1.6 g wrongly subtracts the full drug mass (0.4 g).
- (D) 0.4 g is the drug mass, not the base.

**Final Answer:** base $= 2.0 - (0.4/4) = 1.9$ g $\Rightarrow$ B

**Answer: (B)** Go Back to Q28

## Q29.

### Solution

**Concept — pMDI propellants:** Ozone-depleting chlorofluorocarbons (CFCs) were phased out under the Montreal Protocol. **Reasoning:** Hydrofluoroalkanes (HFAs), chiefly HFA-134a (norflurane) and HFA-227, are the modern non-ozone-depleting liquefied-gas propellants in metered-dose inhalers. **Why the other options are wrong:**

- (A) Dimethyl ether is used in some sprays but is not the standard pMDI replacement.
- (B) Compressed nitrogen is a compressed-gas propellant, giving inconsistent dosing for pMDIs.
- (D) Liquid $CO_2$ is not the inhalation propellant of choice.

**Final Answer:** HFA-134a (a hydrofluoroalkane) $\Rightarrow$ C

**Answer: (C)** Go Back to Q29

## Q30.

### Solution

**Concept — Emulsion instability:** Coalescence of droplets that proceeds to complete, irreversible phase separation is the most severe form of breakdown. **Reasoning:** This permanent separation is called cracking (breaking); unlike creaming it cannot be reversed by shaking because the interfacial film has been destroyed. **Why the other options are wrong:**

- (A) Creaming is reversible upward/downward migration of intact droplets.
- (B) Flocculation is loose, reversible aggregation without coalescence.
- (C) Phase inversion changes the emulsion type (o/w $\leftrightarrow$ w/o) rather than separating the phases.

**Final Answer:** irreversible coalescence and separation $\Rightarrow$ cracking $\Rightarrow$ D

**Answer: (D)** Go Back to Q30

## Q31.

### Solution

**Concept — Flocculated suspensions:** Loosely aggregated flocs settle quickly but form a high, porous, easily redispersed sediment. **Reasoning:** Because the flocs trap liquid, the sediment does not cake; gentle shaking redisperses it, so a controlled-flocculation system is usually preferred. **Why the other options are wrong:**

- (B) A hard cake is the failure mode of a deflocculated system.
- (C) All suspensions of insoluble solids eventually sediment.
- (D) A clear supernatant appears quickly in flocculated systems, not after weeks.

**Final Answer:** rapid settling but loose, redispersible sediment $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q31

## Q32.

### Solution

**Concept — Ball-mill comminution:** A rotating cylinder partly filled with balls reduces size as the balls cascade onto the feed. **Reasoning:** The dominant mechanisms are impact (balls striking particles) and attrition (rubbing between balls and wall); the mill works best near a critical speed where cascading is maximised. **Why the other options are wrong:**

- (A) Cutting is the mechanism of a cutter mill, not a ball mill.
- (C) Compression between rollers describes a roller mill.
- (D) Sieving classifies particles; it does not reduce size.

**Final Answer:** impact and attrition $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q32

## Q33.

**Solution**

**Concept — Reynolds number:** $Re = \rho v d/\eta$ classifies pipe flow; low $Re$ gives ordered laminar flow, high $Re$ gives turbulence. **Reasoning:** For Newtonian flow in a circular pipe, smooth laminar streamlines (pattern i) occur when $Re <\sim 2100$; $2100$–$4000$ is transitional and $> 4000$ fully turbulent. **Why the other options are wrong:**

- (A) $Re > 4000$ is turbulent (pattern ii).
- (B) 2100–4000 is the transition region, not steady laminar.
- (D) $Re = 1.0$ is an arbitrary value, not the laminar threshold.

**Final Answer:** laminar flow when $Re <\sim 2100 \Rightarrow$ C

**Answer: (C)** Go Back to Q33

## Q34.

**Solution**

**Concept — Lyophilisation stages:** Freeze-drying involves freezing, primary drying (ice removal) and secondary drying (bound-moisture removal). **Reasoning:** In primary drying the frozen free water is removed by sublimation, i.e. ice converts directly to vapour under reduced pressure (below the triple point), protecting heat-labile products. **Why the other options are wrong:**

- (A) The ice is sublimed, not melted, so the product never passes through the liquid state.
- (B) Desorbing bound moisture is secondary drying, the later stage.
- (C) Boiling under high pressure would damage thermolabile drugs and is not how lyophilisation works.

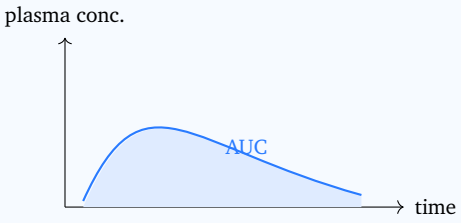
**Final Answer:** primary drying removes ice by sublimation $\Rightarrow$ D

**Answer: (D)** Go Back to Q34

## Q35.

**Solution**

**Concept — Clearance from AUC:** For an IV bolus, total clearance $CL = \text{Dose}/\text{AUC}_{0-\infty}$. **Reasoning:** $CL = 200\,\text{mg}/40\,\text{mg}\cdot\text{h/L} = 5$ L/h. Clearance is the volume of plasma cleared of drug per unit time and is the parameter that links dose to total exposure (AUC), the shaded area under the plasma concentration-time curve.




**Why the other options are wrong:**

- (A) 0.2 L/h inverts the ratio (AUC/Dose).
- (B) 8000 L/h multiplies instead of dividing.
- (D) 0.5 L/h is off by a factor of ten.

**Final Answer:** $CL = 200/40 = 5$ L/h $\Rightarrow$ C

**Answer: (C)** Go Back to Q35

## Q36.

**Solution**

**Concept — First-order elimination on a semi-log plot:** A plot of $\ln C$ against time is linear with slope $-k_e$, and $t_{1/2} = 0.693/k_e$. **Reasoning:** The slope is $-0.10\,\text{h}^{-1}$, so $k_e = 0.10\,\text{h}^{-1}$ and $t_{1/2} = 0.693/0.10 \approx 6.93$ h. The straight semi-log line confirms a single first-order process. **Why the other options are wrong:**

- (A) Uses $t_{1/2} = 0.693$ h, which would need $k_e = 1\,\text{h}^{-1}$.
- (C) Swaps $k_e$ and the half-life relationship.
- (D) Misreads the slope magnitude by a factor of 100.

**Final Answer:** $k_e = 0.10\,\text{h}^{-1}$, $t_{1/2} = 0.693/0.10 \approx 6.93$ h $\Rightarrow$ B

**Answer: (B)** Go Back to Q36

## Q37.

**Solution**

**Concept — Absolute bioavailability:** $F = (\text{AUC}_{oral}/\text{AUC}_{IV})$ when doses are equal. **Reasoning:** With identical 100 mg doses, $F = 30/50 = 0.60$, i.e. 60% of the oral dose reaches the systemic circulation; the rest is lost to incomplete absorption and first-pass metabolism. **Why the other options are wrong:**

- (B) 1.67 inverts the ratio; $F$ cannot exceed 1.
- (C) 0.30 ignores the IV reference AUC.
- (D) 0.50 uses an incorrect denominator.

**Final Answer:** $F = 30/50 = 0.60$ (60%) $\Rightarrow$ A

**Answer: (A)** Go Back to Q37

## Q38.

**Solution**

**Concept — Loading dose:** The loading dose that immediately fills the volume of distribution is $\text{LD} = V_d \times C_{target}/F$. **Reasoning:** With complete IV bioavailability ($F = 1$), $\text{LD} = 35\,\text{L} \times 4\,\text{mg/L} = 140$ mg. The loading dose depends on $V_d$ and the target concentration, not on clearance. **Why the other options are wrong:**

- (A) 8.75 mg divides instead of multiplying.
- (B) 39 mg adds $V_d$ and $C$ rather than multiplying.
- (C) 280 mg/h is a maintenance-rate style answer with wrong arithmetic and units.

**Final Answer:** $\text{LD} = 35 \times 4 = 140$ mg $\Rightarrow$ D

**Answer: (D)** Go Back to Q38

## Q39.

**Solution**

**Concept — Therapeutic index:** $\text{TI} = \text{LD}_{50}/\text{ED}_{50}$; a larger value means a wider margin of safety. **Reasoning:** $\text{TI} = 250/10 = 25$. The wider the separation between the effective-dose curve and the lethal-dose curve, the safer the drug. **Why the other options are wrong:**

- (A) 0.04 inverts the ratio ($\text{ED}_{50}/\text{LD}_{50}$).

- (B) 240 subtracts instead of dividing.
- (D) 260 adds the two doses.

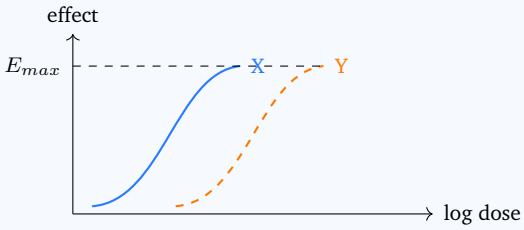
**Final Answer:** TI $= 250/10 = 25 \Rightarrow$ C

**Answer: (C)** Go Back to Q39

## Q40.

### Solution

**Concept — Potency vs efficacy:** A left-shifted curve indicates greater potency (lower $ED_{50}$); an equal plateau indicates equal efficacy ($E_{max}$). **Reasoning:** X reaches the same maximum as Y but does so at lower doses, so X is more potent while both have the same efficacy. Potency is a horizontal-axis property; efficacy is the height of the plateau.




**Why the other options are wrong:**

- (A) Equal plateaus mean equal efficacy, not lower.
- (C) The left curve (X), not Y, is more potent.
- (D) Equal maxima rule out a partial agonist.

**Final Answer:** X is more potent, equal efficacy $\Rightarrow$ B

**Answer: (B)** Go Back to Q40

## Q41.

### Solution

**Concept — $G_q$ / phospholipase C pathway:** $G_q$-coupled receptors activate phospholipase C-$\beta$, which cleaves $PIP_2$. **Reasoning:** Cleavage of $PIP_2$ yields $IP_3$ (which releases $Ca^{2+}$ from the endoplasmic reticulum) and DAG (which, with $Ca^{2+}$, activates protein kinase C). This is the signalling route for $\alpha_1$-adrenergic and $M_1/M_3$ muscarinic receptors. **Why the other options are wrong:**

- (A) Raised cAMP/PKA is the $G_s$ pathway.

- (B) cGMP/PKG is the nitric-oxide/guanylyl-cyclase pathway.
- (C) A fall in cAMP is the $G_i$ pathway.

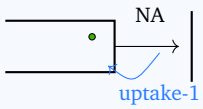
**Final Answer:** $G_q$/PLC generates $IP_3$ and DAG $\Rightarrow$ D

**Answer: (D)** Go Back to Q41

## Q42.

### Solution

**Concept — Termination of noradrenergic transmission:** The dominant route is neuronal reuptake (uptake-1) by the noradrenaline transporter. **Reasoning:** Released noradrenaline is taken back into the nerve terminal by the $Na^+$-dependent transporter; recaptured transmitter is restored to vesicles or degraded by mitochondrial MAO. Reuptake, not enzymatic cleft hydrolysis, is the main off-switch.




**Why the other options are wrong:**

- (B) AChE acts on acetylcholine, not noradrenaline.
- (C) Diffusion alone is minor; active uptake dominates.
- (D) No cleft conversion of NA to acetylcholine occurs.

**Final Answer:** Neuronal reuptake via the NA transporter $\Rightarrow$ A

**Answer: (A)** Go Back to Q42

## Q43.

### Solution

**Concept — Indirectly acting sympathomimetics:** These agents act by releasing stored noradrenaline rather than by direct receptor binding. **Reasoning:** Tyramine and amphetamine are taken up into the adrenergic terminal and displace noradrenaline from vesicles into the synapse, so their effect depends on intact transmitter stores and falls with reserpine pretreatment. This also underlies the tyramine "cheese reaction" with MAO inhibitors. **Why the other options are wrong:**

- (A) They are not direct $\beta_2$ agonists.

- (B) COMT inhibition is not their main action.
- (D) They do not inhibit dopamine $\beta$-hydroxylase.

**Final Answer:** Displacement of stored noradrenaline $\Rightarrow$ C

**Answer: (C)** Go Back to Q43

## Q44.

### Solution

**Concept — Bethanechol:** It is a synthetic choline ester selective for muscarinic receptors and resistant to cholinesterase. **Reasoning:** The $\beta$-methyl group makes bethanechol resistant to acetylcholinesterase, giving a longer action, and it is essentially devoid of nicotinic activity, so it selectively stimulates smooth muscle of the gut and bladder (used for postoperative or neurogenic atony). **Why the other options are wrong:**

- (A) It is muscarinic-selective, not nicotinic.
- (C) It is an agonist, not an antagonist.
- (D) As a charged ester it does not enter the CNS.

