NIPER JEE Pharmacy Subjects

Sample Paper – 8

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. Lead(II) chloride dissolves as $PbCl_2 \rightleftharpoons Pb^{2+} + 2\,Cl^-$. If its molar solubility in water is 2.0×10^{-2} mol/L, its solubility product K_{sp} is:

(A) 4.0×10^{-4}

(B) 8.0×10^{-6}

(C) 3.2×10^{-5}

(D) 2.0×10^{-2}

Q2. A solute with an oil/water partition coefficient $P = 4$ is shaken with equal volumes of oil and water. The fraction of the solute that ends up in the *oil* phase at equilibrium is:

(A) 0.20

(B) 0.80

(C) 0.25

(D) 0.40

Q3. A non-ionic surfactant is heated in aqueous solution until it suddenly turns turbid and the surfactant separates out. The temperature at which this occurs is known as the:

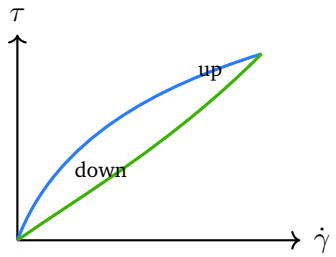
(A) cloud point

(B) Krafft point

(C) eutectic temperature

(D) inversion temperature

Q4. The flow curve below is obtained by first increasing and then decreasing the shear rate on a structured gel; the down-curve lies below the up-curve, enclosing a loop. This time-dependent behaviour is called:



(A) Newtonian flow

(B) dilatant flow

(C) Bingham plastic flow

(D) thixotropy

Q5. In an Ostwald capillary viscometer, the dynamic viscosity of a liquid is determined from the time it takes a fixed volume to flow through the capillary. For two liquids measured in the same viscometer, the viscosity is proportional to:

(A) flow time only, independent of density

(B) the reciprocal of the flow time

(C) the product of density and flow time

(D) the density divided by the flow time

Q6. A powder blend has a bulk density of 0.36 g/mL and a tapped density of 0.45 g/mL. Its Carr's compressibility index is:

(A) 25%

(B) 20%

(C) 16%

(D) 9%

Q7. For a powder made of uniform spherical particles, the specific surface area (surface area per unit mass) is:

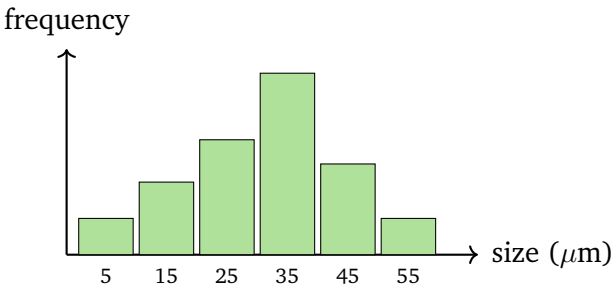
(A) inversely proportional to the particle diameter

(B) directly proportional to the particle diameter

(C) independent of the particle diameter

(D) proportional to the cube of the particle diameter

Q8. The number–frequency histogram below describes a milled powder. The modal (most frequent) size class, in μm, is:



(A) 5 – 15

(B) 15 – 25

(C) 25 – 35

(D) 35 – 45 (tallest bar)

Q9. A buffer is prepared from a weak acid ($pK_a = 4.20$) and its sodium salt in a salt:acid molar ratio of 10:1. Using $\log 10 = 1$, the pH of the buffer is:

(A) 3.20

(B) 4.20

(C) 5.20

(D) 6.20

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

(A) weight of drug osmotically equivalent to 1 g of NaCl

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

(C) molar concentration of NaCl isotonic with blood

(D) freezing-point depression caused by 1% drug solution

Q11. A drug degrades by first-order kinetics with a half-life ($t_{1/2}$) of 50 hours. Its degradation rate constant k (taking $\ln 2 = 0.693$) is approximately:

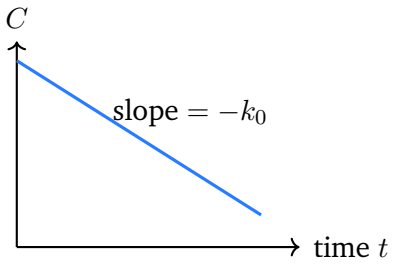
(A) $0.0139\ \text{h}^{-1}$

(B) $0.0693\ \text{h}^{-1}$

(C) $0.693\ \text{h}^{-1}$

(D) $72.1\ \text{h}^{-1}$

Q12. In the plot below, drug concentration C falls in a straight line with time (constant slope). The degradation therefore follows:



(A) first-order kinetics

(B) second-order kinetics

(C) pseudo-first-order kinetics

(D) zero-order kinetics

Q13. In an accelerated stability study, $\ln k$ is plotted against $1/T$ (Arrhenius plot) and a straight line of negative slope is obtained. The slope of this line equals:

(A) $+E_a/R$

(B) $\ln A$

(C) $-E_a/R$

(D) $-A/R$

Q14. When experimental adsorption data fit the Freundlich isotherm, a plot of $\log(x/m)$ against $\log C$ is linear. The slope of this straight line corresponds to:

(A) $\log k$

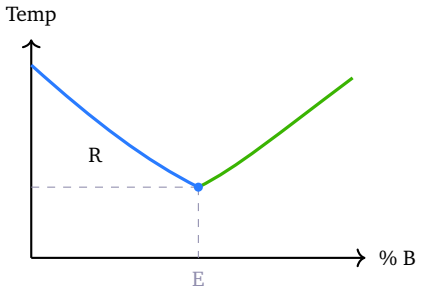
(B) $1/n$

(C) n

(D) k

Q15. The temperature–composition diagram below is for two solids (e.g. menthol and camphor) that are miscible as liquids but immiscible as solids. At point E the two liquidus lines meet at the lowest melting temperature,

and a mixture of this composition melts sharply. Region marked R, below both liquidus lines but above E's temperature line, contains:



(A) solid A in equilibrium with liquid melt

(B) only solid eutectic mixture

(C) only pure liquid of both components

(D) vapour of both components

Q16. In the Noyes–Whitney equation $dC/dt = \dfrac{DA}{h}(C_s - C)$, "sink conditions" are maintained during a dissolution test so that:

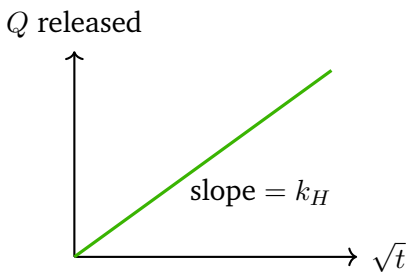
(A) the diffusion-layer thickness h becomes zero

(B) the surface area A stays constant throughout

(C) the saturation solubility C_s is reduced to zero

(D) C remains negligibly small versus C_s, keeping the driving force near-maximal

Q17. For drug release from a homogeneous semisolid ointment, the cumulative amount released Q is plotted against $\sqrt{t}$ and gives a straight line through the origin (figure). This diffusion-controlled release obeys the:



(A) zero-order model

(B) first-order model

(C) Higuchi (square-root-of-time) model

(D) Hixson–Crowell cube-root model

Q18. A new molecule shows poor aqueous solubility but excellent intestinal permeability; its oral absorption is limited mainly by dissolution rate. In the Biopharmaceutics Classification System it belongs to:

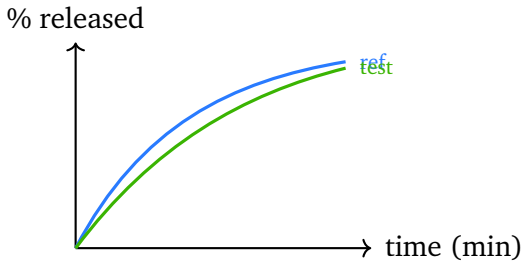
(A) Class I

(B) Class II

(C) Class III

(D) Class IV

Q19. Two dissolution profiles (test vs reference) are compared below. The similarity factor f_2 is used to judge equivalence; profiles are considered similar when f_2 lies in the range:



(A) 50 – 100

(B) 0 – 15

(C) 15 – 50

(D) 100 – 150

Q20. Purified talc is added in small amounts to a direct-compression tablet blend chiefly to improve powder flow into the die. In this role it acts as a:

(A) binder

(B) disintegrant

(C) diluent

(D) glidant

Q21. Cellulose acetate phthalate (CAP) is used to coat tablets so that the drug is protected from gastric acid and is released only in the intestine. It is therefore classified as a(n):

(A) sugar-coating syrup

(B) immediate-release film former

(C) enteric (gastro-resistant) coating polymer

(D) subcoating sealant only

Q22. For uncoated tablets of average weight 250 mg, the pharmacopoeial weight-variation tolerance is $\pm 7.5\%$. The acceptable individual-tablet weight range (mg) is:

(A) 237.5 – 262.5

(B) 231.25 – 268.75

(C) 242.5 – 257.5

(D) 225 – 275

Q23. A drug has a displacement value of 2 in cocoa butter. To prepare 10 suppositories, each moulded from a 1 g base and each containing 0.4 g of the drug, the mass of cocoa butter (g) required is:

(A) 10.0

(B) 6.0

(C) 9.6

(D) 8.0

Q24. An unknown emulsion is added drop-wise to a beaker of water and disperses uniformly without breaking. By the dilution test, this indicates the emulsion is of the:

(A) oil-in-water (o/w) type

(B) water-in-oil (w/o) type

(C) multiple w/o/w type only

(D) a dry emulsion

Q25. A flocculated suspension has a sedimentation volume $F = 0.75$, while the same system when deflocculated gives $F_\infty = 0.15$. The degree of flocculation β $(= F/F_\infty)$ is:

(A) 0.20

(B) 0.90

(C) 5.0

(D) 0.60

Q26. Glass ampoules and metal equipment for parenteral manufacture are commonly rendered sterile and pyrogen-free by dry-heat sterilisation. A typical reference cycle is:

(A) 121°C for 15 minutes at 15 psi

(B) 160°C for 2 hours (or 180°C for 30 min)

(C) 100°C for 30 minutes

(D) filtration through a 0.22 μm membrane only

Q27. A base composed of a blend of polyethylene glycols (PEG 400 and PEG 4000), containing no water or oil and washing off readily with water, is classified as which ointment base?