**Final Answer:** AChE-resistant, muscarinic-selective agonist $\Rightarrow$ B

**Answer: (B)** Go Back to Q44

## Q45.

### Solution

**Concept — Central $\alpha_2$ agonists:** Stimulating presynaptic $\alpha_2$ receptors reduces central sympathetic outflow. **Reasoning:** Dexmedetomidine is a highly selective $\alpha_2$-agonist; activation of central $\alpha_2$ receptors decreases noradrenaline release, lowering sympathetic tone, heart rate and blood pressure, while producing sedation without much respiratory depression. **Why the other options are wrong:**

- (B) It does not primarily block peripheral $\alpha_1$ receptors.
- (C) It is not a $\beta_1$-blocker.
- (D) It does not activate ganglionic nicotinic receptors.

**Final Answer:** Central $\alpha_2$-agonism reducing NA release $\Rightarrow$ A

**Answer: (A)** Go Back to Q45

## Q46.

**Solution**

**Concept — Ganglion blockers:** Nicotinic ($N_N$) antagonists at autonomic ganglia block transmission in both divisions of the autonomic nervous system. **Reasoning:**

Trimethaphan blocks ganglionic nicotinic receptors, interrupting both sympathetic and parasympathetic ganglionic transmission. Loss of sympathetic tone dilates both arterioles (lowering afterload) and veins (lowering preload), giving its rapid hypotensive effect. **Why the other options are wrong:**

- (A) It is not a selective $M_3$ antagonist.
- (B) It does not act as a direct $K^+$-channel-opening vasodilator.
- (C) It is not a $\beta_2$-agonist.

**Final Answer:** Nicotinic ganglion blockade $\Rightarrow$ D

**Answer: (D)** Go Back to Q46

## Q47.

**Solution**

**Concept — Barbiturates vs benzodiazepines at GABA-A:** Both are positive modulators, but barbiturates prolong the duration of channel opening and can gate the channel directly at high doses. **Reasoning:** Phenobarbital increases the *duration* of chloride channel opening; at higher concentrations it opens the channel even without GABA. This GABA-independent action removes the "ceiling" that benzodiazepines have, so barbiturate overdose causes dangerous respiratory depression (a narrow margin of safety). **Why the other options are wrong:**

- (A) Increasing only frequency, and being safe in overdose, describes benzodiazepines.
- (B) It is not a GABA antagonist.
- (D) It clearly does act on the GABA-A receptor.

**Final Answer:** Prolongs channel opening, direct gating, low safety margin $\Rightarrow$ C

**Answer: (C)** Go Back to Q47

## Q48.

**Solution**

**Concept — Atypical antipsychotics:** Combined 5-$HT_{2A}$ and $D_2$ antagonism, with a high 5-$HT_{2A}$:$D_2$ ratio, reduces extrapyramidal liability. **Reasoning:** By blocking 5-$HT_{2A}$ receptors, risperidone disinhibits nigrostriatal dopamine release, partly offsetting striatal $D_2$ blockade and lowering extrapyramidal side effects compared with the purely $D_2$-blocking haloperidol. **Why the other options are wrong:**

- (B) It is a $D_2$ antagonist, not an agonist.
- (C) It does not selectively spare or target only nigrostriatal $D_2$.
- (D) It does have dopamine-receptor affinity.

**Final Answer:** High 5-$HT_{2A}$:$D_2$ blocking ratio $\Rightarrow$ A

**Answer: (A)** Go Back to Q48

## Q49.

**Solution**

**Concept — SNRI antidepressants:** Serotonin-noradrenaline reuptake inhibitors block both the SERT and the NET transporters. **Reasoning:** Venlafaxine inhibits reuptake of both serotonin and noradrenaline (serotonin predominating at low dose, noradrenaline adding at higher dose), raising synaptic levels of both monoamines without the receptor-blocking burden of older tricyclics. **Why the other options are wrong:**

- (A) Irreversible MAO-A inhibition describes the MAOIs.
- (C) $D_2$ blockade is an antipsychotic action.
- (D) It is not a selective 5-$HT_{1A}$ agonist (that is buspirone).

**Final Answer:** Dual 5-HT and NA reuptake inhibition $\Rightarrow$ B

**Answer: (B)** Go Back to Q49

## Q50.

**Solution**

**Concept — Buprenorphine:** It is a high-affinity partial agonist at the $\mu$-opioid receptor. **Reasoning:** Its partial agonism produces a ceiling on respiratory depression and, with its tight, slowly dissociating binding and long duration, it sup-

presses craving and blocks the effect of additional full agonists, which makes it valuable for dependence maintenance. **Why the other options are wrong:**

- (A) It is not a short-acting full agonist.
- (B) It is not a pure antagonist (that is naltrexone).
- (C) Its key action is at $\mu$, not a selective $\delta$ effect.

**Final Answer:** High-affinity $\mu$ partial agonist with a respiratory ceiling $\Rightarrow$ D

**Answer: (D)** Go Back to Q50

## Q51.

### Solution

**Concept — Levetiracetam:** Its molecular target is the synaptic vesicle glycoprotein SV2A. **Reasoning:** By binding SV2A, levetiracetam modulates synaptic vesicle fusion and neurotransmitter release, reducing abnormal hypersynchronous firing. This mechanism is distinct from sodium-channel block, calcium-channel block or direct GABA enhancement. **Why the other options are wrong:**

- (A) Use-dependent $Na^+$ block describes phenytoin/carbamazepine.
- (B) GABA-transaminase enhancement is not its action.
- (D) It is not an AMPA antagonist (that is perampanel).

**Final Answer:** Binds the SV2A vesicle protein $\Rightarrow$ C

**Answer: (C)** Go Back to Q51

## Q52.

### Solution

**Concept — Volatile anaesthetics:** They act on multiple ion channels, enhancing inhibition and depressing excitation. **Reasoning:** Isoflurane and sevoflurane potentiate GABA-A and glycine receptor chloride currents (hyperpolarising neurons) while inhibiting excitatory NMDA-glutamate and neuronal nicotinic transmission, producing immobility, amnesia and hypnosis. Their potency tracks lipid solubility (Meyer-Overton). **Why the other options are wrong:**

- (B) They are not opioid-receptor agonists.
- (C) SA-node calcium-channel block is unrelated to anaesthesia.
- (D) They depress, not stimulate, mesolimbic dopamine for their core effect.

**Final Answer:** Enhance GABA-A/glycine, depress NMDA/nicotinic $\Rightarrow$ A

**Answer: (A)** Go Back to Q52

## Q53.

### Solution

**Concept — COMT inhibitors:** Entacapone inhibits catechol-O-methyltransferase, the enzyme that methylates levodopa to 3-O-methyldopa. **Reasoning:** By blocking peripheral COMT, entacapone reduces metabolism of levodopa, raises and prolongs its plasma levels and increases the fraction reaching the brain, smoothing motor fluctuations and reducing "wearing-off" between doses. **Why the other options are wrong:**

- (A) It is not a dopamine $D_2$ agonist.
- (C) It does not inhibit central acetylcholinesterase.
- (D) NMDA antagonism for dyskinesia describes amantadine.

**Final Answer:** Peripheral COMT inhibition prolonging levodopa $\Rightarrow$ B

**Answer: (B)** Go Back to Q53

## Q54.

### Solution

**Concept — Angiotensin receptor blockers:** ARBs block the $AT_1$ receptor directly and do not affect bradykinin. **Reasoning:** Losartan antagonises angiotensin II at the $AT_1$ receptor, reducing vasoconstriction and aldosterone release. Because it does not inhibit ACE, bradykinin is not accumulated, so the dry cough (and angioedema) seen with ACE inhibitors is uncommon. **Why the other options are wrong:**

- (A) ACE inhibition with raised bradykinin describes enalapril.
- (B) L-type calcium-channel block describes the dihydropyridines.
- (C) $\beta_1$ blockade is a different class.

**Final Answer:** Direct $AT_1$ blockade sparing bradykinin $\Rightarrow$ D

**Answer: (D)** Go Back to Q54

## Q55.

**Solution**

**Concept — Dihydropyridine calcium-channel blockers:** They preferentially relax vascular (arteriolar) smooth muscle. **Reasoning:** Amlodipine blocks L-type calcium channels with vascular selectivity, dilating arterioles and lowering peripheral resistance and blood pressure, with little direct negative effect on cardiac contractility at usual doses. **Why the other options are wrong:**

- (B) It is not a $\beta_1$-blocker.
- (C) It does not act on the renin-angiotensin system.
- (D) It is not a thiazide diuretic.

**Final Answer:** Arteriolar L-type $Ca^{2+}$ channel block $\Rightarrow$ A

**Answer: (A)** Go Back to Q55

## Q56.

**Solution**

**Concept — Loop diuretics:** Furosemide inhibits the $Na^+/K^+/2Cl^-$ cotransporter (NKCC2) in the thick ascending limb. **Reasoning:** Blocking NKCC2 prevents reabsorption of a large fraction of filtered sodium and chloride, abolishing the medullary concentration gradient and producing a powerful diuresis, which rapidly relieves pulmonary oedema by reducing volume and preload. **Why the other options are wrong:**

- (A) Distal $Na^+/Cl^-$ symporter block describes thiazides.
- (B) Carbonic-anhydrase inhibition describes acetazolamide.
- (D) Aldosterone-receptor block describes spironolactone.

**Final Answer:** NKCC2 inhibition in the loop of Henle $\Rightarrow$ C

**Answer: (C)** Go Back to Q56

## Q57.

**Solution**

**Concept — Statins:** They competitively inhibit HMG-CoA reductase, the rate-limiting enzyme of cholesterol synthesis. **Reasoning:** Reduced hepatic cholesterol synthesis upregulates LDL receptors on hepatocytes, increasing clearance of

circulating LDL and lowering plasma LDL cholesterol. This is the principal lipid-lowering effect of atorvastatin. **Why the other options are wrong:**

- (A) Bile-acid binding describes resins (cholestyramine).
- (C) PPAR-$\alpha$ activation describes the fibrates.
- (D) NPC1L1 inhibition describes ezetimibe.

**Final Answer:** HMG-CoA reductase inhibition upregulating LDL receptors $\Rightarrow$ B

**Answer: (B)** Go Back to Q57

## Q58.

### Solution

**Concept — P2Y$_{12}$ antiplatelet agents:** Thienopyridines block the platelet ADP receptor. **Reasoning:** Clopidogrel (a prodrug activated by CYP enzymes) irreversibly blocks the P2Y$_{12}$ ADP receptor, preventing ADP-induced activation of the GP IIb/IIIa complex and platelet aggregation. This is mechanistically distinct from aspirin's COX inhibition. **Why the other options are wrong:**

- (A) Irreversible COX acetylation describes aspirin.
- (B) GP IIb/IIIa blockade describes abciximab/tirofiban.
- (C) Direct thrombin inhibition describes dabigatran.

**Final Answer:** Irreversible P2Y$_{12}$ ADP-receptor blockade $\Rightarrow$ D

**Answer: (D)** Go Back to Q58

## Q59.

### Solution

**Concept — Leukotriene receptor antagonists:** Montelukast blocks the CysLT$_1$ receptor. **Reasoning:** Cysteinyl leukotrienes (LTC$_4$, LTD$_4$, LTE$_4$) cause bronchoconstriction, mucus secretion and airway oedema. By antagonising the CysLT$_1$ receptor, montelukast blunts these effects, providing add-on control in chronic and exercise-induced asthma. **Why the other options are wrong:**

- (B) 5-lipoxygenase inhibition describes zileuton.
- (C) It is not a $\beta_2$-agonist.
- (D) It is not a PDE-4 inhibitor (that is roflumilast).

**Final Answer:** CysLT$_1$ receptor antagonism $\Rightarrow$ A

**Answer: (A)** Go Back to Q59

## Q60.

### Solution

**Concept — Selective COX-2 inhibitors:** Coxibs spare the constitutive, gastroprotective COX-1 isoform. **Reasoning:** Celecoxib selectively inhibits inducible COX-2 (responsible for inflammatory prostaglandins) while largely sparing COX-1, which maintains gastric mucosal prostaglandins. This reduces gastrointestinal ulceration relative to non-selective NSAIDs, at the cost of a relatively higher cardiovascular risk. **Why the other options are wrong:**

- (A) Irreversible acetylation of both COX isoforms describes aspirin.
- (B) It is not a leukotriene antagonist.
- (D) It does not act on lipoxygenase.

**Final Answer:** Selective COX-2 inhibition sparing COX-1 $\Rightarrow$ C

**Answer: (C)** Go Back to Q60

## Q61.

### Solution

**Concept — 5-HT$_3$ antagonist antiemetics:** The "setrons" block serotonin 5-HT$_3$ receptors. **Reasoning:** Cytotoxic drugs release serotonin from gut enterochromaffin cells, which activates 5-HT$_3$ receptors on vagal afferents and in the chemoreceptor trigger zone. Ondansetron blocks these receptors, preventing the emetic signal, making it highly effective against chemotherapy-induced nausea. **Why the other options are wrong:**

- (A) $D_2$ blockade in the CTZ describes metoclopramide/prochlorperazine.
- (C) It is not a prokinetic.
- (D) $H_1$ blockade for motion sickness describes the antihistamines.

**Final Answer:** 5-HT$_3$ receptor antagonism $\Rightarrow$ B

**Answer: (B)** Go Back to Q61

## Q62.

**Solution**

**Concept — Glucocorticoid mechanism:** Glucocorticoids act through cytosolic receptors that regulate gene transcription. **Reasoning:** Dexamethasone binds the intracellular glucocorticoid receptor; the complex enters the nucleus, induces anti-inflammatory proteins such as annexin-1 (lipocortin) and represses pro-inflammatory cytokine genes. Lipocortin inhibits phospholipase $A_2$, reducing release of arachidonic acid and so both prostaglandins and leukotrienes. **Why the other options are wrong:**

- (A) It does not directly block the COX-2 active site.
- (B) It is not an $H_1$ antagonist.
- (C) Mast-cell stabilisation alone does not explain its broad action.

**Final Answer:** Genomic action via annexin-1, reduced $PLA_2 \Rightarrow \boxed{D}$

**Answer: (D)** Go Back to Q62

## Q63.

**Solution**

**Concept — Macrolides:** They bind the 50S ribosomal subunit and block protein synthesis. **Reasoning:** Azithromycin binds the 23S rRNA of the 50S subunit and blocks translocation of the peptidyl-tRNA, inhibiting bacterial protein synthesis (bacteriostatic). Its long tissue half-life allows short, once-daily courses. **Why the other options are wrong:**

- (B) 30S binding with misreading describes aminoglycosides.
- (C) DNA gyrase inhibition describes fluoroquinolones.
- (D) Dihydropteroate synthase inhibition describes sulfonamides.

**Final Answer:** 50S subunit binding blocking translocation $\Rightarrow \boxed{A}$

**Answer: (A)** Go Back to Q63

## Q64.

**Solution**

**Concept — Azole antifungals:** They inhibit fungal ergosterol synthesis. **Reasoning:** Fluconazole inhibits the fungal cytochrome-P450 enzyme lanosterol 14-$\alpha$-demethylase, blocking conversion of lanosterol to ergosterol. The resulting depletion of ergosterol and accumulation of toxic sterols disrupt the fungal membrane, giving a fungistatic effect against Candida. **Why the other options are wrong:**

- (A) $\beta$-glucan synthesis inhibition describes the echinocandins.
- (C) It does not inhibit fungal RNA polymerase.
- (D) Microtubule disruption describes griseofulvin.

**Final Answer:** 14-$\alpha$-demethylase inhibition blocking ergosterol $\Rightarrow$ B

**Answer: (B)** Go Back to Q64

## Q65.

**Solution**

**Concept — 5-Fluorouracil:** It is a pyrimidine antimetabolite that targets thymidylate synthase. **Reasoning:** Its active metabolite FdUMP forms a stable ternary complex with thymidylate synthase and the cofactor methylene-tetrahydrofolate, inhibiting the enzyme. The resulting fall in dTMP starves cells of thymidine for DNA synthesis ("thymineless death"). **Why the other options are wrong:**

- (A) DNA cross-linking describes alkylating agents (e.g. cyclophosphamide).
- (B) Intercalation/topoisomerase-II inhibition describes doxorubicin.
- (C) Microtubule stabilisation describes the taxanes.

**Final Answer:** Thymidylate synthase inhibition $\Rightarrow$ D

**Answer: (D)** Go Back to Q65

## Q66.

**Solution**

**Concept — Nucleoside reverse-transcriptase inhibitors:** After phosphorylation they act as chain terminators. **Reasoning:** Zidovudine is phosphorylated intracellularly to its triphosphate, which the viral reverse transcriptase incorporates into the growing DNA chain; lacking a 3′-OH, it prevents further chain elongation,

blocking conversion of viral RNA to DNA. **Why the other options are wrong:**

- (A) Protease inhibition describes ritonavir/lopinavir.
- (B) CCR5 antagonism describes maraviroc.
- (D) Integrase inhibition describes raltegravir/dolutegravir.

**Final Answer:** Chain-terminating reverse-transcriptase inhibition $\Rightarrow$ C

**Answer: (C)** Go Back to Q66

## Q67.

### Solution

**Concept — Sulfonylureas:** They are insulin secretagogues acting on the $\beta$-cell $K_{ATP}$ channel. **Reasoning:** Glimepiride binds the SUR1 subunit and closes ATP-sensitive potassium channels, depolarising the $\beta$-cell, opening voltage-gated calcium channels and triggering insulin exocytosis. Because the effect needs functioning $\beta$-cells, sulfonylureas can cause hypoglycaemia. **Why the other options are wrong:**

- (B) AMP-kinase activation and reduced gluconeogenesis describe metformin.
- (C) $\alpha$-glucosidase inhibition describes acarbose.
- (D) Glucagon-receptor antagonism is not its mechanism.

**Final Answer:** Closes $\beta$-cell $K_{ATP}$ channels, stimulating insulin release $\Rightarrow$ A

**Answer: (A)** Go Back to Q67

## Q68.

### Solution

**Concept — Chelation therapy:** The correct chelator must match the metal it binds for renal excretion. **Reasoning:** Lead poisoning is treated with calcium disodium EDTA, often with dimercaprol (BAL) in severe cases, and oral succimer (DMSA) for milder/chronic exposure; these agents chelate lead into a water-soluble complex that is excreted in urine. Option (B) is correct. **Why the other options are wrong:**

- (A) Acute iron poisoning uses deferoxamine, not dimercaprol.
- (C) Cyanide poisoning uses hydroxocobalamin or sodium thiosulfate/nitrite, not deferoxamine.

- (D) Methanol poisoning uses fomepizole (or ethanol), not penicillamine.

**Final Answer:** Lead $\rightarrow$ calcium disodium EDTA / DMSA $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q68

## Q69.

### Solution

**Concept — E2 stereoelectronics:** Bimolecular elimination requires the C–H and C–X bonds to be coplanar so the developing $\pi$ bond overlaps continuously. **Reasoning:** The lowest-energy and kinetically favoured arrangement places the leaving group and the $\beta$-hydrogen anti to one another (dihedral 180°, anti-periplanar). This staggered geometry both avoids eclipsing strain and gives ideal orbital overlap, maximising the E2 rate. **Why the other options are wrong:**

- (A) Syn-periplanar (0°) elimination is possible but far less favourable (eclipsed, poor for most acyclic cases).
- (B) Gauche (60°) does not place the bonds coplanar.
- (D) A 120° eclipsed relationship gives no proper antiperiplanar overlap.

**Final Answer:** Anti-periplanar (180°) $\Rightarrow$ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q69

## Q70.

### Solution

**Concept — $S_N1$ kinetics:** A unimolecular substitution is first order, depending only on the substrate concentration. **Reasoning:** The slow, rate-determining step is heterolytic ionisation of the C–Br bond to give the stable tertiary *tert*-butyl carbocation; the nucleophile (water) is not involved until the fast second step, so its concentration does not appear in the rate law. **Why the other options are wrong:**

- (B) Backside attack is the $S_N2$ picture, which would be second order.
- (C) Proton transfer is fast and not rate-limiting.
- (D) A single concerted step describes $S_N2$, not $S_N1$.

**Final Answer:** Ionisation to the *tert*-butyl cation $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q70

## Q71.

**Solution**

**Concept — Friedel–Crafts acylation:** An acyl halide with a Lewis acid generates an acylium ion that acylates an arene. **Reasoning:** $AlCl_3$ abstracts chloride from acetyl chloride to give $CH_3CO^+$, which substitutes onto benzene to give acetophenone ($C_6H_5COCH_3$). Acylation (unlike alkylation) does not rearrange and stops cleanly at mono-substitution. **Why the other options are wrong:**

- (A) Alkylation needs an alkyl halide, not an acyl chloride.
- (B) $AlCl_3$ does not promote nucleophilic substitution on benzene.
- (C) Sulfonation requires fuming $H_2SO_4/SO_3$.

**Final Answer:** Friedel–Crafts acylation giving acetophenone $\Rightarrow$ D

**Answer: (D)** Go Back to Q71

## Q72.

**Solution**

**Concept — Beckmann rearrangement:** An acid converts a ketoxime into a substituted amide via an anti-migration of the group trans to the leaving –OH. **Reasoning:** Protonation of the oxime –OH, loss of water and concerted 1,2-migration give a nitrilium ion that is hydrated to the amide. (Industrially, cyclohexanone oxime $\rightarrow$ caprolactam.) **Why the other options are wrong:**

- (A) Hofmann rearrangement converts an amide (not an oxime) to an amine with one fewer carbon.
- (C) Claisen rearrangement is a [3,3]-sigmatropic shift of allyl vinyl ethers.
- (D) Pinacol rearrangement involves 1,2-diols, not oximes.

**Final Answer:** Beckmann rearrangement $\Rightarrow$ B

**Answer: (B)** Go Back to Q72

## Q73.

**Solution**

**Concept — Wittig olefination:** A phosphorus ylide condenses with a carbonyl to form an alkene. **Reasoning:** The ylide carbon attacks the carbonyl carbon to give a betaine/oxaphosphetane, which collapses to the alkene and triphenylphosphine

oxide ($Ph_3P{=}O$). It builds a C=C bond at a defined position. **Why the other options are wrong:**

- (A) Reformatsky uses a zinc enolate of an $\alpha$-halo ester, giving a $\beta$-hydroxy ester.
- (B) Grignard adds to a carbonyl giving an alcohol, not an alkene.
- (D) Cannizzaro is base disproportionation of non-enolisable aldehydes.

**Final Answer:** Wittig reaction $\Rightarrow$ C

**Answer: (C)** Go Back to Q73

## Q74.

### Solution

**Concept — E/Z (CIP for alkenes):** On each double-bond carbon rank the two substituents; if the higher-priority groups are on the same side it is *Z*, on opposite sides it is *E*. **Reasoning:** On the left carbon Cl (Z=17) > H; on the right carbon Br (Z=35) > $CH_3$. The figure shows both higher-priority groups (Cl and Br) on the same (upper) side, so the alkene is *Z* (zusammen). **Why the other options are wrong:**

- (B) *E* would need Cl and Br on opposite sides.
- (C) The alkene shows geometric isomerism; this is not about being achiral.
- (D) There is no $sp^3$ stereocentre, so no optical isomerism here.

**Final Answer:** *Z* configuration $\Rightarrow$ A

**Answer: (A)** Go Back to Q74

## Q75.

### Solution

**Concept — Aromatic cations (Hückel):** A planar, fully conjugated cyclic ion is aromatic with $(4n + 2)$ $\pi$ electrons. **Reasoning:** Tropylium ($C_7H_7^+$) is a seven-membered planar ring with three double bonds and an empty p-orbital on the cationic carbon, giving 6 delocalised $\pi$ electrons ($n = 1$). This satisfies Hückel's rule, explaining its remarkable stability. **Why the other options are wrong:**

- (A) 4 $\pi$ electrons would be antiaromatic; tropylium has 6.
- (B) It has 6, not 8, $\pi$ electrons.

- (C) The ring is fully conjugated, not non-conjugated.

**Final Answer:** 6 $\pi$ electrons, aromatic $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q75

## Q76.

### Solution

**Concept — Amine basicity:** Basicity reflects availability of the nitrogen lone pair; alkyl groups donate electron density (raise basicity) while aryl conjugation lowers it. **Reasoning:** In aniline the lone pair is delocalised into the benzene ring (least basic). Ammonia is intermediate. Ethylamine has an electron-donating ethyl group, so it is the most basic. Increasing order: aniline $<$ ammonia $<$ ethylamine, i.e. (i) $<$ (ii) $<$ (iii). **Why the other options are wrong:**

- (A) Reverses the order; aniline is the weakest base.
- (C) Places aniline as most basic, which is wrong.
- (D) They differ markedly in basicity.

**Final Answer:** (i) $<$ (ii) $<$ (iii) $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q76

## Q77.

### Solution

**Concept — Reformatsky reaction:** An $\alpha$-halo ester plus zinc forms a stable organozinc enolate that adds to carbonyls. **Reasoning:** The zinc enolate (less reactive than a Grignard, so it tolerates the ester) attacks the aldehyde/ketone; aqueous work-up gives a $\beta$-hydroxy ester. The mild organozinc avoids self-condensation of the ester. **Why the other options are wrong:**

- (A) Diels–Alder is a diene/dienophile cycloaddition.
- (B) Aldol uses an enol/enolate of an aldehyde or ketone, not an organozinc.
- (C) Claisen condenses two esters to a $\beta$-keto ester.

**Final Answer:** Reformatsky reaction $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q77

## Q78.

**Solution**

**Concept — EAS intermediate:** Addition of $E^+$ to an arene first gives a non-aromatic cationic intermediate. **Reasoning:** The positive charge is delocalised over the ortho/para carbons of the ring; this resonance-stabilised cation is the arenium ion (also called the $\sigma$-complex or Wheland intermediate). Loss of $H^+$ then restores aromaticity. **Why the other options are wrong:**

- (B) A carbanion is electron-rich and negative, the opposite of this cation.
- (C) No unpaired electron is generated; it is not a radical.
- (D) Benzyne is a strained alkyne intermediate of a different (elimination–addition) pathway.