(A) oleaginous (hydrocarbon) base

(B) absorption base

(C) water-removable (o/w cream) base

(D) water-soluble (PEG) base

Q28. In a pressurised metered-dose inhaler, the liquefied-gas propellant delivers a constant spray throughout the life of the canister mainly because:

(A) its vapour pressure stays constant as long as liquid propellant remains at a given temperature

(B) its vapour pressure continuously rises as the canister empties

(C) the propellant is a compressed (non-liquefiable) gas only

(D) the product contains no headspace vapour

Q29. Which size-reduction equipment reduces particle size mainly by intense *shear* between a high-speed rotor and a stationary stator separated by a very narrow gap, and is especially suited to wet milling of emulsions and suspensions?

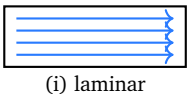
(A) ball mill

(B) hammer mill

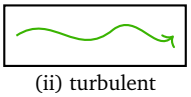
(C) colloid mill

(D) fluid energy mill

Q30. The two pipe-flow sketches below contrast smooth parallel streamlines (i) with chaotic swirling eddies (ii). For flow through a circular pipe, the chaotic pattern (ii) corresponds to a Reynolds number of:



(i) laminar



(ii) turbulent

(A) less than 2100

(B) greater than 4000

(C) exactly 2100

(D) between 1 and 100

Q31. During the drying of a wet granulation, the moisture that remains in equilibrium with the surrounding air at a fixed temperature and humidity, and which cannot be removed by further drying under those conditions, is the:

(A) equilibrium moisture content

(B) free moisture content

(C) unbound moisture content

(D) critical moisture content

Q32. Heat-labile parenteral solutions are sterilised by passage through a membrane filter that removes bacteria without heat. The nominal pore size of a sterilising-grade membrane filter is:

(A) 5.0 μm

(B) 1.2 μm

(C) 0.45 μm

(D) 0.22 μm

Q33. Solid lipid nanoparticles (SLNs), a colloidal carrier introduced as an alternative to emulsions and polymeric nanoparticles, consist of:

(A) a phospholipid bilayer enclosing an aqueous core

(B) non-ionic surfactant bilayer vesicles

(C) a matrix of lipid that is solid at body temperature, stabilised by surfactant

(D) cross-linked natural polymer microspheres

Q34. An elementary osmotic pump tablet releases its drug at an essentially constant (zero-order) rate. The driving force for drug delivery from this system is:

(A) osmotic water influx through the semipermeable membrane, expelling drug through a laser-drilled orifice

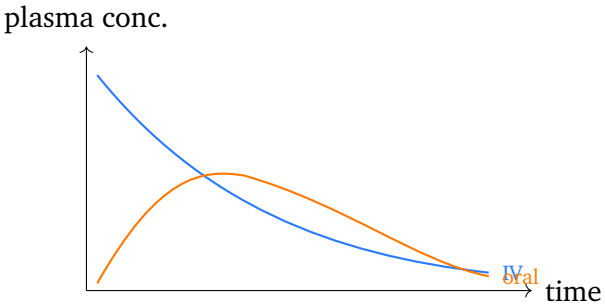
(B) simple diffusion of drug across an intact non-porous coat

(C) disintegration of the tablet core in gastric fluid

(D) swelling and erosion of a hydrophilic matrix only

Part B: Pharmacology & Toxicology

Q35. The two plasma concentration-time curves below compare an intravenous dose and an equal oral dose of the same drug. The absolute oral bioavailability (F) is best estimated from these curves as:



(A) The ratio of the peak (C_{max}) values, oral over IV

(B) The difference between the two C_{max} values

(C) The ratio of the area under the curve (AUC) after oral dosing to the AUC after IV dosing, doses being equal

(D) The ratio of the two t_{max} values

Q36. For a drug with a volume of distribution of 40 L and a target plasma concentration of 5 mg/L, the loading dose required to fill the apparent volume immediately (bioavailability $F = 1$) is:

(A) 200 mg

(B) 8 mg

(C) 45 mg

(D) 0.125 mg

Q37. During a constant-rate intravenous infusion of a drug following first-order elimination, the time taken to reach approximately 94% of the eventual steady-state concentration is closest to:

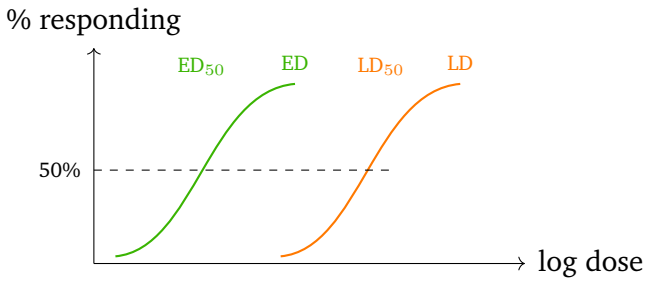
(A) One half-life

(B) Two half-lives

(C) Three half-lives

(D) Four half-lives

Q38. The quantal log dose-response curves below show the cumulative percentage of a population responding (ED) and dying (LD). The standard therapeutic index (TI) is defined as:



(A) $ED_{50} \div LD_{50}$

(B) $LD_{50} \div ED_{50}$

(C) $LD_{1} \div ED_{99}$

(D) $LD_{50} - ED_{50}$

Q39. Glucuronidation, sulfation and acetylation of a drug or its metabolite are examples of:

(A) Phase I functionalisation reactions catalysed by cytochrome P450

(B) Renal tubular secretion

(C) Phase II conjugation (synthetic) reactions that usually increase polarity and aid excretion

(D) Enterohepatic recirculation

Q40. Concurrent use of a potent CYP3A4 inducer with a substrate drug metabolised by CYP3A4 will typically:

(A) Increase the metabolism of the substrate, lowering its plasma level and possibly its therapeutic effect

(B) Increase the plasma level of the substrate and risk toxicity

(C) Have no effect on the substrate concentration

(D) Convert first-order elimination of the substrate to zero-order

Q41. Genetically determined "slow acetylators" eliminate certain drugs more slowly through reduced N-acetyltransferase activity. Which agent's toxicity (e.g. peripheral neuropathy) is increased in slow acetylators?

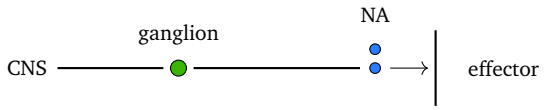
(A) Amlodipine

(B) Isoniazid

(C) Atorvastatin

(D) Metformin

Q42. At the autonomic synapse depicted, the postganglionic neuron releases a transmitter onto an effector organ. For the *postganglionic sympathetic* fibre supplying most effectors, the transmitter released and its principal receptor are:



(A) Acetylcholine acting on nicotinic receptors

(B) Acetylcholine acting on muscarinic receptors

(C) Dopamine acting on D_1 receptors at every effector

(D) Noradrenaline acting on adrenergic (α and β) receptors (sweat glands being the cholinergic exception)

Q43. Which directly acting cholinergic (muscarinic) agonist is resistant to hydrolysis by acetylcholinesterase and is used to stimulate the bladder and gut in post-operative urinary retention and atony?

(A) Bethanechol

(B) Acetylcholine

(C) Nicotine

(D) Hexamethonium

Q44. A hypertensive patient with mild chronic airway disease is started on a β_1-selective blocker that additionally promotes nitric-oxide-mediated vasodilation. Which agent fits this description?

(A) Carvedilol

(B) Sotalol

(C) Nebivolol

(D) Pindolol

Q45. Dexmedetomidine lowers sympathetic outflow and produces sedation chiefly by acting as an agonist at:

(A) Peripheral α_1-adrenoceptors causing vasoconstriction

(B) Central α_2-adrenoceptors, reducing noradrenaline release

(C) β_2-adrenoceptors in bronchial smooth muscle

(D) Nicotinic receptors at the neuromuscular junction

Q46. A long-acting non-depolarizing neuromuscular blocker used in anaesthesia is the bis-quaternary steroidal agent that is vagolytic and largely renally excreted. Which agent is this?

(A) Succinylcholine

(B) Dantrolene

(C) Cisatracurium

(D) Pancuronium

Q47. The potency of an inhalational general anaesthetic is expressed by its minimum alveolar concentration (MAC). A *lower* MAC value indicates:

(A) Greater anaesthetic potency (less agent needed to prevent movement in 50% of patients)

(B) Lower potency requiring more agent

(C) Faster induction unrelated to potency

(D) A higher blood-gas partition coefficient only

Q48. Ramelteon promotes sleep onset by a mechanism distinct from benzodiazepines, namely:

(A) Positive allosteric modulation of the GABA-A receptor

(B) Agonism at MT_1/MT_2 melatonin receptors in the suprachiasmatic nucleus

(C) Blockade of histamine H_1 receptors

(D) Antagonism of orexin receptors

Q49. Atypical (second-generation) antipsychotics are distinguished from typical agents by a relatively higher ratio of serotonin to dopamine receptor blockade. Which of the following is such an atypical antipsychotic acting as a 5-HT_{2A}/D_2 antagonist?

(A) Fluphenazine

(B) Trifluoperazine

(C) Lurasidone

(D) Pimozide

Q50. Which antidepressant relieves depression by inhibiting reuptake of *both* serotonin and noradrenaline (an SNRI) rather than serotonin alone?

(A) Escitalopram

(B) Fluvoxamine

(C) Paroxetine

(D) Desvenlafaxine

Q51. Nalbuphine provides analgesia with a lower risk of severe respiratory depression than morphine because it is:

(A) A κ-receptor agonist and μ-receptor antagonist (mixed agonist-antagonist)

(B) A pure μ-receptor full agonist

(C) A selective serotonin reuptake inhibitor

(D) A peripheral COX-2 inhibitor

Q52. Lacosamide controls focal seizures by a sodium-channel action that differs from phenytoin in that it:

(A) Blocks T-type calcium channels

(B) Selectively enhances the *slow* inactivation of voltage-gated sodium channels

(C) Acts as a GABA-transaminase inhibitor

(D) Antagonises AMPA glutamate receptors

Q53. Among local anaesthetics, esters are hydrolysed by plasma pseudocholinesterase whereas amides undergo hepatic metabolism. Which of the following is an *amide*-type local anaesthetic?

(A) Procaine

(B) Tetracaine

(C) Articaine

(D) Benzocaine

Q54. Which antiparkinsonian drug acts by selectively and irreversibly inhibiting monoamine oxidase-B, sparing the dopamine breakdown in the brain, and (unlike an older congener) is not metabolised to amphetamine?