**Final Answer:** Arenium ($\sigma$-complex/Wheland) ion $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q78

## Q79.

**Solution**

**Concept — Claisen condensation:** Base deprotonates the $\alpha$-carbon of an ester; the enolate attacks a second ester carbonyl, expelling alkoxide. **Reasoning:** Two ethyl acetate molecules give ethyl acetoacetate ($CH_3COCH_2COOC_2H_5$), a $\beta$-keto ester, with ethoxide as the leaving group. The driving force is deprotonation of the acidic product by base. **Why the other options are wrong:**

- (A) Aldol joins aldehydes/ketones, not esters, giving a $\beta$-hydroxy carbonyl.
- (C) Cannizzaro needs a non-enolisable aldehyde.
- (D) Perkin uses an aromatic aldehyde with an anhydride.

**Final Answer:** Claisen condensation $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q79

## Q80.

**Solution**

**Concept — Counting stereoisomers:** With $n$ non-equivalent stereocentres and no symmetry, the number of stereoisomers is $2^n$. **Reasoning:** For $n = 2$, $2^2 = 4$ stereoisomers. They form two pairs of enantiomers; isomers that are not mirror

images of one another are diastereomers. **Why the other options are wrong:**

- (A) Two would apply to a single stereocentre.
- (B) Three arises only when an internal symmetry (a meso form) reduces the count.
- (D) Eight ($2^3$) needs three stereocentres.

**Final Answer:** 4 stereoisomers $\Rightarrow$ C

**Answer: (C)** Go Back to Q80

## Q81.

### Solution

**Concept — Carbocation rearrangement:** A carbocation can rearrange to a more stable one by migration of an adjacent H or alkyl group with its bonding pair. **Reasoning:** A hydride on the carbon next to a secondary cation migrates (a 1,2-hydride shift), moving the positive charge to a carbon that becomes tertiary and is more stabilised by hyperconjugation and +I effects. **Why the other options are wrong:**

- (A) Markovnikov describes regiochemistry of HX addition, not the shift itself.
- (B) Nucleophilic acyl substitution involves acyl carbonyls, not this.
- (C) No radicals are produced in this ionic process.

**Final Answer:** 1,2-hydride shift (rearrangement) $\Rightarrow$ D

**Answer: (D)** Go Back to Q81

## Q82.

### Solution

**Concept — Diels–Alder electronic demand:** A normal-demand reaction is fastest with an electron-rich diene and an electron-poor dienophile. **Reasoning:** An electron-withdrawing group such as –CHO lowers the dienophile LUMO, improving overlap with the diene HOMO and accelerating the [4+2] cycloaddition. Hence –CHO makes the dienophile the most reactive. **Why the other options are wrong:**

- (B), (C), (D) $-CH_3$, $-OCH_3$ and $-N(CH_3)_2$ are electron donors; they raise the LUMO and slow a normal-demand reaction.

**Final Answer:** –CHO (electron-withdrawing) $\Rightarrow$ A

**Answer: (A)** Go Back to Q82

## Q83.

### Solution

**Concept — Aldol condensation:** An enolate from an aldehyde/ketone with $\alpha$-hydrogens adds to another carbonyl, then dehydrates on heating. **Reasoning:** Acetaldehyde has $\alpha$-hydrogens; base forms its enolate, which adds to a second acetaldehyde to give 3-hydroxybutanal (the aldol), and heating eliminates water to give but-2-enal (an $\alpha,\beta$-unsaturated aldehyde). **Why the other options are wrong:**

- (A) Cannizzaro requires a non-enolisable aldehyde.
- (C) Wittig needs a phosphorus ylide.
- (D) Hofmann elimination is an amine-based elimination, unrelated.

**Final Answer:** Aldol condensation $\Rightarrow$ B

**Answer: (B)** Go Back to Q83

## Q84.

### Solution

**Concept — Classical bioisosterism:** Replacing an atom/group with another of similar valence and size (e.g. H by F) while keeping activity. **Reasoning:** Fluorine has a van der Waals radius close to hydrogen but high electronegativity and a strong C–F bond. The H$\rightarrow$F swap in 5-fluorouracil blocks thymidylate synthase, exploiting near-isosteric steric demand with altered reactivity. This is classical (monovalent) bioisosterism. **Why the other options are wrong:**

- (A) No latent inactive group is unmasked, so it is not a prodrug.
- (B) The ring size is unchanged; no expansion occurs.
- (D) Racemic switching concerns enantiomers, not atom replacement.

**Final Answer:** Classical (monovalent) bioisosterism $\Rightarrow$ C

**Answer: (C)** Go Back to Q84

## Q85.

**Solution**

**Concept — Barbiturate chemistry:** Barbiturates are 5,5-disubstituted derivatives of barbituric acid. **Reasoning:** Condensing a substituted malonic ester with urea gives the barbituric acid (pyrimidine-2,4,6-trione) ring. Phenobarbital (5-ethyl-5-phenyl) and thiopental (a 2-thiobarbiturate) are built on this nucleus. **Why the other options are wrong:**

- (A) Imidazole is a five-membered diazole, not the barbiturate ring.
- (B) The phenothiazine tricycle belongs to antipsychotics.
- (C) The 1,4-benzodiazepine ring is the benzodiazepine scaffold.

**Final Answer:** Barbituric acid (pyrimidine-2,4,6-trione) ring $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q85

## Q86.

**Solution**

**Concept — Phenothiazine SAR:** Antipsychotic potency depends on the length of the chain between the ring N10 and the terminal basic nitrogen. **Reasoning:** A three-carbon (propyl) bridge gives the geometry that best fits the dopamine $D_2$ receptor; chlorpromazine has this optimal three-carbon spacer. Shorter chains (as in some antihistaminic phenothiazines) reduce antipsychotic activity. **Why the other options are wrong:**

- (B), (C) One- or two-carbon chains favour antihistaminic rather than antipsychotic action.
- (D) A six-carbon chain is far longer than the optimal spacing and lowers activity.

**Final Answer:** A three-carbon chain $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q86

## Q87.

**Solution**

**Concept — Ester prodrugs for absorption:** Masking a polar group as a lipophilic ester improves passive membrane permeation, then esterases release the active drug. **Reasoning:** Ampicillin is polar and incompletely absorbed orally. Bacampicillin is a lipophilic ester that is absorbed better and then hydrolysed by gut/plasma esterases to liberate active ampicillin, raising bioavailability. **Why the other options are wrong:**

- (A) The aim is improved delivery, not increased toxicity.
- (C) It is designed for oral, not injection-only, activation.
- (D) The therapeutic class (penicillin antibiotic) is unchanged.

**Final Answer:** To improve oral absorption/bioavailability $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q87

## Q88.

**Solution**

**Concept — Hammett $\rho$:** The reaction constant $\rho$ measures how sensitive a reaction is to substituent electronics; its sign reveals the charge built in the transition state. **Reasoning:** A positive $\rho$ means the reaction is accelerated by electron-withdrawing substituents (positive $\sigma$). This is the case when negative charge develops at or near the reaction centre in the rate-determining step, which EWGs stabilise. **Why the other options are wrong:**

- (A) $\rho \approx 0$ would mean insensitivity, not a positive value.
- (B) Favoured by electron donors corresponds to a *negative* $\rho$.
- (D) Lipophilicity is a Hansch term, not the Hammett $\rho$.

**Final Answer:** Favoured by electron-withdrawing groups (negative charge develops) $\Rightarrow$ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q88

## Q89.

**Solution**

**Concept — Phase I reactions:** Phase I includes oxidation, reduction and hydrolysis; reductions add electrons/hydrogen. **Reasoning:** Reduction of an aromatic nitro group (–$NO_2$) to an amine (–$NH_2$) is a classic Phase I reductive reaction (e.g. chloramphenicol, nitrazepam), often carried out by gut flora and hepatic reductases. **Why the other options are wrong:**

- (A) Aromatic hydroxylation is an oxidation.
- (B) O-dealkylation is an oxidative (CYP450) reaction.
- (C) Sulfoxidation is an oxidation.

**Final Answer:** Nitro reduction to an amine $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q89

## Q90.

**Solution**

**Concept — Ionisation of local anaesthetics:** As weak bases, they partition between an un-ionised free base and a protonated cation depending on pH and $pK_a$. **Reasoning:** The lipophilic, un-ionised free base diffuses across the nerve membrane. Once inside the more acidic axoplasm, it is re-protonated; the ionised cation is the active form that binds the inner pore of the voltage-gated sodium channel and blocks conduction. **Why the other options are wrong:**

- (A) Reverses the two forms; the cation cannot easily cross the membrane.
- (B) The charged cation does not readily cross the lipid membrane.
- (C) The neutral free base is a poor channel blocker.

**Final Answer:** Free base crosses; cation blocks the $Na^+$ channel $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q90

## Q91.

**Solution**

**Concept — Eudismic ratio:** The potency ratio of the more active enantiomer (eutomer) to the less active one (distomer). **Reasoning:** For propranolol the (*S*)-form is the eutomer and the (*R*)-form the distomer; their activity ratio ($\approx 100$) is

the eudismic ratio, a measure of how stereoselective the target is. **Why the other options are wrong:**

- (B) The partition coefficient ($\log P$) measures lipophilicity.
- (C) The therapeutic index relates toxic to effective dose, not enantiomer potency.
- (D) The Hammett constant is an electronic substituent parameter.

**Final Answer:** Eudismic ratio $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q91

## Q92.

### Solution

**Concept — $\beta$-lactam reactivity:** In an ordinary amide, nitrogen lone-pair donation into the carbonyl gives resonance stabilisation and low reactivity. **Reasoning:** The strained, near-planar four-membered $\beta$-lactam forces the nitrogen out of ideal overlap, so the usual amide resonance is largely lost. The carbonyl therefore stays electrophilic, and ring strain is relieved on opening, making it react readily with the serine of penicillin-binding proteins (and with $\beta$-lactamases). **Why the other options are wrong:**

- (A) The carbonyl is not aromatic and is far from stable.
- (C) The very point is that nitrogen does *not* donate effectively into the carbonyl.
- (D) Sulfur does not render the ring inert; the ring is highly reactive.

**Final Answer:** Ring strain prevents amide resonance, leaving the carbonyl electrophilic $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q92

## Q93.

### Solution

**Concept — Benzodiazepine scaffold:** A benzene ring fused to a seven-membered ring bearing two nitrogens at the 1 and 4 positions. **Reasoning:** The figure shows exactly this fusion, the 1,4-benzodiazepine ring system that defines diazepam, lorazepam and alprazolam. It potentiates $GABA_A$ chloride currents. **Why the other options are wrong:**

- (A) Barbituric acid is a six-membered pyrimidinetrione, not fused to benzene.
- (B) Phenothiazine is a tricyclic system with sulfur and nitrogen.
- (D) The $\beta$-lactam is a strained four-membered ring.

**Final Answer:** 1,4-benzodiazepine ring system $\Rightarrow$ C

**Answer: (C)** Go Back to Q93

## Q94.

### Solution

**Concept — Henderson–Hasselbalch (acid):** $\text{pH} = \text{pK}_a + \log \dfrac{[\text{ionised}]}{[\text{un-ionised}]}$ for a weak acid. **Reasoning:** $\text{pH} - \text{pK}_a = 7.4 - 4.4 = 3$, so $\log([\text{A}^-]/[\text{HA}]) = 3$, giving a ratio of $10^3 = 1000$ ionised to 1 un-ionised. The acid is almost completely ionised at plasma pH. **Why the other options are wrong:**

- (A) A 1:1 ratio occurs only when $\text{pH} = \text{pK}_a$.
- (B) 1:1000 (mostly un-ionised) would need pH well below $\text{pK}_a$.
- (C) 3:1 misreads the logarithm as a simple difference.

**Final Answer:** About 1000 : 1 (mostly ionised) $\Rightarrow$ D

**Answer: (D)** Go Back to Q94

## Q95.

### Solution

**Concept — Radio-opaque contrast media:** A high atomic-number, insoluble, non-absorbed solid scatters X-rays to outline the GI tract. **Reasoning:** Barium sulfate ($BaSO_4$) is essentially insoluble (so the toxic $Ba^{2+}$ is not absorbed) and the heavy barium atoms are strongly X-ray opaque, making it the standard oral/rectal GI contrast agent. **Why the other options are wrong:**

- (A) Sodium chloride solution is radiolucent.
- (B) Calcium carbonate is used as an antacid/calcium source, not as a GI contrast.
- (C) Magnesium trisilicate is an antacid/adsorbent.

**Final Answer:** Barium sulfate $\Rightarrow$ D

**Answer: (D)** Go Back to Q95

## Q96.

### Solution

**Concept — Reaction profiles:** A concerted reaction has one transition state and no intermediate; a stepwise reaction shows an intermediate (energy minimum) between two transition states. **Reasoning:** The diagram shows two energy maxima with a well in between, that is, a discrete carbocation intermediate. This stepwise picture (ionisation then nucleophilic capture) is the hallmark of the $S_N1$ mechanism. **Why the other options are wrong:**

- (B) $S_N2$ is concerted with a single transition state and no intermediate.
- (C) A pericyclic reaction is concerted, also without an intermediate.
- (D) A radical chain involves radical intermediates and a different profile.

**Final Answer:** $S_N1$ (stepwise via a carbocation) $\Rightarrow$ A

**Answer: (A)** Go Back to Q96

## Q97.

### Solution

**Concept — Adrenergic SAR:** The size of the amine N-substituent steers selectivity between $\alpha$- and $\beta$-adrenoceptors. **Reasoning:** Bulky N-substituents (isopropyl, *tert*-butyl) favour $\beta$-adrenergic binding; a *tert*-butyl group (as in salbutamol/terbutaline-type agents) confers $\beta_2$ selectivity over $\alpha$. Primary amines (noradrenaline) retain strong $\alpha$ activity. **Why the other options are wrong:**

- (A) Bulky N-substitution decreases, not increases, $\alpha$ selectivity.
- (C) Activity is retained (shifted toward $\beta_2$), not abolished.
- (D) It does not produce anticholinergic activity.

**Final Answer:** Increases $\beta$ ($\beta_2$) selectivity over $\alpha$ $\Rightarrow$ B

**Answer: (B)** Go Back to Q97

## Q98.

**Solution**

**Concept — Electron-rich aromatic heterocycles:** When the heteroatom contributes a lone pair to the aromatic sextet, the ring becomes $\pi$-excessive and very reactive to electrophiles. **Reasoning:** An oxygen heteroatom donating a lone pair into a planar five-membered aromatic ring (6 $\pi$ electrons) defines furan. It is electron-rich and undergoes electrophilic substitution preferentially at C2. **Why the other options are wrong:**

- (A) Pyridine is a six-membered $\pi$-deficient ring with nitrogen.
- (B) Benzene has no heteroatom.
- (D) Piperidine is a saturated, non-aromatic ring.

**Final Answer:** Furan $\Rightarrow$ C

**Answer: (C)** Go Back to Q98

## Q99.

**Solution**

**Concept — Reading a Beer–Lambert calibration line:** the line $A = 0.40\,c$ lets one convert a measured absorbance into concentration by rearrangement. **Reasoning:** With $A = 0.60$ and slope $0.40$ ($\mu$g mL$^{-1}$)$^{-1}$, the concentration is $c = A/0.40 = 0.60/0.40 = 1.5$ $\mu$g mL$^{-1}$. **Why the other options are wrong:**

- (A) 0.24 multiplies $0.60 \times 0.40$ instead of dividing.
- (B) 0.67 inverts the absorbance and slope incorrectly.
- (D) 2.4 divides by 0.25 rather than 0.40.

**Final Answer:** $c = 0.60/0.40 = 1.5$ $\mu$g mL$^{-1}$ $\Rightarrow$ C

**Answer: (C)** Go Back to Q99

## Q100.

**Solution**

**Concept — Non-aqueous titration of weak acids:** weak acids are titrated in an aprotic/basic solvent with a strong base titrant. **Reasoning:** A weakly acidic drug dissolved in dimethylformamide is titrated with sodium methoxide (in methanol–benzene), with thymol blue as indicator. The basic solvent enhances the acidity,

giving a sharp end point. **Why the other options are wrong:**

- (A) Perchloric acid in glacial acetic acid titrates weak *bases*, not acids.
- (C) Aqueous HCl is for base titration and is too weak an approach for weak acids.
- (D) Iodine is a redox titrant, irrelevant to acid–base assay.

**Final Answer:** Sodium methoxide in methanol–benzene $\Rightarrow$ B

**Answer: (B)** Go Back to Q100

## Q101.

### Solution

**Concept — Karl Fischer titration:** a specific iodine-based reaction in which iodine is consumed only in the presence of water. **Reasoning:** The Karl Fischer reagent (iodine, sulphur dioxide, a base, and methanol) reacts stoichiometrically with water, so the method is the standard pharmacopoeial determination of moisture (water) content in drug substances. **Why the other options are wrong:**

- (A) Ash value is found by incineration, not titration.
- (B) Free acidity is an acid–base, not a Karl Fischer, determination.
- (D) Heavy metals are tested by limit/colour or instrumental methods.

**Final Answer:** Water (moisture) content $\Rightarrow$ C

**Answer: (C)** Go Back to Q101

## Q102.

### Solution

**Concept — Back (residual) titration:** a measured excess of reagent is added, and the leftover is titrated with a second standard. **Reasoning:** Adding excess EDTA to the metal ion and then titrating the unreacted EDTA with standard zinc solution is a classic back-titration; it is used when the direct end point is poor or the reaction is slow. **Why the other options are wrong:**

- (A) A direct titration would add EDTA straight to the end point, with no excess.
- (B) Displacement titration liberates one metal from a complex, which is not described here.

- (C) Masking only blocks an interfering ion; it is not a titration mode.

**Final Answer:** Excess EDTA, leftover titrated back ⇒ back titration ⇒ D

**Answer: (D)** Go Back to Q102

## Q103.

### Solution

**Concept — IR group frequencies:** a broad band near 3200–3550 $cm^{-1}$ signals O–H (or N–H) stretching with hydrogen bonding. **Reasoning:** A broad, intense absorption centred about 3350 $cm^{-1}$ is the textbook hydrogen-bonded O–H stretch of an alcohol; the broadening arises from a distribution of hydrogen-bond strengths. **Why the other options are wrong:**

- (A) C≡N stretch is a sharp band near 2210–2260 $cm^{-1}$.
- (B) Ester C=O stretch is a strong band near 1735 $cm^{-1}$.
- (C) C–Cl stretch appears low, around 600–800 $cm^{-1}$.

**Final Answer:** Broad 3350 $cm^{-1}$ ⇒ hydrogen-bonded O–H ⇒ D

**Answer: (D)** Go Back to Q103

## Q104.

### Solution

**Concept — Cerimetry indicators:** $Ce^{4+}/Ce^{3+}$ is a strong redox couple requiring a redox indicator. **Reasoning:** Ferroin (the iron(II)–1,10-phenanthroline complex) is the standard redox indicator for cerimetric titrations, changing from red (reduced) to pale blue (oxidised) at the end point. **Why the other options are wrong:**

- (B) Starch is specific to iodine titrations.
- (C) Potassium chromate is the Mohr argentometric indicator.
- (D) Eriochrome Black T is a complexometric metal indicator.

**Final Answer:** Ferroin ⇒ A

**Answer: (A)** Go Back to Q104

## Q105.

**Solution**

**Concept — Resolution calculation:** $R_s = \dfrac{2(t_{R2} - t_{R1})}{w_1 + w_2}$. **Reasoning:** Substituting, $R_s = \dfrac{2(5.0 - 4.0)}{0.8 + 1.2} = \dfrac{2(1.0)}{2.0} = \dfrac{2.0}{2.0} = 1.0$. A value of 1.0 indicates partial (not yet baseline) separation. **Why the other options are wrong:**

- (A) 0.50 omits the factor of 2 in the numerator.
- (C) 1.5 would need a width sum of about 1.33, not 2.0.
- (D) 2.0 forgets to divide by the width sum.

**Final Answer:** $R_s = 2(1.0)/2.0 = 1.0 \Rightarrow$ B

**Answer: (B)** Go Back to Q105

## Q106.

**Solution**

**Concept — Size-exclusion chromatography:** separation by molecular size; large molecules cannot enter the pores. **Reasoning:** Large molecules are excluded from the gel pores, travel only through the interstitial volume, and therefore elute first; small molecules permeate the pores, take a longer path, and elute last. **Why the other options are wrong:**

- (A) Smallest molecules elute last, not first.
- (B) Charge governs ion-exchange, not size exclusion.
- (D) Hydrophobicity governs reverse-phase, not size exclusion.

**Final Answer:** Largest molecules elute first $\Rightarrow$ C

**Answer: (C)** Go Back to Q106

## Q107.

**Solution**

**Concept — Volhard method indicator:** excess $Ag^+$ is back-titrated with thiocyanate; the first excess $SCN^-$ reacts with $Fe^{3+}$. **Reasoning:** Ferric alum supplies $Fe^{3+}$; once all $Ag^+$ is consumed, the first slight excess of thiocyanate forms the red $[Fe(SCN)]^{2+}$ complex, marking the end point. **Why the other options are wrong:**

- (A) Potassium chromate is the Mohr (direct) indicator.
- (B) Fluorescein is a Fajans adsorption indicator.
- (C) Starch is for iodine titrations.

**Final Answer:** Ferric alum gives the red end point $\Rightarrow$ D

**Answer: (D)** Go Back to Q107

## Q108.

### Solution

**Concept — Deshielding in $^1$H NMR:** electronegative atoms withdraw electron density, reducing shielding and raising $\delta$. **Reasoning:** Electron withdrawal by chlorine deshields the $CHCl_3$ proton, shifting it downfield (to higher $\delta$, about 7.3 ppm) relative to the TMS reference at $\delta = 0$. **Why the other options are wrong:**

- (B) Upfield (shielded) is the opposite of deshielding.
- (C) Only TMS itself sits at $\delta = 0$.
- (D) Negative shifts are rare and not produced by electron withdrawal.

**Final Answer:** Deshielded protons appear downfield (higher $\delta$) $\Rightarrow$ A

**Answer: (A)** Go Back to Q108

## Q109.

### Solution

**Concept — Theoretical plates from half-height width:** $N = 5.54\,(t_R/w_{1/2})^2$. **Reasoning:** Here $t_R/w_{1/2} = 5.0/0.20 = 25$, so $(25)^2 = 625$ and $N = 5.54 \times 625 \approx 3460$ plates. **Why the other options are wrong:**

- (A) 1390 uses the wrong constant (about 16 with baseline width logic mismatched).
- (C) 138 takes $5.54 \times 25$ without squaring the ratio.
- (D) 25 is just the ratio $t_R/w_{1/2}$, not $N$.

**Final Answer:** $N = 5.54(25)^2 \approx 3460 \Rightarrow$ B

**Answer: (B)** Go Back to Q109

## Q110.

**Solution**

**Concept — Half-equivalence point of a weak acid:** the Henderson–Hasselbalch equation gives pH $= pK_a + \log([\text{A}^-]/[\text{HA}])$. **Reasoning:** At half-neutralisation, exactly half the weak acid has been converted to its conjugate base, so $[\text{A}^-] = [\text{HA}]$, the log term is zero, and pH $= pK_a$. Point H is where the curve is flattest (maximum buffering). **Why the other options are wrong:**

- (A) pH 7 applies only to the strong-acid–strong-base equivalence point, not here.
- (B) $pK_a + 1$ holds at a 10:1 base-to-acid ratio, not at half-equivalence.
- (D) $pK_w - pK_a$ is $pK_b$, unrelated to this pH.

**Final Answer:** At $\frac{1}{2}V_{eq}$, pH $= pK_a \Rightarrow$ C

**Answer: (C)** Go Back to Q110

## Q111.

**Solution**

**Concept — Nitrogen rule:** a neutral organic molecule with an odd-mass molecular ion contains an odd number of nitrogen atoms. **Reasoning:** Because nitrogen has an even mass (14) but an odd valence (3), each nitrogen makes the nominal molecular mass odd. Hence an odd-mass $\text{M}^{+\bullet}$ implies an odd number of nitrogens (1, 3, 5, ...). **Why the other options are wrong:**

- (A) No nitrogen gives an even molecular mass.
- (B) An even number of nitrogens also gives an even mass.
- (C) Oxygen-only molecules have even nominal masses.

**Final Answer:** Odd-mass $\text{M}^{+\bullet} \Rightarrow$ odd number of N atoms $\Rightarrow$ D

**Answer: (D)** Go Back to Q111

## Q112.

**Solution**

**Concept — AAS principle:** ground-state free atoms absorb radiation at their characteristic resonance wavelength. **Reasoning:** In AAS the sample is atomised, and a hollow-cathode lamp emits the element's resonance line. The ground-state atoms

absorb this radiation; the attenuation, governed by Beer's law, is proportional to the metal concentration. **Why the other options are wrong:**

- (A) Measuring emitted light is flame emission/atomic emission, not absorption.
- (B) Mass-to-charge measurement is mass spectrometry.
- (D) Measuring re-emitted fluorescence is atomic fluorescence spectroscopy.

**Final Answer:** Absorption of the resonance line by ground-state atoms $\Rightarrow$ C

**Answer: (C)** Go Back to Q112

## Q113.

### Solution

**Concept — Conductometric titration of strong acid with strong base:** ionic mobilities govern the conductance. **Reasoning:** Before the equivalence point, highly mobile $H^+$ ions are progressively neutralised and effectively replaced by less mobile $Na^+$ ions, so the conductance falls. After the equivalence point, excess NaOH adds mobile $OH^-$ and conductance rises again, giving a V-shaped plot. **Why the other options are wrong:**

- (B) Conductance does not increase before the equivalence point; it decreases.
- (C) It is not constant; the ionic make-up changes.
- (D) $Cl^-$ is a spectator and is not removed.

**Final Answer:** Conductance decreases as $H^+$ is replaced by $Na^+$ $\Rightarrow$ A

**Answer: (A)** Go Back to Q113

## Q114.

### Solution

**Concept — Choice of analytical wavelength:** assays are run at $\lambda_{max}$ for maximum sensitivity and minimum wavelength sensitivity. **Reasoning:** Band Y at 278 nm has the higher molar absorptivity, so it gives the largest, most sensitive signal; the peak is also flat ($dA/d\lambda \approx 0$), so small monochromator errors barely affect the reading, improving reproducibility. **Why the other options are wrong:**

- (A) The lowest absorbance would give the poorest sensitivity.