(A) Apomorphine

(B) Entacapone

(C) Trihexyphenidyl

(D) Rasagiline

Q55. Olmesartan lowers blood pressure by a mechanism that, unlike enalapril, does not raise bradykinin (so it causes little cough). Its action is:

(A) Selective blockade of the angiotensin II AT_1 receptor

(B) Inhibition of angiotensin-converting enzyme

(C) Direct renin inhibition

(D) Aldosterone receptor antagonism

Q56. Lercanidipine, a dihydropyridine calcium-channel blocker, lowers blood pressure predominantly by:

(A) Slowing AV-nodal conduction with little vasodilation

(B) Blocking L-type calcium channels in vascular smooth muscle, causing arteriolar vasodilation

(C) Blocking β_1-adrenoceptors in the heart

(D) Inhibiting the Na^+/K^+-ATPase

Q57. Dronedarone, used to maintain sinus rhythm in atrial fibrillation, is structurally related to amiodarone but lacks iodine. Its dominant Vaughan-Williams action is:

(A) Class I sodium channel block only

(B) Class II β-blockade only

(C) Class III potassium channel block prolonging repolarisation (with multichannel effects)

(D) Class IV calcium channel block only

Q58. Milrinone produces a positive inotropic and vasodilator (inodilator) effect in acute heart failure by:

(A) Inhibiting the Na^+/K^+-ATPase like digoxin

(B) Activating β_1-adrenoceptors directly

(C) Blocking angiotensin II receptors

(D) Inhibiting phosphodiesterase-3, raising intracellular cAMP in cardiac and vascular muscle

Q59. Apixaban differs from warfarin and unfractionated heparin because it:

(A) Directly and reversibly inhibits activated factor Xa, is given orally at fixed dose and needs no routine INR/aPTT monitoring

(B) Inhibits vitamin-K epoxide reductase and is monitored by INR

(C) Potentiates antithrombin and is monitored by aPTT

(D) Acts only after several days of loading

Q60. Bilastine is preferred over chlorpheniramine for chronic allergic rhinitis mainly because it:

(A) Blocks H_2 receptors and reduces gastric acid

(B) Is a non-sedating second-generation H_1 antagonist that poorly crosses the blood-brain barrier

(C) Is a mast-cell stabiliser with no receptor blockade

(D) Irreversibly acetylates cyclooxygenase

Q61. Montelukast is used as add-on therapy in asthma because it:

(A) Stimulates β_2-adrenoceptors in bronchi

(B) Inhibits phosphodiesterase like theophylline

(C) Antagonises the cysteinyl-leukotriene $CysLT_1$ receptor, reducing bronchoconstriction and inflammation

(D) Inhibits 5-lipoxygenase (the zileuton mechanism)

Q62. Etoricoxib provides anti-inflammatory and analgesic effects with less gastric mucosal injury than non-selective NSAIDs because it:

(A) Irreversibly acetylates platelet COX-1

(B) Inhibits lipoxygenase rather than cyclooxygenase

(C) Blocks bradykinin receptors

(D) Selectively inhibits the inducible COX-2 isoenzyme, sparing the constitutive gastroprotective COX-1

Q63. Which urate-lowering agent acts as a *uricosuric* by inhibiting the URAT1 transporter and increasing renal uric-acid excretion, rather than by blocking xanthine oxidase?

(A) Lesinurad

(B) Febuxostat

(C) Allopurinol

(D) Colchicine

Q64. Meropenem is a broad-spectrum bactericidal antibiotic that, like the penicillins, kills bacteria by:

(A) Inhibiting the 50S ribosomal subunit

(B) Binding penicillin-binding proteins and inhibiting peptidoglycan (cell-wall) cross-linking

(C) Inhibiting DNA gyrase

(D) Disrupting folate synthesis

Q65. Moxifloxacin exerts its bactericidal action by inhibiting which bacterial enzymes?

(A) The 30S ribosomal subunit

(B) Dihydropteroate synthase

(C) DNA gyrase (topoisomerase II) and topoisomerase IV, blocking DNA supercoiling and replication

(D) RNA polymerase

Q66. Telithromycin, a ketolide related to the macrolides, inhibits bacterial protein synthesis by binding which target?

(A) DNA gyrase

(B) Penicillin-binding proteins

(C) The 30S ribosomal subunit causing codon misreading

(D) The 50S ribosomal subunit, blocking the exit tunnel and translocation

Q67. Dapagliflozin lowers blood glucose in type-2 diabetes by an insulin-independent mechanism, namely:

(A) Inhibiting the sodium-glucose cotransporter-2 in the proximal renal tubule, increasing urinary glucose excretion

(B) Stimulating pancreatic insulin secretion via the sulfonylurea receptor

(C) Inhibiting hepatic gluconeogenesis as the primary action like metformin

(D) Inhibiting intestinal α-glucosidase

Q68. Which antidote-poison pairing is CORRECT for the emergency management of acute poisoning?

(A) Iron overdose $\rightarrow$ flumazenil

(B) Cyanide poisoning $\rightarrow$ hydroxocobalamin

(C) β-blocker overdose $\rightarrow$ naloxone

(D) Methanol poisoning $\rightarrow$ atropine

Part C: Pharmaceutical & Medicinal Chemistry

Q69. The palladium-catalysed cross-coupling shown below joins an aryl boronic acid to an aryl halide (in the presence of a base) to form a new biaryl C–C bond. This widely used C–C bond-forming reaction is named the:

$$\mathrm{Ar\text{–}B(OH)_2} \quad + \quad \mathrm{Ar'\text{–}Br} \xrightarrow[\text{base}]{\mathrm{Pd(0)}} \mathrm{Ar\text{–}Ar'}$$

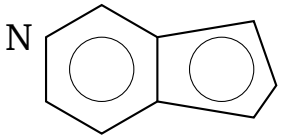
(A) Heck reaction

(B) Stille coupling

(C) Suzuki–Miyaura coupling

(D) Sonogashira coupling

Q70. The bicyclic aromatic heterocycle drawn below is a benzene ring fused to a pyridine ring (sharing two carbons). It is the core of antimalarials such as chloroquine and of the antibacterial fluoroquinolones.



Identify this ring system.

(A) indole

(B) quinoline

(C) isoquinoline

(D) quinazoline

Q71. During rotation about the C2–C3 bond of *n*-butane, the conformation of **highest** potential energy is the one in which the two methyl groups are eclipsing each other (dihedral angle 0°). This maximum-energy form is described as having:

(A) only torsional strain and no steric strain

(B) neither torsional nor steric strain

(C) minimal strain (it is the global minimum)

(D) both maximal torsional and steric (van der Waals) strain

Q72. Dehydration of a tertiary alcohol with hot, concentrated H_2SO_4 proceeds through a carbocation intermediate and obeys first-order kinetics in the substrate. This elimination mechanism is best classified as:

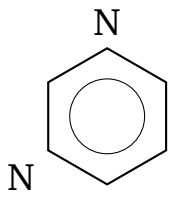
(A) E1 (unimolecular elimination)

(B) E2 (bimolecular, concerted)

(C) E1cb (carbanion intermediate)

(D) S_N2 substitution

Q73. The six-membered aromatic heterocycle drawn below contains two nitrogen atoms at the 1- and 3-positions (*meta* to each other). It forms the core of the nucleobases cytosine, thymine and uracil.



Identify this heterocycle.

(A) pyridazine (N at 1,2)

(B) pyrazine (N at 1,4)

(C) pyrimidine (N at 1,3)

(D) pyridine (one N)

Q74. 2,4-Dinitrochlorobenzene reacts readily with hydroxide ion to give the corresponding phenol, whereas chlorobenzene itself is inert under the same conditions. The nitro groups accelerate the reaction by stabilising the negatively charged intermediate (Meisenheimer complex). This mechanism is:

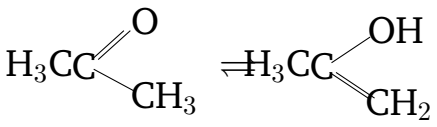
(A) electrophilic aromatic substitution

(B) nucleophilic aromatic substitution (addition–elimination, S_NAr)

(C) free-radical substitution

(D) an E2 elimination

Q75. The equilibrium drawn below interconverts two constitutional isomers differing in the position of a hydrogen atom and a double bond. This phenomenon is called:



(A) keto–enol tautomerism

(B) geometric (cis–trans) isomerism

(C) resonance (mesomerism)

(D) optical isomerism

Q76. The cyclisation of a 1,4-diketone with a primary amine to give a substituted pyrrole (or with P_2S_5/Lawesson's reagent to give a thiophene, or with acid to give a furan) is known as the:

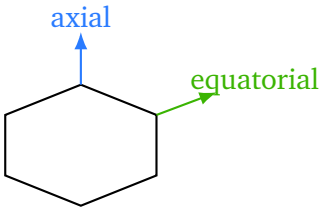
(A) Fischer indole synthesis

(B) Knorr pyrrole synthesis

(C) Hantzsch thiazole synthesis

(D) Paal–Knorr synthesis

Q77. In the chair conformation of cyclohexane drawn below, a bulky substituent (e.g. a *tert*-butyl group) strongly prefers one type of position to minimise 1,3-diaxial interactions. The favoured position is:



(A) the axial position

(B) the equatorial position

(C) the position is irrelevant; both are equal in energy

(D) a boat-form position

Q78. The synthesis of an α-amino acid by reacting an aldehyde with ammonia and hydrogen cyanide to form an α-aminonitrile, followed by hydrolysis, is the classical:

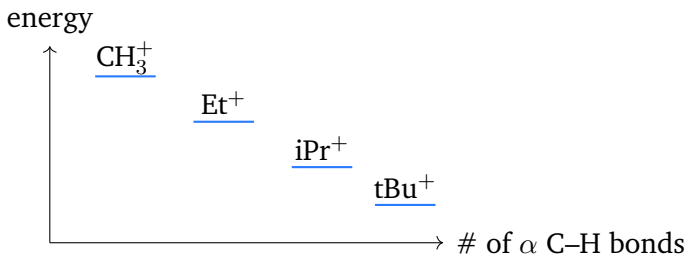
(A) Gabriel synthesis

(B) Hofmann degradation

(C) Strecker synthesis

(D) Curtius rearrangement

Q79. The qualitative energy diagram below compares the relative energies of the methyl, ethyl, isopropyl and *tert*-butyl carbocations. The decreasing energy from left to right is explained mainly by an increasing number of α C–H bonds donating electron density into the empty p-orbital. This stabilising interaction is called:



(A) the inductive ($-$I) electron-withdrawing effect

(B) steric strain relief

(C) aromatic delocalisation

(D) hyperconjugation (with the $+$I inductive effect)

Q80. The palladium-catalysed formation of an aryl C–N bond by coupling an aryl halide with a primary or secondary amine (using a Pd catalyst with a bulky phosphine ligand and a base) is known as the:

(A) Buchwald–Hartwig amination

(B) Ullmann ether synthesis

(C) Mitsunobu reaction

(D) Chichibabin reaction

Q81. A solution of a pure enantiomer rotates the plane of plane-polarised light. The observed rotation normalised to a path length of 1 dm and a concentration of 1 g/mL (at a stated wavelength and temperature) is termed the:

(A) optical density

(B) molar absorptivity

(C) specific rotation $[\alpha]$

(D) dihedral angle

Q82. A primary amide treated with bromine and aqueous NaOH is converted to a primary amine containing **one fewer carbon atom**, via an isocyanate intermediate. This carbon-count-reducing conversion of an amide to an amine is the:

(A) Gabriel phthalimide synthesis

(B) Hofmann bromamide (rearrangement) degradation

(C) reductive amination

(D) Mannich reaction

Q83. Captopril, the first orally active angiotensin-converting-enzyme (ACE) inhibitor, binds the active-site zinc of the enzyme through which functional group in its structure?