- (C) Transmittance is at a minimum, not a maximum, at an absorbance peak.
- (D) Molar absorptivity is maximal, not zero, at $\lambda_{max}$.

**Final Answer:** Higher absorptivity at $\lambda_{max}$ gives best sensitivity and reproducibility $\Rightarrow$ B

**Answer: (B)** Go Back to Q114

## Q115.

### Solution

**Concept — Ion-exchange chromatography:** separation by electrostatic affinity between charged analytes and oppositely charged resin groups. **Reasoning:** A cation-exchange resin carries fixed negative groups (e.g. sulphonate). Cationic analytes exchange onto these sites; those with greater cationic charge/affinity are retained longer, so separation depends on the analyte's charge and affinity for the resin. **Why the other options are wrong:**

- (A) Size governs size-exclusion chromatography.
- (B) Volatility/boiling point governs gas chromatography.
- (D) Refractive index is a detection property, not a separation basis.

**Final Answer:** Separation by cationic charge/affinity for the resin $\Rightarrow$ C

**Answer: (C)** Go Back to Q115

## Q116.

### Solution

**Concept — Fluorimetry vs UV absorption:** fluorescence is measured against a dark background, boosting sensitivity and selectivity. **Reasoning:** Because emitted light is measured against near-zero background and two wavelengths (excitation and emission) must match, fluorimetry is typically more sensitive and more selective than UV absorption, but it applies only to molecules that fluoresce (usually rigid, conjugated structures). **Why the other options are wrong:**

- (A) It is more, not less, sensitive, and not all compounds fluoresce.
- (B) It is not restricted to inorganic salts; many organic drugs fluoresce.
- (C) Fluorescence intensity does depend on the excitation wavelength.

**Final Answer:** More sensitive and selective, but limited to fluorescent molecules $\Rightarrow$ D

**Answer: (D)** Go Back to Q116

## Q117.

### Solution

**Concept — Iodimetry:** direct titration of a reducing analyte with standard iodine. **Reasoning:** Ascorbic acid is a reducing agent that is oxidised directly by standard iodine; the first slight excess of iodine turns the starch indicator blue-black, marking the end point. Direct titration with $I_2$ is iodimetry. **Why the other options are wrong:**

- (B) Iodometry is indirect, titrating iodine liberated from iodide.
- (C) Permanganometry uses $KMnO_4$, not iodine.
- (D) Argentometry is a silver precipitation titration.

**Final Answer:** Direct titration with iodine $\Rightarrow$ iodimetry $\Rightarrow$ $\boxed{A}$

**Answer: (A)** Go Back to Q117

## Q118.

### Solution

**Concept — HPLC flow path:** reservoir $\rightarrow$ pump $\rightarrow$ injector $\rightarrow$ column $\rightarrow$ detector. **Reasoning:** The component immediately after the column that converts the separated analytes into a measurable electrical signal is the detector (commonly a UV-Vis absorbance detector). It is the last unit in the flow path before the data system. **Why the other options are wrong:**

- (A) The reservoir is the first component, holding the mobile phase.
- (C) The pump precedes the injector, delivering pressurised flow.
- (D) The injector sits before the column, not after it.

**Final Answer:** Z is the detector $\Rightarrow$ $\boxed{B}$

**Answer: (B)** Go Back to Q118

## Q119.

**Solution**

**Concept — GC mobile phase:** the carrier gas must be chemically inert so it does not react with the sample or stationary phase. **Reasoning:** Gas chromatography uses an inert gas (commonly nitrogen, helium, or hydrogen) as the mobile phase to sweep volatilised analytes through the column. The gas only transports; it does not interact chemically. **Why the other options are wrong:**

- (A) Methanol is a liquid HPLC solvent, not a GC carrier.
- (B) Acetonitrile–water is a reverse-phase HPLC mobile phase.
- (D) Liquid $CO_2$ is the mobile phase in supercritical-fluid chromatography.

**Final Answer:** An inert gas ($N_2$, He, or $H_2$) $\Rightarrow$ C

**Answer: (C)** Go Back to Q119

## Q120.

**Solution**

**Concept — Standardisation of permanganate:** $KMnO_4$ is not a primary standard because it is hard to obtain pure and is slowly reduced by traces of organic matter and water. **Reasoning:** A freshly prepared $KMnO_4$ solution is standardised against a primary standard reductant, most commonly sodium oxalate (or oxalic acid), in warm acidic medium. The reaction $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ fixes its exact normality. **Why the other options are wrong:**

- (A) Sodium chloride standardises silver nitrate, not permanganate.
- (B) Potassium hydrogen phthalate standardises bases (acid–base titrations).
- (C) Silver nitrate is itself a titrant, not a standard for $KMnO_4$.

**Final Answer:** Standardise against sodium oxalate/oxalic acid $\Rightarrow$ D

**Answer: (D)** Go Back to Q120

## Q121.

**Solution**

**Concept — Linearity in validation (ICH Q2):** a near-unity correlation coefficient shows response is proportional to concentration. **Reasoning:** For assay methods, a correlation coefficient $r \geq 0.999$ (or $r^2 \geq 0.998$) is generally taken as acceptable

evidence of a good linear relationship over the working range. **Why the other options are wrong:**

- (B) $r \leq 0.50$ indicates little or no linear correlation.
- (C) $r = 0$ means no correlation at all.
- (D) A negative $r$ alone (e.g. $-0.3$) does not demonstrate acceptable linearity.

**Final Answer:** $r \geq 0.999 \Rightarrow$ A

**Answer: (A)** Go Back to Q121

## Q122.

### Solution

**Concept — Official pharmacopoeias:** each country's compendium of drug standards has a recognised abbreviation. **Reasoning:** IP is the Indian Pharmacopoeia, BP the British Pharmacopoeia, and USP the United States Pharmacopeia. These set the official quality standards for medicines in their respective regions. **Why the other options are wrong:**

- (A) NF, EP, JP are the National Formulary, European, and Japanese pharmacopoeias, not Indian/British/US.
- (C) ChP is the Chinese Pharmacopoeia; this set is mismatched.
- (D) The order is scrambled, mislabelling each abbreviation.

**Final Answer:** IP, BP, USP $\Rightarrow$ B

**Answer: (B)** Go Back to Q122

## Q123.

### Solution

**Concept — Morphological classification:** Crude drugs are arranged according to the morphological (organographic) plant part used, such as leaves, barks, roots, rhizomes, seeds, flowers and fruits. **Reasoning:** Sorting drugs purely by the part of the plant employed, without any regard to chemistry, therapeutics or taxonomy, is the defining feature of morphological (organoleptic) classification. **Why the other options are wrong:**

- (A) Chemical grouping is by constituent class.
- (C) Pharmacological grouping is by therapeutic action.

- (D) Taxonomical grouping is by botanical family/genus.

**Final Answer:** Grouping by plant part is morphological classification $\Rightarrow$ B

**Answer: (B)** Go Back to Q123

## Q124.

### Solution

**Concept — Organized vs unorganized drugs:** Organized drugs are entire plant organs with cellular tissue; unorganized drugs are cell-free metabolic products such as gums, balsams, resins, exudates and waxes. **Reasoning:** Tragacanth is a dried gummy exudate, benzoin is a balsamic resin exudate, and beeswax is a secretory wax. None has organized cellular tissue, so option (C) is entirely unorganized. **Why the other options are wrong:**

- (A) Bark, fruit and root are organized organs.
- (B) Fruit, leaf and rhizome are organized.
- (D) Root and seed are organized; the set is mixed.

**Final Answer:** Tragacanth, benzoin and beeswax are all cell-free exudates/secretions $\Rightarrow$ C

**Answer: (C)** Go Back to Q124

## Q125.

### Solution

**Concept — Chemical classification:** Crude drugs may be grouped by the chemical nature of their chief constituents, independent of their botanical or therapeutic relationship. **Reasoning:** Sorting drugs as diterpene taxanes, indole alkaloids and tropane alkaloids is grouping strictly by the chemical class of the constituent, which is chemical classification. **Why the other options are wrong:**

- (B) Morphological grouping is by plant part.
- (C) Serotaxonomy uses serological/protein relationships.
- (D) Pharmacological grouping is by therapeutic action.

**Final Answer:** Grouping by constituent chemistry is chemical classification $\Rightarrow$ A

**Answer: (A)** Go Back to Q125

## Q126.

**Solution**

**Concept — Ephedra alkaloids:** Ephedrine is a protoalkaloid (the basic nitrogen lies in a side chain, not in a ring) from the dried stems of *Ephedra* species. **Reasoning:** *Ephedra gerardiana* yields ephedrine and pseudoephedrine, used as bronchodilators and decongestants. The drug is the dried aerial stem. **Why the other options are wrong:**

- (A) *Catharanthus roseus* yields vincristine/vinblastine.
- (B) *Physostigma venenosum* yields physostigmine.
- (D) *Colchicum autumnale* yields colchicine.

**Final Answer:** Ephedrine is sourced from *Ephedra gerardiana* $\Rightarrow$ C

**Answer: (C)** Go Back to Q126

## Q127.

**Solution**

**Concept — Jaborandi:** Pilocarpine is an imidazole alkaloid obtained from the dried leaflets of *Pilocarpus* (jaborandi). **Reasoning:** *Pilocarpus jaborandi* yields pilocarpine, a cholinergic (parasympathomimetic) drug used as a miotic to reduce intra-ocular pressure in glaucoma. **Why the other options are wrong:**

- (B) *Hyoscyamus niger* yields hyoscyamine/hyoscine (tropane alkaloids).
- (C) *Lobelia inflata* yields lobeline.
- (D) *Erythroxylum coca* yields cocaine.

**Final Answer:** Pilocarpine is from *Pilocarpus jaborandi* $\Rightarrow$ A

**Answer: (A)** Go Back to Q127

## Q128.

**Solution**

**Concept — Protoalkaloids:** In a protoalkaloid the nitrogen comes from an amino acid but lies outside any heterocyclic ring (an amino-alkaloid). **Reasoning:** Colchicine arises from phenylalanine and tyrosine, but its nitrogen is present as an open-chain acetamido (amide) substituent and is not part of a ring; it is therefore classed as a protoalkaloid. **Why the other options are wrong:**

- (A) Its nitrogen is not in a heterocyclic ring, so it is not a true alkaloid.
- (B) Purine pseudo-alkaloids are caffeine-type, not colchicine.
- (C) Steroidal pseudo-alkaloids (e.g. solanidine) have a steroid nucleus.

**Final Answer:** Colchicine is a protoalkaloid (amino-alkaloid) $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q128

## Q129.

### Solution

**Concept — Alkaloid precipitating reagents:** Mayer's reagent is potassium mercuric iodide; it precipitates alkaloids as a cream/white amorphous solid. **Reasoning:** A cream to white precipitate with potassium mercuric iodide is the classic positive Mayer's test for alkaloids, matching the reagent described. **Why the other options are wrong:**

- (A) Wagner's (iodine–potassium iodide) gives a reddish-brown precipitate, but it is not potassium mercuric iodide.
- (C) Hager's (picric acid) gives a yellow precipitate.
- (D) Dragendorff's (potassium bismuth iodide) gives an orange precipitate.

**Final Answer:** Potassium mercuric iodide giving a cream precipitate is Mayer's test $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q129

## Q130.

### Solution

**Concept — Cyanogenetic glycosides:** Amygdalin is a cyanogenetic glycoside; its aglycone mandelonitrile is joined to the disaccharide gentiobiose by an O-glycosidic bond, and on hydrolysis it releases hydrocyanic acid. **Reasoning:** Enzymatic hydrolysis cleaves the sugar, and the freed mandelonitrile decomposes to benzaldehyde and HCN. The HCN is detected as a brick-red colour on sodium picrate (Guignard) paper. **Why the other options are wrong:**

- (A) Carbon dioxide is not the diagnostic gas here.
- (B) Ammonia is released by some amides, not by cyanogenetic glycosides.
- (C) Hydrogen sulphide is liberated by sulphur glycosides (glucosinolates), not amygdalin.

**Final Answer:** Amygdalin liberates hydrocyanic acid $\Rightarrow$ D

**Answer: (D)** Go Back to Q130

## Q131.

### Solution

**Concept — Keller–Kiliani test:** This test detects the 2-deoxysugars characteristic of the sugar chain of cardiac glycosides. **Reasoning:** *Strophanthus kombe* seeds contain cardenolide glycosides whose 2-deoxysugars give a reddish-brown ring between the glacial acetic acid (with ferric chloride) and concentrated sulphuric acid layers, with a blue-green upper layer, in the Keller–Kiliani test. **Why the other options are wrong:**

- (B) Bornträger's detects anthraquinones.
- (C) Molisch's is a general carbohydrate test, not specific to deoxysugars.
- (D) Liebermann–Burchard detects the steroid/triterpene nucleus, not the deoxysugar.