(A) a carboxylate group

(B) a phosphinate group

(C) a hydroxamic acid group

(D) a sulfhydryl (thiol, –SH) group

Q84. First-generation H_1-antihistamines (e.g. diphenhydramine, chlorpheniramine) commonly cause sedation, whereas second-generation agents (e.g. loratadine, cetirizine) are largely non-sedating. The principal reason for the reduced sedation of the second-generation drugs is that they:

(A) poorly cross the blood–brain barrier (less CNS H_1 blockade)

(B) do not bind the H_1 receptor at all

(C) are administered only parenterally

(D) are prodrugs that are never activated

Q85. In medicinal chemistry, the specific three-dimensional arrangement of steric and electronic features (H-bond donors/acceptors, charged centres, hydrophobic regions) that is **necessary** for a molecule to be recognised by its biological target is termed the:

(A) auxophore

(B) pharmacophore

(C) chromophore

(D) metabolite

Q86. Sulfasalazine is taken orally and is cleaved by colonic bacterial azoreductase to release 5-aminosalicylic acid (the active anti-inflammatory) plus sulfapyridine. This design is an example of a prodrug intended to achieve:

(A) improved blood–brain-barrier penetration

(B) prolongation of plasma half-life by protein binding

(C) site-specific (colon-targeted) drug delivery

(D) increased lipid solubility for transdermal use

Q87. A reversible **competitive** antagonist shifts the agonist dose–response curve in a characteristic way. That characteristic effect is:

(A) a downward shift, reducing the maximal response ($E_{\max}$)

(B) no change in the curve at all

(C) an increase in agonist potency (leftward shift)

(D) a parallel rightward shift with $E_{\max}$ unchanged (surmountable)

Q88. Lipinski's "Rule of Five" predicts poor oral absorption/permeability when a candidate violates more than one of the stated limits. Which set of limits is correct?

(A) MW $\leq$ 500; log$P \leq$ 5; H-bond donors $\leq$ 5; H-bond acceptors $\leq$ 10

(B) MW $\leq$ 200; log$P \leq$ 2; donors $\leq$ 2; acceptors $\leq$ 2

(C) MW $\leq$ 1000; log$P \leq$ 10; donors $\leq$ 10; acceptors $\leq$ 20

(D) MW $\leq$ 500; log$P \geq$ 5; donors $\geq$ 5; acceptors $\geq$ 10

Q89. Which QSAR approach assumes that each substituent at a given position contributes a constant, additive increment to the biological activity (using indicator variables rather than physicochemical parameters)?

(A) Hansch (linear free-energy) analysis

(B) Free–Wilson (de novo) analysis

(C) molecular-docking scoring

(D) the Topliss decision tree

Q90. The "statin" drugs (e.g. atorvastatin, simvastatin) lower plasma cholesterol by competitively inhibiting which enzyme of the cholesterol-biosynthesis pathway?

(A) cyclooxygenase (COX)

(B) angiotensin-converting enzyme

(C) HMG-CoA reductase

(D) acetylcholinesterase

Q91. Fluoroquinolone antibacterials (e.g. ciprofloxacin) exert their bactericidal action by inhibiting which bacterial enzyme(s)?

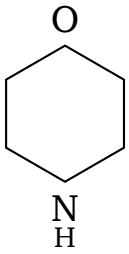
(A) dihydropteroate synthase

(B) the 50S ribosomal subunit

(C) cell-wall transpeptidase (PBP)

(D) DNA gyrase (topoisomerase II) and topoisomerase IV

Q92. The saturated six-membered heterocycle drawn below contains one oxygen and one nitrogen atom at the 1- and 4-positions (*para*). It is a common solubilising/basic group in drugs such as gefitinib and timolol.



Identify this saturated heterocycle.

(A) piperazine

(B) morpholine

(C) piperidine

(D) tetrahydropyran

Q93. Thalidomide is the classic cautionary example in stereochemistry-aware drug design because:

(A) one enantiomer is sedative while the other is teratogenic, and the enantiomers racemise *in vivo*

(B) it is achiral and has no stereocentres

(C) both enantiomers are completely inactive

(D) it is a covalent irreversible inhibitor of DNA

Q94. Methotrexate is an antineoplastic/antifolate that acts by tightly binding and inhibiting which enzyme, thereby blocking the regeneration of tetrahydrofolate?

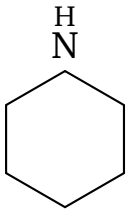
(A) thymidylate synthase only

(B) dihydrofolate reductase (DHFR)

(C) dihydropteroate synthase

(D) ribonucleotide reductase

Q95. The saturated six-membered heterocycle drawn below contains a single nitrogen atom and is fully saturated (no ring double bonds). It is a very common building block in drugs such as haloperidol, raloxifene and many opioids.



Identify this saturated heterocycle.

(A) pyridine

(B) pyrrolidine

(C) morpholine

(D) piperidine

Q96. Which radionuclide, eluted as pertechnetate from a molybdenum-99 "generator," is the most widely used γ-emitter in diagnostic nuclear-medicine imaging?

(A) iodine-131

(B) cobalt-60

(C) technetium-99m

(D) radium-226

Q97. Which insoluble inorganic salt is administered orally or rectally as a radio-opaque contrast medium for X-ray examination of the gastrointestinal tract, its safety depending on its extremely low water solubility?

(A) barium sulfate ($BaSO_4$)

(B) barium chloride ($BaCl_2$)

(C) sodium chloride (NaCl)

(D) calcium carbonate ($CaCO_3$)

Q98. For a weak acid HA and its conjugate base A^-, the Henderson–Hasselbalch equation gives the pH of the buffer as $pH = pK_a + \log([A^-]/[HA])$. It follows that the buffer pH equals the pK_a exactly when:

A^- is ten times [HA]

A^- = [HA] (equal concentrations)

HA is ten times $[A^-]$

(A) the acid is fully ionised

Part D: Pharmaceutical Analysis & Quality Assurance

Q99. The Karl Fischer titration is the official pharmacopoeial method used specifically for the determination of:

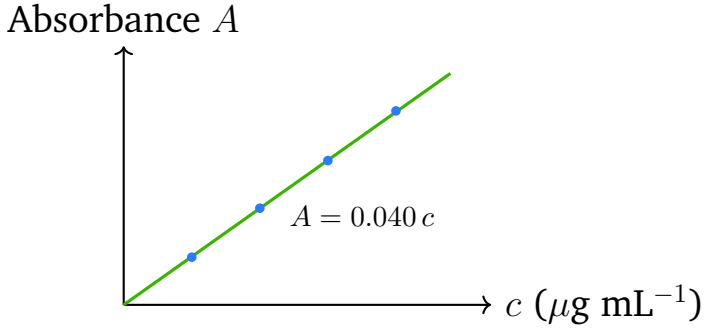
(A) Total ash value of a crude drug

(B) Free acidity of a fixed oil

(C) Water (moisture) content of a sample

(D) Saponification value of a wax

Q100. The calibration line below was constructed at the λ_{max} of a drug; the fitted equation is $A = 0.040\,c$ with c in μg mL^{-1}. A sample solution gives an absorbance of 0.30. Assuming Beer's law holds, the concentration of the drug in the sample is:



(A) 1.2 μg mL^{-1}

(B) 7.5 μg mL^{-1}

(C) 0.012 μg mL^{-1}

(D) 75 μg mL^{-1}

Q101. 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, largest last

(B) Most charged species elute first

(C) Most hydrophobic species elute first

(D) Largest molecules elute first, smallest last

Q102. A sulphonamide drug bearing a free primary aromatic amine is assayed by diazotisation titration. The standard titrant used and the species formed are:

(A) Sodium nitrite, forming a diazonium salt

(B) Potassium bromate, forming a bromamine

(C) Silver nitrate, forming a silver salt

(D) Ceric sulphate, forming a nitroso compound

Q103. In fluorescence spectroscopy, the difference (in wavelength or wavenumber) between the absorption maximum and the emission maximum of a fluorophore is known as the:

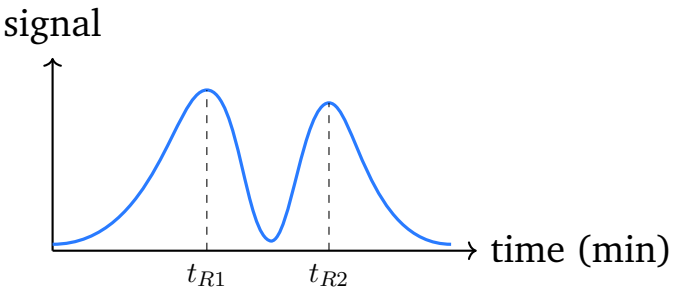
(A) Beer shift

(B) Doppler shift

(C) Stokes shift

(D) Bathochromic shift

Q104. For the two adjacent HPLC peaks shown, the retention times are $t_{R1} = 6.0$ min and $t_{R2} = 7.2$ min, and the baseline peak widths are $w_1 = w_2 = 0.80$ min. Using $R_s = \dfrac{2(t_{R2} - t_{R1})}{w_1 + w_2}$, the resolution is:



(A) 0.75

(B) 1.5

(C) 3.0

(D) 0.50

Q105. In cerimetric titrations, ceric ammonium sulphate acts as a powerful oxidant. The indicator most commonly used to detect the end point of a cerimetric titration is:

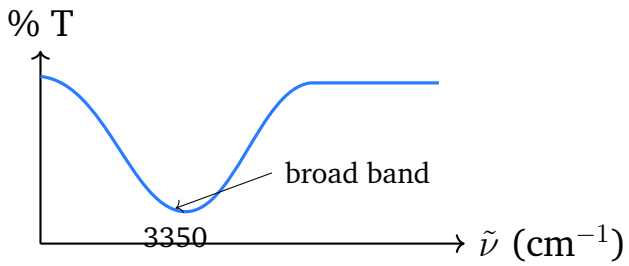
(A) Methyl orange

(B) Potassium chromate

(C) Eriochrome Black T

(D) Ferroin (ferrous 1,10-phenanthroline)

Q106. The schematic IR spectrum shows a broad, intense absorption centred near **3350 cm^{-1}**. Such a broad band in this region is most characteristic of:



(A) O–H stretch of a hydrogen-bonded hydroxyl group

(B) C=O stretch of an ester

(C) C≡N stretch of a nitrile

(D) C–Cl stretch of an alkyl chloride

Q107. A strong cation-exchange resin used in ion-exchange chromatography typically carries which functional group on its matrix?