**Final Answer:** Deoxysugars of cardiac glycosides are detected by the Keller–Kiliani test $\Rightarrow$ A

**Answer: (A)** Go Back to Q131

## Q132.

### Solution

**Concept — Anthraquinone purgatives:** Anthraquinone glycosides act on the colon to stimulate peristalsis; they are stimulant (anthraquinone) laxatives. **Reasoning:** Rhubarb owes its purgative action to anthraquinone derivatives (rhein, emodin, chrysophanol), placing it firmly among the stimulant anthraquinone laxatives along with senna and aloe. **Why the other options are wrong:**

- (A) Cardiotonic glycosides are cardenolides such as digoxin.
- (C) Iridoid bitters are a different chemical and therapeutic class.
- (D) Cyanogenetic glycosides release HCN and are not purgatives.

**Final Answer:** Rhubarb anthraquinones are stimulant laxatives $\Rightarrow$ B

**Answer: (B)** Go Back to Q132

## Q133.

**Solution**

**Concept — Steroidal saponins:** Diosgenin is a steroidal sapogenin used as a starting material for the partial synthesis of corticosteroids and sex hormones. **Reasoning:** *Dioscorea deltoidea* tubers/rhizomes are the chief source of diosgenin, a saponin glycoside that froths in water and haemolyses red cells. **Why the other options are wrong:**

- (A) *Cinchona* bark yields quinine (an alkaloid).
- (B) *Digitalis lanata* yields cardiac glycosides, not diosgenin.
- (D) *Papaver somniferum* latex yields opium alkaloids.

**Final Answer:** Diosgenin is obtained from *Dioscorea deltoidea* $\Rightarrow$ C

**Answer: (C)** Go Back to Q133

## Q134.

**Solution**

**Concept — Flavonoid vs coumarin skeletons:** A flavonoid is built on a C6–C3–C6 (diphenylpropane / phenyl-benzopyran) framework, while a coumarin is a C6–C3 benzo-$\alpha$-pyrone (lactone). **Reasoning:** Rutin is a flavonol glycoside on the 15-carbon C6–C3–C6 skeleton; umbelliferone is a 7-hydroxycoumarin, a benzo-$\alpha$-pyrone lactone. Option (A) states these skeletons correctly. **Why the other options are wrong:**

- (B) Neither is a simple C6–C1 phenolic acid.
- (C) The skeletons are reversed.
- (D) Both are non-nitrogenous, not alkaloidal.

**Final Answer:** Flavonoid is C6–C3–C6; coumarin is a C6–C3 benzo-$\alpha$-pyrone $\Rightarrow$ A

**Answer: (A)** Go Back to Q134

## Q135.

**Solution**

**Concept — Cinnamon oil:** The volatile oil of cinnamon bark (*Cinnamomum zeylanicum*) is dominated by the aromatic aldehyde cinnamaldehyde. **Reasoning:** Cinnamaldehyde constitutes roughly 60–75% of cinnamon bark oil and is responsible for its characteristic aroma and flavour. **Why the other options are wrong:**

- (A) Eugenol dominates clove oil (and cinnamon leaf oil), not cinnamon bark.
- (B) Carvone characterises caraway/spearmint.
- (C) Citral is the chief constituent of lemongrass oil.

**Final Answer:** Chief constituent of cinnamon bark oil is cinnamaldehyde $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q135

## Q136.

**Solution**

**Concept — Lemongrass oil:** Lemongrass oil from *Cymbopogon flexuosus* is rich in citral, an acyclic monoterpene aldehyde (a mixture of geranial and neral). **Reasoning:** Citral makes up the bulk of lemongrass oil and is the industrial starting material for ionones used in vitamin A synthesis and perfumery. **Why the other options are wrong:**

- (A) Anethole is from fennel/anise.
- (C) Menthol is the chief constituent of peppermint oil.
- (D) Thymol is from thyme/ajowan.

**Final Answer:** The chief aldehyde of lemongrass oil is citral $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q136

## Q137.

**Solution**

**Concept — Asafoetida:** Asafoetida is an oleo-gum-resin made of gum, resin and a volatile oil; the volatile oil contains organic sulphur compounds. **Reasoning:** The garlic-like odour and carminative action come from the volatile oil fraction, which is rich in disulphides and other organic sulphides. **Why the other options are wrong:**

- (A) The gum fraction is odourless and only provides emulsifying mucilage.
- (B) The resin carries ferulic acid esters and umbelliferone but not the sulphur odour.
- (D) The ash is mineral matter and is not odoriferous.

**Final Answer:** The garlic odour is due to the volatile oil's organic sulphides $\Rightarrow$ C

**Answer: (C)** Go Back to Q137

## Q138.

### Solution

**Concept — Tragacanth fractions:** Tragacanth is composed of a small water-soluble fraction, tragacanthin, and a large water-insoluble swelling fraction, bassorin. **Reasoning:** Tragacanthin dissolves to give the soluble portion, while bassorin absorbs water and swells to form the stiff translucent gel that characterises tragacanth mucilage. **Why the other options are wrong:**

- (B) Arabin is the soluble component of acacia, not tragacanth; inulin is a storage polysaccharide.
- (C) Agarose is from agar and pectin is from fruits.
- (D) Glycyrrhizin is a saponin from liquorice, unrelated to tragacanth.

**Final Answer:** Soluble tragacanthin plus swelling bassorin $\Rightarrow$ A

**Answer: (A)** Go Back to Q138

## Q139.

### Solution

**Concept — Acetate–malonate (polyketide) pathway:** Acetyl-CoA is carboxylated to malonyl-CoA, which is repeatedly condensed to build a poly-$\beta$-keto chain. **Reasoning:** Folding and cyclisation of the poly-$\beta$-keto chain, or its reduction, yields fatty acids and aromatic polyketide phenols such as anthraquinones. The scheme therefore depicts the acetate–malonate pathway. **Why the other options are wrong:**

- (A) Shikimate gives aromatic amino acids via a different route.
- (C) Acetate–mevalonate gives terpenoids, not poly-$\beta$-keto chains.
- (D) The pentose phosphate pathway supplies sugars and NADPH.

**Final Answer:** It is the acetate–malonate (polyketide) pathway $\Rightarrow$ B

**Answer: (B)** Go Back to Q139

## Q140.

### Solution

**Concept — Gallic acid origin:** Gallic acid is formed by aromatisation of 3-dehydroshikimate, an intermediate of the shikimic acid pathway. **Reasoning:** Hydrolysable gallotannins are esters of glucose with gallic acid, and gallic acid is biosynthesised directly from 3-dehydroshikimate on the shikimate pathway, not by the acetate routes. **Why the other options are wrong:**

- (A) Acetate–mevalonate gives terpenoids.
- (B) Acetate–malonate gives fatty acids and some polyketide phenols, but not gallic acid.
- (C) The pentose phosphate pathway supplies sugars/NADPH.

**Final Answer:** Gallic acid arises via the shikimic acid pathway $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q140

## Q141.

### Solution

**Concept — Stomatal types:** Leaf stomata are classified by the number and arrangement of subsidiary cells: anomocytic, anisocytic, diacytic, paracytic, etc. **Reasoning:** When a stoma is surrounded by three subsidiary cells, one of which is markedly smaller than the other two, the apparatus is anisocytic (cruciferous type), seen for example in *Datura* and *Atropa*. **Why the other options are wrong:**

- (A) Diacytic has two subsidiary cells at right angles to the pore.
- (B) Paracytic has two subsidiary cells parallel to the guard cells.
- (D) Anomocytic has no specialised subsidiary cells.

**Final Answer:** Three unequal subsidiary cells make it anisocytic $\Rightarrow$ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q141

## Q142.

**Solution**

**Concept — Retardation factor ($R_f$):** $R_f$ is the ratio of the distance moved by the solute to the distance moved by the solvent front, both measured from the baseline. **Reasoning:** Here $R_f = d/D = 2.4/6.0 = 0.40$. The value is dimensionless and lies between 0 and 1, as required. **Why the other options are wrong:**

- (B) 2.50 is $D/d$ (the inverse) and exceeds 1, which is impossible.
- (C) 0.60 uses the wrong ratio.
- (D) 0.24 misplaces the decimal point.

**Final Answer:** $R_f = 2.4/6.0 = 0.40 \Rightarrow$ A

**Answer: (A)** Go Back to Q142

## Q143.

**Solution**

**Concept — Expression vectors:** An expression vector places the cloned gene under the control of a strong promoter so that host RNA polymerase transcribes it at high level; the *ori* and selection marker serve replication and selection, not transcription of the insert. **Reasoning:** The MCS sits immediately downstream of the promoter. RNA polymerase binds the promoter and reads through into the inserted gene, giving efficient transcription. This promoter–insert arrangement is what makes the construct an expression (not merely a cloning) vector. **Why the other options are wrong:**

- (A) The *kan*$^R$ gene only allows selection on kanamycin; it does not drive the insert.
- (C) The *ori* controls plasmid replication, not transcription initiation.
- (D) A cloned coding sequence does not bring a functional bacterial promoter of its own.

**Final Answer:** The strong vector promoter just upstream of the insert drives transcription $\Rightarrow$ B

**Answer: (B)** Go Back to Q143

## Q144.

**Solution**

**Concept — Blunt vs sticky cutters:** An enzyme that cleaves both strands at the same central position leaves flush (blunt) ends; staggered cuts leave single-stranded overhangs. **Reasoning:** *Eco*RV recognises GATATC and cuts GAT↓ATC at the exact centre of both strands, producing blunt ends with no overhang. **Why the other options are wrong:**

- (A) *Bam*HI cuts G↓GATCC, leaving a 5′ GATC sticky overhang.
- (B) *Hind*III cuts A↓AGCTT, leaving a 5′ AGCT overhang.
- (D) *Pst*I cuts CTGCA↓G, leaving a 3′ overhang (still sticky, not blunt).

**Final Answer:** Only *Eco*RV makes a central, flush cut ⇒ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q144

## Q145.

**Solution**

**Concept — cDNA synthesis:** Reverse transcriptase is an RNA-dependent DNA polymerase that copies an RNA template into a complementary DNA strand, the first step in making intron-free cDNA for expression in bacteria. **Reasoning:** Mature eukaryotic mRNA has had its introns spliced out. Reverse transcriptase reads this mRNA and synthesises cDNA, which encodes the protein without introns the bacterium cannot remove. This is why cDNA cloning is used for eukaryotic proteins. **Why the other options are wrong:**

- (B) Terminal transferase adds untemplated nucleotides to 3′ ends (tailing).
- (C) DNA ligase joins DNA ends; it does not copy RNA.
- (D) RNA polymerase II makes RNA from DNA, the reverse direction.

**Final Answer:** cDNA is made from mRNA by reverse transcriptase ⇒ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q145

## Q146.

**Solution**

**Concept — Blotting techniques:** Southern detects DNA, Northern detects RNA, Western detects protein (mnemonic "SNoW DRoP"). **Reasoning:** Separating RNA transcripts by electrophoresis, transferring them to a membrane, and probing with a labelled complementary nucleic-acid probe is **Northern blotting**, used to study mRNA size and expression level. **Why the other options are wrong:**

- (A) Western blotting detects proteins using antibody probes.
- (B) Southern blotting detects DNA with a DNA probe.
- (C) A protein dot blot does not separate or size RNA transcripts.

**Final Answer:** RNA separated and probed with a nucleic-acid probe is Northern blotting $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q146

## Q147.

**Solution**

**Concept — Recombinant erythropoietin:** EPO is a glycoprotein hormone made by the kidney that stimulates erythroid progenitors in the bone marrow to make red blood cells. The recombinant form is produced in mammalian cells to ensure correct glycosylation. **Reasoning:** Recombinant human EPO is given to raise red-cell mass in conditions such as the anaemia of chronic kidney disease and chemotherapy-induced anaemia. Its action is on erythropoiesis, not glucose, clots, or growth plates. **Why the other options are wrong:**

- (A) Lowering blood glucose is the action of insulin.
- (C) Thrombolysis is the role of tissue plasminogen activator (tPA)/streptokinase.
- (D) Promoting bone growth describes recombinant human growth hormone.

**Final Answer:** EPO stimulates red-cell production to treat anaemia $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q147

## Q148.

**Solution**

**Concept — Antibiotic-producing organisms:** Many clinically important antibiotics, especially aminoglycosides and tetracyclines, are secondary metabolites of soil actinomycetes of the genus *Streptomyces*. **Reasoning:** Streptomycin was the first aminoglycoside, isolated from *Streptomyces griseus*. It is manufactured by submerged aerobic fermentation of this actinomycete and harvested in the idiophase. **Why the other options are wrong:**

- (A) *Penicillium* (a mould) yields penicillin, a $\beta$-lactam, not streptomycin.
- (B) Gram-negative enteric bacteria are not the streptomycin source.
- (D) Brewer's yeast is used for ethanol/baking, not aminoglycosides.

**Final Answer:** Streptomycin comes from *Streptomyces griseus*, an actinomycete $\Rightarrow$ C

**Answer: (C)** Go Back to Q148

## Q149.

**Solution**

**Concept — Oxygen transfer ($k_La$):** The oxygen-transfer rate equals $k_La \times (C^* - C_L)$. Raising $k_La$ increases supply; agitation shears bubbles to raise interfacial area while aeration raises the gas supply. **Reasoning:** Increasing impeller speed disperses air into smaller bubbles (more surface area) and increasing the air-flow rate raises the oxygen feed, both of which lift the volumetric oxygen-transfer rate to match the rising demand of dense cultures. **Why the other options are wrong:**

- (B) Reducing stirring lowers $k_La$ and worsens oxygenation.
- (C) Closing the air inlet starves the culture of oxygen.
- (D) Cutting volume without aeration does not improve transfer rate.

**Final Answer:** Higher agitation plus higher aeration raises oxygen transfer $\Rightarrow$ A

**Answer: (A)** Go Back to Q149

## Q150.

**Solution**

**Concept — Covalent immobilisation:** The enzyme is bonded through stable covalent links between its side-chain groups (e.g. $-NH_2$, $-COOH$, $-SH$) and an activated carrier, giving firm attachment and little leakage. **Reasoning:** Forming covalent bonds between protein functional groups and a chemically activated matrix is, by definition, covalent coupling. It binds the enzyme tightly so it is not washed off during continuous operation, though it can lower activity if active-site residues react. **Why the other options are wrong:**

- (A) Entrapment cages the enzyme in a gel without bonding it.
- (B) Adsorption uses weak physical forces, easily reversed.
- (C) Encapsulation surrounds the enzyme with a membrane, again without covalent bonds.

**Final Answer:** Bonding through protein groups to an activated support is covalent coupling $\Rightarrow$ $\boxed{\text{D}}$

**Answer: (D)** Go Back to Q150

## Q151.

**Solution**

**Concept — Lineweaver–Burk plot:** The double-reciprocal form $\frac{1}{v} = \frac{K_m}{V_{max}} \cdot \frac{1}{[\text{S}]} + \frac{1}{V_{max}}$ is a straight line. Its $y$-intercept is $1/V_{max}$ and its $x$-intercept is $-1/K_m$. **Reasoning:** Setting $1/[\text{S}] = 0$ gives $1/v = 1/V_{max}$ (the $1/v$-axis intercept). Setting $1/v = 0$ gives $1/[\text{S}] = -1/K_m$ (the $1/[\text{S}]$-axis intercept), exactly as marked on the plot. **Why the other options are wrong:**

- (A) The intercepts are swapped and the sign of the $x$-intercept is wrong.
- (C) $V_{max}$ and $K_m$ are not read directly off the intercepts; their reciprocals are.
- (D) The slope (not an intercept) equals $K_m/V_{max}$.

**Final Answer:** $y$-intercept $= 1/V_{max}$, $x$-intercept $= -1/K_m$ $\Rightarrow$ $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q151

## Q152.

**Solution**

**Concept — Non-competitive inhibition:** The inhibitor binds a site away from the active site on both E and ES with equal affinity, so it cannot be overcome by adding substrate. **Reasoning:** Because some enzyme is always inactivated regardless of [S], the achievable $\mathbf{V}_{max}$ **falls**. Substrate binding itself is unaffected, so the $\mathbf{K}_m$ **stays unchanged**. On a Lineweaver–Burk plot the lines meet on the $1/[\mathrm{S}]$ axis (same $-1/K_m$) but the $1/v$ intercept rises. **Why the other options are wrong:**

- (A) Rising $\mathrm{K}_m$ with unchanged $\mathrm{V}_{max}$ is competitive inhibition.
- (B) Inhibitors do not raise $\mathrm{V}_{max}$ or affinity.
- (D) Both parameters increasing fits no standard reversible inhibitor.

**Final Answer:** $\mathrm{K}_m$ unchanged, $\mathrm{V}_{max}$ decreased $\Rightarrow$ $\boxed{\mathrm{C}}$

**Answer: (C)** Go Back to Q152

## Q153.

**Solution**

**Concept — Antibody regions:** An IgG monomer splits into two Fab arms (antigen binding, at the variable tips) and one Fc stem (the paired heavy-chain constant domains $\mathrm{C}_H2$–$\mathrm{C}_H3$) that carries out effector functions. **Reasoning:** The stem labelled Y is the **Fc region**. It binds C1q to trigger the classical complement pathway and binds Fc receptors on phagocytes and NK cells, mediating opsonisation and ADCC. It does not bind antigen. **Why the other options are wrong:**

- (B) The light-chain variable region lies at the Fab tip, not the stem.
- (C) The paratope (antigen-binding site) is at the Fab tips, not in Fc.
- (D) CDR loops form the antigen-binding site in the variable domains, again at the Fab arms.

**Final Answer:** The effector stem of the heavy chains is the Fc region $\Rightarrow$ $\boxed{\mathrm{A}}$

**Answer: (A)** Go Back to Q153

## Q154.

**Solution**

**Concept — Toxoid vaccines:** A toxoid is an exotoxin chemically inactivated (classically with formaldehyde) so it can no longer harm the host but still raises neutralising antibodies against the toxin. **Reasoning:** Diphtheria and tetanus disease is caused by potent exotoxins. Treating the purified toxin with formaldehyde abolishes toxicity while preserving the antigenic epitopes, giving a **toxoid vaccine** that elicits antitoxin immunity. **Why the other options are wrong:**

- (A) A live attenuated vaccine uses weakened whole organisms (e.g. BCG, MMR).
- (B) A conjugate vaccine links a polysaccharide to a carrier protein.
- (C) A whole killed vaccine uses inactivated whole cells, not detoxified toxin.

**Final Answer:** Formaldehyde-detoxified exotoxin is a toxoid vaccine $\Rightarrow$ D

**Answer: (D)** Go Back to Q154

## Q155.

**Solution**

**Concept — ELISA:** The enzyme-linked immunosorbent assay detects antigen or antibody by linking the recognition event to an enzyme that converts a colourless substrate into a coloured product whose absorbance is measured. **Reasoning:** In a sandwich ELISA the antigen is captured between a coating antibody and a detection antibody; the detection antibody (or a secondary antibody) carries an enzyme such as HRP or alkaline phosphatase. Adding the chromogenic substrate gives a colour proportional to antigen, read on a plate reader. **Why the other options are wrong:**

- (A) Visible agglutination is the readout of agglutination tests, not ELISA.
- (C) A radioactive label is the basis of radioimmunoassay (RIA), not ELISA.
- (D) Gel precipitation is immunodiffusion, a different technique.

**Final Answer:** An enzyme on the detection antibody yields a chromogenic signal $\Rightarrow$ B

**Answer: (B)** Go Back to Q155

## Q156.

**Solution**

**Concept — Gell and Coombs classification:** Type I is immediate IgE-mediated; Type II is antibody-mediated cytotoxic; Type III is immune-complex; Type IV is delayed cell-mediated. **Reasoning:** An immediate anaphylactic response in which IgE bound to mast cells and basophils triggers histamine release on re-exposure is the textbook **Type I (immediate) hypersensitivity**. Penicillin anaphylaxis is a classic clinical example. **Why the other options are wrong:**

- (A) Type II involves IgG/IgM against cell-surface antigens (e.g. haemolytic reactions).
- (B) Type III involves circulating immune complexes (e.g. serum sickness).
- (D) Type IV is T-cell mediated and delayed (e.g. contact dermatitis, tuberculin test).

**Final Answer:** IgE-mediated immediate anaphylaxis is Type I $\Rightarrow$ $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q156

## Q157.

**Solution**

**Concept — Stationary phase:** After exponential growth, nutrient depletion and toxic by-products slow division until it just balances death, holding the viable count near constant. Most secondary metabolites (antibiotics) are made here (the idiophase). **Reasoning:** The flat plateau of the curve, Phase R, is the stationary phase: net growth rate $\approx 0$ and the culture diverts metabolism toward secondary products. This matches the description of balanced division and death with peak secondary-metabolite formation. **Why the other options are wrong:**

- (B) Phase P (lag) is the early adaptation period with little division.
- (C) Phase Q (log) has maximal exponential growth, not a plateau.
- (D) Phase S (death) shows a falling viable count.

**Final Answer:** The constant-count, secondary-metabolite plateau is Phase R (stationary) $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q157

## Q158.

**Solution**

**Concept — Dry-heat sterilisation:** Hot air kills microbes by oxidation rather than coagulation. The pharmacopoeial reference cycle is a hot-air oven at 160°C for about 2 hours. **Reasoning:** Glass, metal instruments, and anhydrous oils tolerate high temperature but cannot be penetrated by steam, so dry heat at 160°C/2 h (or equivalent higher-temperature shorter cycles) is the validated condition. **Why the other options are wrong:**

- (A) 121°C saturated steam is moist-heat (autoclave) for aqueous loads.
- (B) Membrane filtration is for heat-labile solutions, not glassware/oils.
- (C) Ethylene oxide is a gaseous chemical method for heat-sensitive plastics.

**Final Answer:** Hot air oven at 160°C for ∼2 h is the dry-heat standard ⇒ D

**Answer: (D)** Go Back to Q158

## Q159.

**Solution**

**Concept — Phenol coefficient:** It is the ratio of the greatest dilution of a test disinfectant that kills a standard organism in a set time to the greatest dilution of phenol giving the same result under identical conditions. **Reasoning:** The phenol coefficient therefore expresses the **germicidal potency of a disinfectant relative to phenol**. A value above 1 means the agent is more potent than phenol; below 1 means less potent. **Why the other options are wrong:**

- (A) It is not a measure of relative solubility.
- (B) It has nothing to do with boiling point.
- (C) It rates killing power, not tissue toxicity (a separate therapeutic-index consideration).

**Final Answer:** It is germicidal activity relative to phenol under standard conditions ⇒ D

**Answer: (D)** Go Back to Q159

## Q160.

**Solution**

**Concept — Sterility testing:** The two pharmacopoeial methods are membrane filtration and direct inoculation. Membrane filtration is preferred when the product can be filtered, especially if it has antimicrobial activity, because the rinse step removes the inhibitory substance. **Reasoning:** For an antibiotic injection, residual drug would inhibit the growth of any contaminating organisms and mask a positive result. Filtering the sample traps organisms on the membrane, which is then rinsed free of antibiotic before being added to the culture media, giving a valid test. **Why the other options are wrong:**

- (B) Direct inoculation without rinsing leaves the antibiotic to suppress growth.
- (C) The phenol-coefficient assay rates disinfectants, it is not a sterility test.
- (D) Sterility testing requires incubation (typically 14 days), not an instant reading.

**Final Answer:** Membrane filtration with rinsing is preferred for antimicrobial injections $\Rightarrow$ $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q160

# Answer Key

| Q | Ans | Q | Ans | Q | Ans | Q | Ans | Q | Ans |
|---|---|---|---|---|---|---|---|---|---|
| 1 | D | 2 | C | 3 | A | 4 | B | 5 | C |
| 6 | D | 7 | A | 8 | B | 9 | C | 10 | D |
| 11 | A | 12 | B | 13 | C | 14 | D | 15 | A |
| 16 | B | 17 | C | 18 | D | 19 | A | 20 | B |
| 21 | C | 22 | D | 23 | A | 24 | B | 25 | C |
| 26 | D | 27 | A | 28 | B | 29 | C | 30 | D |
| 31 | A | 32 | B | 33 | C | 34 | D | 35 | C |
| 36 | B | 37 | A | 38 | D | 39 | C | 40 | B |
| 41 | D | 42 | A | 43 | C | 44 | B | 45 | A |
| 46 | D | 47 | C | 48 | A | 49 | B | 50 | D |
| 51 | C | 52 | A | 53 | B | 54 | D | 55 | A |
| 56 | C | 57 | B | 58 | D | 59 | A | 60 | C |
| 61 | B | 62 | D | 63 | A | 64 | B | 65 | D |
| 66 | C | 67 | A | 68 | B | 69 | C | 70 | A |
| 71 | D | 72 | B | 73 | C | 74 | A | 75 | D |
| 76 | B | 77 | D | 78 | A | 79 | B | 80 | C |
| 81 | D | 82 | A | 83 | B | 84 | C | 85 | D |
| 86 | A | 87 | B | 88 | C | 89 | D | 90 | D |
| 91 | A | 92 | B | 93 | C | 94 | D | 95 | D |
| 96 | A | 97 | B | 98 | C | 99 | C | 100 | B |
| 101 | C | 102 | D | 103 | D | 104 | A | 105 | B |
| 106 | C | 107 | D | 108 | A | 109 | B | 110 | C |
| 111 | D | 112 | C | 113 | A | 114 | B | 115 | C |
| 116 | D | 117 | A | 118 | B | 119 | C | 120 | D |
| 121 | A | 122 | B | 123 | B | 124 | C | 125 | A |
| 126 | C | 127 | A | 128 | D | 129 | B | 130 | D |
| 131 | A | 132 | B | 133 | C | 134 | A | 135 | D |
| 136 | B | 137 | C | 138 | A | 139 | B | 140 | D |
| 141 | C | 142 | A | 143 | B | 144 | C | 145 | A |
| 146 | D | 147 | B | 148 | C | 149 | A | 150 | D |
| 151 | B | 152 | C | 153 | A | 154 | D | 155 | B |
| 156 | C | 157 | A | 158 | D | 159 | D | 160 | A |