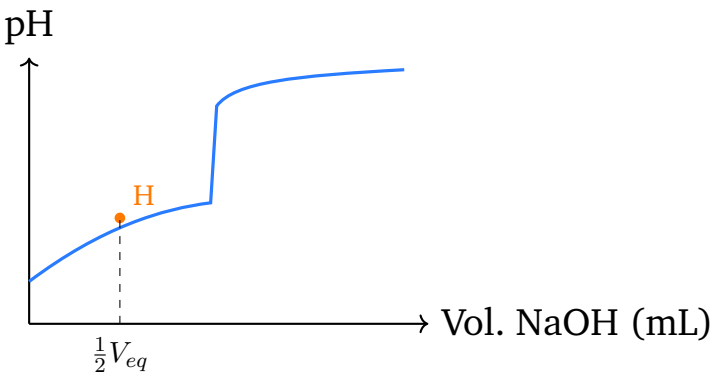
(A) Quaternary ammonium ($-NR_3^+$)

(B) Diethylaminoethyl ($-NEt_2H^+$)

(C) Sulphonic acid ($-SO_3^-$)

(D) Octadecyl (C18) chains

Q108. The curve shows the titration of a weak acid (HA, $pK_a = 4.8$) with NaOH. At the point marked **H**, exactly half the acid has been neutralised. The pH at point H equals:



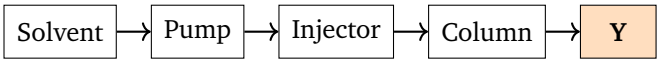
(A) 7.0 (neutral)

(B) 4.8 (equal to the pK_a)

(C) 9.2 (equal to $14 - pK_a$)

(D) 2.4 (half the pK_a)

Q109. The HPLC block diagram is shown. Identify the component labelled **Y**, which is placed immediately *after* the column and converts the separated analytes into a measurable electrical signal.



(A) Mobile-phase reservoir

(B) High-pressure pump

(C) Sample injection valve

(D) Detector (e.g. UV–visible flow cell)

Q110. Atomic absorption spectroscopy (AAS) quantifies a metal by measuring the:

(A) Absorption of resonance-line radiation by ground-state free atoms in a flame

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

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

(D) Fluorescence of the metal complex in solution

Q111. In a potentiometric pH measurement, the glass electrode serves as the:

(A) Reference electrode of fixed potential

(B) Indicator electrode whose potential depends on H^+ activity

(C) Counter electrode that supplies current

(D) Salt bridge between the two half-cells

Q112. In gas–liquid chromatography (GLC), separation of the components of a volatile mixture is primarily governed by differences in the analytes':

(A) Molecular charge

(B) Ultraviolet absorptivity

(C) Volatility and partitioning into the liquid stationary phase

(D) Refractive index in the mobile phase

Q113. A back (residual) titration is preferred over a direct titration when:

(A) The analyte reacts instantaneously and a sharp end point is already available

(B) The titrant is the same as the analyte

(C) The analyte reacts slowly or is insoluble, so an excess of reagent is added and the unreacted excess is titrated

(D) No suitable indicator exists for any reaction

Q114. In ^{1}H NMR spectroscopy, tetramethylsilane (TMS) is used as the internal reference standard and is assigned a chemical shift of:

(A) $\delta = 7.26$ ppm

(B) $\delta = 10.0$ ppm

(C) $\delta = 2.50$ ppm

(D) $\delta = 0.00$ ppm

Q115. On a developed silica-gel TLC plate, two compounds X and Y show R_f values of 0.65 and 0.20 respectively, using a non-polar mobile phase on a polar stationary phase. Which statement is correct?

(A) X is less polar than Y, so X travels farther and has the higher R_f

(B) Y is less polar than X, so Y travels farther

(C) Both compounds have identical polarity

(D) R_f values above 0.5 are physically impossible

Q116. According to the "nitrogen rule" in mass spectrometry, an organic compound that shows an *odd* nominal molecular mass ($M^{+\bullet}$) must contain:

(A) Only carbon, hydrogen and oxygen

(B) An odd number of nitrogen atoms

(C) No heteroatoms at all

(D) An even number of nitrogen atoms

Q117. Which substance is an ideal *primary standard* for standardising a sodium hydroxide solution because of its high purity, high equivalent weight and non-hygroscopic, stable nature?

(A) Sodium hydroxide pellets

(B) Potassium hydrogen phthalate (KHP)

(C) Concentrated hydrochloric acid

(D) Sodium thiosulphate

Q118. In HPLC, an unretained solute elutes at $t_0 = 1.0$ min and an analyte elutes at $t_R = 5.0$ min. The capacity (retention) factor k' of the analyte, defined as $k' = (t_R - t_0)/t_0$, is:

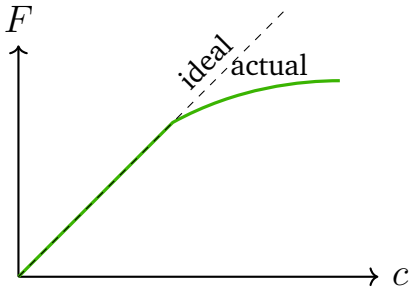
(A) 5.0

(B) 1.0

(C) 4.0

(D) 0.25

Q119. The fluorimetric calibration graph plots emission intensity F against concentration c. The plot is linear at low concentration but bends over (deviates downward) at high concentration. This high-concentration deviation is primarily attributed to:



(A) Inner-filter (self-absorption / self-quenching) effects at high concentration

(B) Failure of the detector at low light levels

(C) An increase in the quantum yield with concentration

(D) The Stokes shift becoming negative

Q120. Phenolphthalein is a suitable indicator for the titration of a strong acid with a strong base, but *not* ideal for titrating a weak acid with a weak

base, mainly because phenolphthalein changes colour over the approximate pH range:

(A) 1.2 – 2.8 (red to yellow)

(B) 3.1 – 4.4 (red to orange)

(C) 6.0 – 7.6 (yellow to blue)

(D) 8.3 – 10.0 (colourless to pink)

Q121. In ICH Q2 method validation, the measure of an analytical procedure's capacity to remain unaffected by small, deliberate variations in method parameters (e.g. slight change in mobile-phase pH or flow rate) is termed:

(A) Robustness

(B) Linearity

(C) Specificity

(D) Detection limit

Q122. A solution transmits 10% of the incident monochromatic light at its λ_{max} (i.e. transmittance $T = 0.10$). The corresponding absorbance $A = -\log_{10} T$ of the solution is:

(A) 0.10

(B) 0.90

(C) 1.0

(D) 2.0

Part E: Pharmacognosy & Natural Products

Q123. Several pharmacopoeias arrange their monographs of crude drugs in the simple sequence Acacia, Belladonna, Cinchona, Digitalis, Ergot, and so on, irrespective of botany, chemistry or use. This basis of arranging crude drugs is called:

(A) Pharmacological classification

(B) Alphabetical classification

(C) Chemical classification

(D) Taxonomical classification

Q124. A pharmacognosist groups crude drugs strictly according to the botanical family, genus and species of the source plant, for instance placing all Solanaceae drugs together. This basis of grouping is the:

(A) Taxonomical (botanical) classification

(B) Chemical classification

(C) Pharmacological classification

(D) Morphological classification

Q125. In the morphological scheme of classification, crude drugs are placed in "organized" groups based on the plant part used. Which of the following pairs are **both subterranean (underground) organized drugs**?

(A) Senna leaf and clove bud

(B) Cinchona bark and nux vomica seed

(C) Ginger rhizome and ipecac root

(D) Fennel fruit and ergot sclerotium

Q126. Galantamine, a reversible cholinesterase inhibitor used in mild-to-moderate Alzheimer's disease, is an Amaryllidaceae alkaloid originally isolated from the bulbs of the snowdrop. Its botanical source is:

(A) *Galanthus nivalis*

(B) *Vinca minor*

(C) *Colchicum autumnale*

(D) *Lupinus albus*

Q127. Hyoscine (scopolamine), a tropane alkaloid bearing an epoxide bridge across the tropane ring and used as an anti-emetic for motion sickness, is obtained commercially in highest yield from the leaves of which Australian plant?

(A) *Erythroxylum coca*

(B) *Lobelia inflata*

(C) *Papaver somniferum*

(D) *Duboisia myoporoides*

Q128. Sparteine, an oxytocic and class-Ia antiarrhythmic alkaloid from broom tops (*Cytisus scoparius*), is built from two fused piperidine rings sharing a single nitrogen. To which structural class of alkaloids does it belong?

(A) Tropane alkaloid

(B) Quinolizidine (lupin) alkaloid

(C) Indole alkaloid

(D) Purine alkaloid

Q129. Jervine and cyclopamine, teratogenic steroidal alkaloids isolated from the rhizomes of *Veratrum* species, possess a nitrogen incorporated into a modified steroid skeleton. They are best classified as:

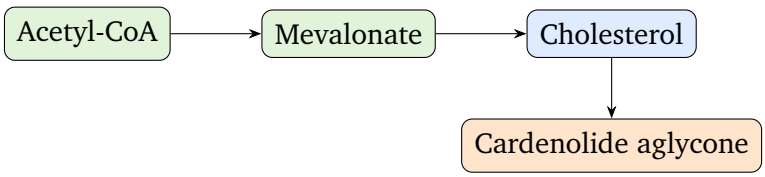
(A) Isoquinoline alkaloids

(B) Tropane alkaloids

(C) Steroidal alkaloids (pseudo-alkaloids)

(D) Imidazole alkaloids

Q130. The biosynthetic scheme below traces the origin of the steroidal aglycone of cardiac glycosides such as k-strophanthin in *Strophanthus* seeds.



The C_{23} cardenolide aglycone (e.g. strophanthidin) is therefore derived from a sterol precursor formed through which pathway?

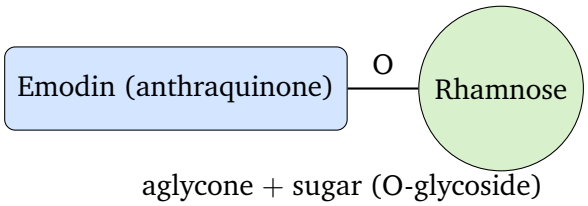
(A) Shikimic acid pathway

(B) Acetate–malonate pathway

(C) Pentose phosphate pathway

(D) Acetate–mevalonate pathway (via cholesterol)

Q131. Frangulin, the active purgative glycoside of frangula (alder buckthorn) bark, is shown schematically below as an aglycone joined to a sugar.



The aglycone (genin) of frangulin and the sugar it carries are, respectively:

(A) Emodin (an anthraquinone) and rhamnose

(B) Digitoxigenin (a steroid) and digitoxose

(C) Quercetin (a flavonol) and rutinose

(D) Hesperetin (a flavanone) and glucose

Q132. On hydrolysis the purgative glycoside sennoside A yields glucose and an aglycone formed by two anthrone units linked at their 10,10′ positions. This dimeric anthrone aglycone of senna is named:

(A) Barbaloin

(B) Sennidin (a dianthrone)

(C) Aloe-emodin

(D) Chrysophanol

Q133. Diosmin, a flavonoid glycoside used to improve venous tone in chronic venous insufficiency, is the 7-rutinoside of diosmetin. Chemically it therefore belongs to the same broad class as:

(A) Cardiac (steroidal) glycosides

(B) Anthraquinone glycosides

(C) Flavonoid glycosides

(D) Cyanogenetic glycosides

Q134. Indican, the colourless glycoside present in the leaves of *Indigofera tinctoria*, on enzymatic hydrolysis liberates glucose and an aglycone that air-oxidises to the blue dye indigo. The aglycone released is:

(A) Hydroquinone

(B) Coumarin

(C) Salicyl alcohol

(D) Indoxyl (3-hydroxyindole)

Q135. Star anise, the dried fruit of *Illicium verum*, yields a volatile oil whose chief constituent ($\sim$80–90%) is a phenylpropene also found in aniseed and fennel. This constituent is:

(A) *trans*-Anethole

(B) Eugenol

(C) Carvone

(D) Citral

Q136. Sweet basil herb (*Ocimum basilicum*) yields an aromatic volatile oil whose principal odour constituents are linalool together with an isomer of anethole. That isomeric phenylpropene is:

(A) Menthone

(B) Methyl chavicol (estragole)

(C) Thymol

(D) Cinnamaldehyde

Q137. Vetiver oil, distilled from the washed and dried roots of *Vetiveria zizanioides* and prized as a fixative in perfumery, is dominated by which class of terpenoid constituents?

(A) Monoterpene hydrocarbons

(B) Phenylpropanoids

(C) Sesquiterpenes (e.g. khusimol, vetiverol)

(D) Diterpene alcohols

Q138. Siam benzoin, a balsamic resin obtained by incising the trunk of *Styrax tonkinensis*, is distinguished from Sumatra benzoin by the type of aromatic acid it contains. Siam benzoin yields chiefly esters of:

(A) Cinnamic acid only

(B) Gallic acid

(C) Salicylic acid

(D) Benzoic acid (largely free of cinnamic acid)

Q139. Xanthan gum, a high-molecular-weight polysaccharide widely used as a suspending and viscosity-building agent, is produced not by a plant but by aerobic fermentation using the bacterium:

(A) *Xanthomonas campestris*

(B) *Astragalus gummifer*

(C) *Acacia senegal*

(D) *Cyamopsis tetragonoloba*

Q140. In the mevalonate pathway the C_5 isoprene unit isopentenyl pyrophosphate (IPP) is assembled by way of mevalonic acid. How many molecules of acetyl-CoA are condensed to form one molecule of mevalonate (and hence one IPP unit)?

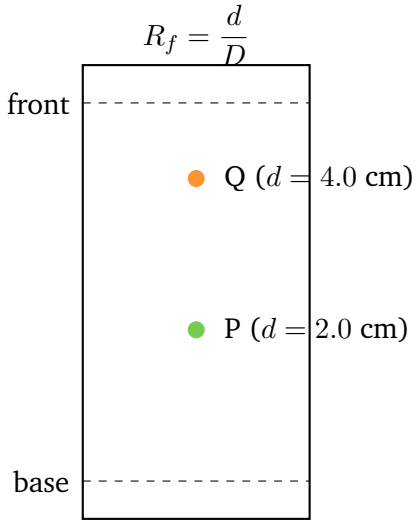
(A) Two molecules of acetyl-CoA

(B) Three molecules of acetyl-CoA

(C) Four molecules of acetyl-CoA

(D) Six molecules of acetyl-CoA

Q141. The TLC plate below was developed to standardise a herbal extract; two constituents resolved as spots P and Q above the spotting line, with the solvent front D reaching 5.0 cm.



Taking distances from the baseline, the R_f values of spots P and Q are, respectively:

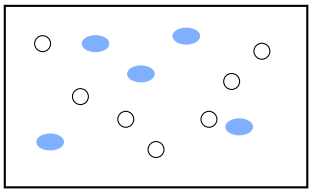
(A) 0.50 and 1.00

(B) 0.20 and 0.40

(C) 0.40 and 0.80

(D) 0.25 and 0.50

Q142. The leaf surface preparation below is used in quantitative microscopy. The stomata (S) and ordinary epidermal cells (E) are counted within a defined field.



S = stomata (filled), E = epidermal cells (open)

The ratio $\dfrac{S}{S+E} \times 100$, which is constant for a species and independent of leaf maturity, is defined as the:

(A) Palisade ratio

(B) Vein-islet number

(C) Stomatal number

(D) Stomatal index

Part F: Pharmaceutical Biotechnology & Microbiology

Q143. Each enzyme below is paired with its recognition sequence and cut position. Which one is a **blunt-end** cutter that cleaves a 6-bp palindrome exactly at its centre?

(A) *Eco*RV, which cuts GAT↓ATC at the centre, leaving blunt ends

(B) *Hin*dIII, which cuts A↓AGCTT, leaving 5′ overhangs

(C) *Sal*I, which cuts G↓TCGAC, leaving 5′ overhangs

(D) *Kpn*I, which cuts GGTAC↓C, leaving 3′ overhangs

Q144. To clone DNA fragments in the **0.2–2 megabase** range (far larger than a BAC can carry stably), and to propagate them in yeast complete with a centromere, two telomeres, and an autonomously replicating sequence, the vector used is the:

(A) Cosmid built on the λ *cos* site

(B) Yeast artificial chromosome (YAC)

(C) Phagemid rescued by helper phage

(D) pBR322-derived plasmid

Q145. In a real-time quantitative PCR (qPCR) run using SYBR Green chemistry, the parameter that is inversely related to the starting amount of target template, so that a more abundant template gives a **lower** value, is the:

(A) Annealing temperature of the primers

(B) Length of the amplicon in base pairs

(C) Threshold cycle (C_t), the cycle at which fluorescence crosses the threshold

(D) Melting temperature (T_m) of the final product

Q146. Which one of the following recombinant therapeutic peptides is the 1–34 N-terminal fragment of **human parathyroid hormone**, used as an anabolic agent to stimulate new bone formation in severe osteoporosis?

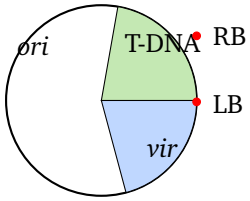
(A) Becaplermin (recombinant PDGF)

(B) Urokinase

(C) Recombinant human growth hormone (somatropin)

(D) Teriparatide (recombinant hPTH 1–34)

Q147. The circular plasmid below is the **Ti plasmid** of *Agrobacterium tumefaciens*, carrying a T-DNA region (flanked by left and right borders), *vir* genes, and an origin. In plant genetic engineering, the segment that is actually transferred into and integrated within the plant-cell genome is the:



(A) The *vir* region, which directly inserts into plant chromosomes

(B) The origin of replication

(C) The whole Ti plasmid intact

(D) The T-DNA segment lying between the left and right borders

Q148. The classical **acetone–butanol–ethanol (ABE) fermentation**, historically important for industrial solvent production from carbohydrate feedstocks, is carried out by the anaerobic, spore-forming bacterium:

(A) *Gluconobacter oxydans*

(B) *Clostridium acetobutylicum*

(C) *Xanthomonas campestris*

(D) *Propionibacterium freudenreichii*

Q149. Monosodium glutamate (MSG) is made industrially from **L-glutamic acid**, produced by aerobic fermentation of carbohydrates under biotin-limited conditions by:

(A) *Aspergillus niger*

(B) *Saccharomyces cerevisiae*

(C) *Corynebacterium glutamicum*

(D) *Lactobacillus delbrueckii*

Q150. **Gibberellic acid**, a plant-growth-regulator hormone produced on a commercial scale by submerged fermentation, is obtained from the fungus:

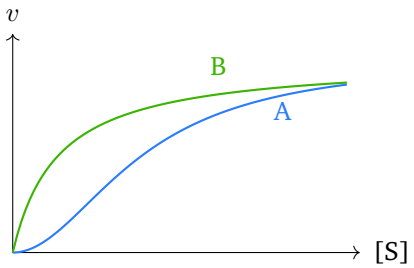
(A) *Gibberella fujikuroi* (*Fusarium moniliforme*)

(B) *Ashbya gossypii*

(C) *Penicillium griseofulvum*

(D) *Rhizopus arrhizus*

Q151. The plot of initial velocity v against [S] for an allosteric enzyme (curve A) is **sigmoidal**, unlike the hyperbolic Michaelis–Menten curve (B). The sigmoidal shape and a Hill coefficient $n_H > 1$ indicate:



(A) That the enzyme obeys simple Michaelis–Menten kinetics with one site

(B) That the substrate is acting as a competitive inhibitor

(C) Positive cooperativity between multiple substrate-binding subunits

(D) That V_{max} is independent of substrate concentration

Q152. Among enzyme-immobilization techniques, the method in which the enzyme is bound to a support through stable **covalent bonds** formed between functional groups of the enzyme (e.g. amino or carboxyl) and an activated carrier is:

(A) Entrapment within a calcium-alginate gel lattice

(B) Encapsulation inside a semipermeable microcapsule

(C) Physical adsorption onto activated charcoal

(D) Covalent attachment to a chemically activated matrix

Q153. In an immediate (Type I) allergic response, the antibody that binds via its Fc region to high-affinity FcεRI receptors on **mast cells and basophils**, so that subsequent antigen cross-linking triggers histamine release, is:

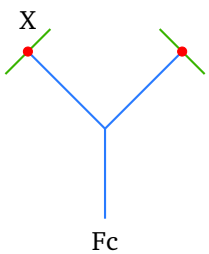
(A) IgG

(B) IgE

(C) IgM

(D) IgA

Q154. In **antibody-dependent cell-mediated cytotoxicity (ADCC)**, the IgG antibody coats a target cell through its Fab arms (region X below), while the effector NK cell engages the antibody through its Fcγ receptor binding the antibody's:



(A) Fc region (the stem of the Y), which is recognised by Fcγ receptors on NK cells

(B) Variable region at X, which the NK cell binds

(C) Hinge region, which inserts into the target membrane

(D) Light chain only, independent of the heavy chain

Q155. In the WHO naming scheme for therapeutic monoclonal antibodies, a **chimeric** antibody (mouse variable regions grafted onto human constant regions, for example rituximab) is identified by the sub-stem:

(A) `-omab` (fully murine)

(B) `-umab` (fully human)

(C) `-zumab` (humanised)

(D) `-ximab` (chimeric)

Q156. The tuberculin (Mantoux) skin reaction and contact dermatitis to nickel, which develop over 24–72 hours and are mediated by sensitised **T lymphocytes and macrophages** (not antibody), are examples of:

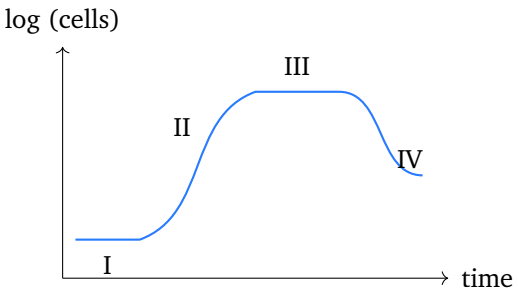
(A) Type IV (delayed, cell-mediated) hypersensitivity

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

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

(D) Type III (immune-complex) hypersensitivity

Q157. Spore-forming bacteria such as *Bacillus* are stained by the Schaeffer–Fulton method, in which heat drives **malachite green** into the resistant spore (which then resists decolourisation) while the vegetative cell takes up the safranin counterstain. On the growth curve below, the formation of these endospores (sporulation) is triggered mainly during the labelled phase:



(A) Phase I (lag), as soon as cells are inoculated

(B) Phase III (stationary), where nutrient depletion triggers sporulation; spores stain green and cells red

(C) Phase II (log), at the maximal growth rate

(D) No phase, because sporulation is unrelated to the growth curve

Q158. In validation of moist-heat sterilisation, the $\mathbf{F_0}$ **value** of a process is defined as the:

(A) Temperature rise needed to cut the D-value to one-tenth

(B) Number of decimal reductions achieved at the spore's D-value

(C) Equivalent lethal time, in minutes, delivered at 121°C (with $z = 10$°C reference)

(D) Initial bioburden of the product before sterilisation

Q159. Sterile pharmaceutical products are filled under a unidirectional (laminar) air stream passed through a **HEPA filter**. The critical filling zone must meet the cleanest air grade, equivalent to ISO Class 5 / Grade A, historically called:

(A) Class 100 (no more than 100 particles $\geq$0.5 μm per cubic foot)

(B) Class 100 000

(C) Class 10 000

(D) An uncontrolled (unclassified) area

Q160. The **minimum inhibitory concentration (MIC)** of an antibiotic determined by the broth-dilution method is read as the:

(A) Highest antibiotic concentration that still allows visible turbid growth

(B) Lowest antibiotic concentration that prevents visible turbidity (growth) in the tube

(C) Concentration that kills 100% of the inoculum on subculture (this defines the MBC)

(D) Diameter of the zone of inhibition on an agar plate

Detailed Solutions

Q1.

Solution

Concept — Solubility product (1:2 salt): For $PbCl_2 \rightleftharpoons Pb^{2+} + 2\,Cl^-$, $K_{sp} = [Pb^{2+}][Cl^-]^2 = (s)(2s)^2 = 4s^3$. **Reasoning:** $s = 2.0 \times 10^{-2}$, so $K_{sp} = 4(2.0 \times 10^{-2})^3 = 4 \times 8.0 \times 10^{-6} = 3.2 \times 10^{-5}$. **Why the other options are wrong:**

- (A) 4.0×10^{-4} is $s^2 \times 1$, ignoring the factor 4 and the cube.
- (B) 8.0×10^{-6} is s^3 without the factor of 4.
- (D) 2.0×10^{-2} is the solubility s itself.

Final Answer: $K_{sp} = 4s^3 = 3.2 \times 10^{-5} \Rightarrow$ C

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Partition / fraction extracted: With equal volumes, fraction in oil $= \dfrac{P}{P+1}$ and fraction in water $= \dfrac{1}{P+1}$. **Reasoning:** $P = 4$, so fraction in oil $= 4/(4+1) = 4/5 = 0.80$. **Why the other options are wrong:**

- (A) 0.20 is the fraction left in water, $1/(P+1)$.
- (C) 0.25 is $1/P$, not the equal-volume fraction.
- (D) 0.40 misplaces a factor.

Final Answer: fraction in oil $= P/(P+1) = 0.80 \Rightarrow$ B

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Cloud point: On heating, non-ionic (e.g. polyoxyethylene) surfactants progressively dehydrate; above a characteristic temperature the solution turns cloudy as surfactant phase-separates. **Reasoning:** That temperature is the cloud point, a key stability parameter for non-ionic surfactant systems. **Why the other options are wrong:**

- (B) The Krafft point is the temperature *above* which ionic surfactant solubil-

ity rises sharply (micelles form), the opposite phenomenon.
- (C) The eutectic temperature relates to melting of solid mixtures, not surfactant turbidity.
- (D) The inversion temperature is where an emulsion changes type (o/w $\rightarrow$ w/o).

Final Answer: turbidity of a heated non-ionic surfactant = cloud point $\Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Thixotropy: A time-dependent reversible reduction in apparent viscosity under shear; structure breaks down on shearing and rebuilds on standing. **Reasoning:** The up-curve and down-curve do not coincide; the down-curve lies below, enclosing a hysteresis loop, the diagnostic signature of thixotropy (desirable in shake-before-use suspensions and gels). **Why the other options are wrong:**

- (A) Newtonian flow is a single straight line through the origin, no loop.
- (B) Dilatant flow shears-thicken but is time-independent, no hysteresis loop.
- (C) Bingham plastic has a yield value but again no loop.

Final Answer: hysteresis loop (structure breakdown/recovery) = thixotropy $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Ostwald viscometer: From Poiseuille's law, for the same viscometer $\eta = K\rho t$, where ρ is density, t flow time, K an instrument constant. **Reasoning:** Thus dynamic viscosity is proportional to the *product* of density and flow time; the relative viscosity of two liquids is $(\rho_1 t_1)/(\rho_2 t_2)$. **Why the other options are wrong:**

- (A) Flow time alone gives kinematic viscosity ($\nu = \eta/\rho = Kt$), not dynamic.
- (B) Viscosity rises (not falls) with flow time.
- (D) Dividing density by time inverts the time dependence.

Final Answer: $\eta \propto \rho t \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Carr's index: Carr's % $= \dfrac{\rho_{tapped} - \rho_{bulk}}{\rho_{tapped}} \times 100$. **Reasoning:** $= \dfrac{0.45 - 0.36}{0.45} \times 100 = \dfrac{0.09}{0.45} \times 100 = 20\%$, indicating fair-to-passable flow. **Why the other options are wrong:**

- (A) 25% wrongly uses bulk density in the denominator.
- (C) 16% mixes up the densities.
- (D) 9% forgets to express the difference as a percentage of tapped density.

Final Answer: $(0.09/0.45) \times 100 = 20\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Specific surface area: For a sphere of diameter d and density ρ, surface area $= \pi d^2$ and mass $= \rho \pi d^3/6$, so specific surface $S_w = 6/(\rho d)$. **Reasoning:** $S_w \propto 1/d$; halving the particle diameter doubles the specific surface area. This is why micronisation raises dissolution rate. **Why the other options are wrong:**

- (B) Larger particles have *less* surface per unit mass, not more.
- (C) Surface area per mass clearly depends on size.
- (D) Volume (and mass) scales with d^3, but specific surface scales with $1/d$.

Final Answer: $S_w = 6/(\rho d) \propto 1/d \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Modal size class: The mode is the size interval represented by the tallest bar in the frequency histogram. **Reasoning:** The tallest bar (height 3.0) is the fourth one, spanning the 35–45 μm interval (labelled at the 35 μm class). Hence the modal class is 35–45 μm. **Why the other options are wrong:**

- (A) 5–15 is one of the shortest bars.
- (B) 15–25 is a rising, sub-modal bar.
- (C) 25–35 is still below the peak.

Final Answer: tallest bar lies in 35–45 μm $\Rightarrow$ D

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Henderson–Hasselbalch: $\text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$. **Reasoning:** salt:acid $= 10:1$, so $\log(10) = 1$ and $\text{pH} = 4.20 + 1 = 5.20$. **Why the other options are wrong:**

- (A) 3.20 corresponds to a 1:10 (acid-rich) ratio, $\log(0.1) = -1$.
- (B) 4.20 is the pK_a (equal salt and acid).
- (D) 6.20 would need a 100:1 ratio.

Final Answer: $\text{pH} = 4.20 + 1 = 5.20 \Rightarrow$ C

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Sodium chloride equivalent (E): E is the weight of sodium chloride that gives the same osmotic (tonicity) effect as 1 g of the drug. **Reasoning:** If a drug has $E = 0.2$, then 1 g of that drug is osmotically equivalent to 0.2 g NaCl; E values are used to adjust ophthalmic and parenteral solutions to isotonicity. **Why the other options are wrong:**

- (A) Reverses the definition (NaCl per drug, not drug per NaCl).

- (C) A fixed NaCl concentration is not the meaning of E.
- (D) Freezing-point depression is a related but different (cryoscopic) method.

Final Answer: $E =$ g NaCl osmotically equal to 1 g drug $\Rightarrow$ B

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — First-order half-life: $t_{1/2} = \dfrac{0.693}{k}$, so $k = \dfrac{0.693}{t_{1/2}}$. **Reasoning:** $k = 0.693/50 = 0.01386 \approx 0.0139$ h^{-1}. **Why the other options are wrong:**

- (B) 0.0693 h^{-1} uses $t_{1/2} = 10$ h.
- (C) 0.693 h^{-1} uses $t_{1/2} = 1$ h.
- (D) 72.1 h^{-1} inverts the relation $(50/0.693)$.

Final Answer: $k = 0.693/50 = 0.0139$ h^{-1} $\Rightarrow$ A

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Order by plot: Zero-order: $C = C_0 - k_0 t$, so a plot of C (not ln C) versus t is a straight line of slope $-k_0$. **Reasoning:** A linear C vs t plot directly identifies zero-order kinetics (e.g. suspensions, where solid drug keeps the solution saturated). **Why the other options are wrong:**

- (A) First-order gives a linear $\ln C$ vs t plot.
- (B) Second-order gives a linear $1/C$ vs t plot.
- (C) Pseudo-first-order also gives a linear $\ln C$ vs t plot.

Final Answer: linear C vs $t \Rightarrow$ zero-order $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Arrhenius plot: Taking logs of $k = Ae^{-E_a/RT}$ gives $\ln k = \ln A - \frac{E_a}{R} \cdot \frac{1}{T}$. **Reasoning:** A plot of $\ln k$ vs $1/T$ is a straight line of slope $-E_a/R$ and intercept $\ln A$; the negative slope reflects faster degradation at higher temperature. **Why the other options are wrong:**

- (A) $+E_a/R$ would give a positive slope, contradicting the observed negative slope.
- (B) $\ln A$ is the intercept, not the slope.
- (D) $-A/R$ is not a term in the Arrhenius equation.

Final Answer: slope $= -E_a/R \Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Freundlich linearisation: $\log(x/m) = \log k + \frac{1}{n} \log C$. **Reasoning:** Comparing with $y = c + mx$, the slope of the $\log(x/m)$ vs $\log C$ line is $1/n$ and the intercept is $\log k$. **Why the other options are wrong:**

- (A) $\log k$ is the intercept, not the slope.
- (C) n is the reciprocal of the slope.
- (D) k is obtained from the antilog of the intercept, not the slope.

Final Answer: slope $= 1/n \Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Eutectic phase diagram regions: Below a liquidus branch but above the eutectic temperature, solid of one component coexists with the residual liquid melt. **Reasoning:** Region R lies under the left (component A) liquidus and above the eutectic horizontal, so it contains solid A in equilibrium with liquid melt; only at E (and below) is the system fully solid. **Why the other options are wrong:**

- (B) The solid eutectic mixture forms only at or below the eutectic temperature line, not in R.
- (C) Pure liquid of both components exists only *above* both liquidus lines.
- (D) No vapour phase is represented on this temperature–composition (condensed) diagram.

Final Answer: R contains solid A + liquid melt $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Sink conditions: The dissolution medium volume is large enough (usually $\geq 3\times$ saturation volume) that dissolved C never exceeds about 10–15% of C_s. **Reasoning:** With $C \ll C_s$, the driving force $(C_s - C) \approx C_s$ stays near-maximal, so dissolution proceeds at a rate set by the solid, mimicking in-vivo absorption. **Why the other options are wrong:**

- (A) h is not made zero; it is the stagnant diffusion layer.
- (B) Surface area changes as particles dissolve; sink conditions do not fix A.
- (C) C_s is a constant property of the drug, not reduced to zero.

Final Answer: $C \ll C_s$ keeps driving force near-maximal $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Higuchi model: $Q = k_H\sqrt{t}$; release from a homogeneous matrix/ointment is diffusion-controlled, so the cumulative amount is linear with $\sqrt{t}$. **Reasoning:** A straight line of Q vs $\sqrt{t}$ through the origin (slope k_H) is the signature of the Higuchi square-root-of-time model. **Why the other options are wrong:**

- (A) Zero-order plots Q linearly vs t (not $\sqrt{t}$).
- (B) First-order plots $\log(\%$ remaining$)$ linearly vs t.
- (D) Hixson–Crowell plots the cube root of remaining mass vs t.

Final Answer: Q vs $\sqrt{t}$ linear $\Rightarrow$ Higuchi model $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — BCS: Class I high sol/high perm; Class II low sol/high perm; Class III high sol/low perm; Class IV low sol/low perm. **Reasoning:** Poor solubility with high permeability, absorption limited by dissolution, is the defining profile of Class II (e.g. many lipophilic drugs benefiting from solubility enhancement). **Why the other options are wrong:**

- (A) Class I is high solubility/high permeability.
- (C) Class III is high solubility/low permeability.
- (D) Class IV is low solubility/low permeability.

Final Answer: low solubility + high permeability $\Rightarrow$ Class II $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — f_2 similarity factor: $f_2 = 50 \log\left\{[1 + \frac{1}{n}\sum(R_t - T_t)^2]^{-0.5} \times 100\right\}$, ranging 0–100. **Reasoning:** f_2 between 50 and 100 means the average difference between test and reference at each time point is small, so the two dissolution profiles are judged similar. **Why the other options are wrong:**

- (B) 0–15 indicates clearly dissimilar profiles.
- (C) 15–50 still indicates dissimilarity ($f_2 < 50$).
- (D) f_2 cannot exceed 100, so 100–150 is impossible.

Final Answer: profiles similar when $f_2 = 50$–$100 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Glidant: A glidant improves the flow of a powder blend by reducing inter-particle friction; talc and colloidal silica are common examples. **Reasoning:**

Added in small amounts to aid uniform die-filling, talc here functions chiefly as a glidant (it can also act as a lubricant, but the flow-into-die role described is glidant action). **Why the other options are wrong:**

- (A) Binders impart cohesion to granules (e.g. PVP).
- (B) Disintegrants break the tablet up after swallowing.
- (C) Diluents add bulk (e.g. lactose, MCC).

Final Answer: talc improving flow into the die = glidant $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Enteric coating: Enteric polymers are insoluble in acidic gastric pH but dissolve at the higher pH of the intestine, delaying release. **Reasoning:** Cellulose acetate phthalate (CAP) carries free phthalic-acid groups that ionise and dissolve only above about pH 6, so it is a classic enteric (gastro-resistant) coating. **Why the other options are wrong:**

- (A) A sugar-coating syrup is a cosmetic/protective coat, not pH-dependent.
- (B) An immediate-release film former (e.g. plain HPMC) dissolves in the stomach.
- (D) A subcoating sealant only smooths the core; it does not resist gastric acid.

Final Answer: CAP is an enteric coating polymer $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept — Weight variation: Limits $= \bar{w} \pm (\%\text{tolerance}) \times \bar{w}$. **Reasoning:** 7.5% of 250 mg $= 18.75$ mg, so the range is $250 \pm 18.75 = 231.25$ to 268.75 mg. **Why the other options are wrong:**

- (A) 237.5–262.5 corresponds to $\pm 5\%$.
- (C) 242.5–257.5 corresponds to $\pm 3\%$.
- (D) 225–275 corresponds to $\pm 10\%$.

Final Answer: $250 \pm 18.75 = 231.25$–268.75 mg $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Displacement value (DV): Mass of base $=$ (number $\times$ mould wt) $-$ $\frac{\text{total drug}}{DV}$. **Reasoning:** Total mould capacity $= 10 \times 1 = 10$ g. Total drug $= 10 \times 0.4 = 4$ g, which displaces $4/DV = 4/2 = 2$ g of base. Base required $= 10 - 2 = 8$ g. **Why the other options are wrong:**

- (A) 10.0 g ignores the drug displacement entirely.
- (B) 6.0 g subtracts the full 4 g of drug instead of the displaced 2 g.
- (C) 9.6 g uses a wrong DV factor.

Final Answer: base $= 10 - (4/2) = 8.0$ g $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Dilution test: An emulsion can be diluted only with its own external (continuous) phase without breaking. **Reasoning:** The unknown disperses uniformly in water, so water is the continuous phase, identifying it as an oil-in-water (o/w) emulsion. **Why the other options are wrong:**

- (B) A w/o emulsion would *not* dilute with water (it would with oil).
- (C) The simple uniform dilution does not indicate a multiple w/o/w system.

- (D) A dry emulsion is a reconstitutable powder, not relevant to this test.

Final Answer: dilutes with water ⇒ o/w emulsion ⇒ A

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Degree of flocculation: $\beta = \dfrac{F}{F_\infty}$, comparing the sedimentation volume of the flocculated system to that of the deflocculated one. **Reasoning:** $\beta = 0.75/0.15 = 5.0$, meaning the flocculated sediment occupies five times the volume of the deflocculated sediment. **Why the other options are wrong:**

- (A) 0.20 is the inverted ratio F_∞/F.
- (B) 0.90 has no basis in the data.
- (D) 0.60 confuses β with the difference $F - F_\infty$.

Final Answer: $\beta = 0.75/0.15 = 5.0 \Rightarrow$ C

Answer: (C) Go Back to Q25

Q26.

Solution

Concept — Dry-heat sterilisation: Dry heat kills micro-organisms (and destroys pyrogens) by oxidation; it needs higher temperatures and longer times than moist heat. **Reasoning:** The standard reference cycles are 160°C for 2 h or 180°C for 30 min, used for glassware, oils and powders. **Why the other options are wrong:**

- (A) 121°C/15 min at 15 psi is the *moist-heat* (autoclave) cycle.
- (C) 100°C/30 min is sub-sterilising (Tyndallisation step).
- (D) Membrane filtration is for heat-labile solutions, not glass/metal.

Final Answer: dry heat = 160°C/2 h (or 180°C/30 min) ⇒ B

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Water-soluble base: PEG (polyethylene glycol) bases are anhydrous, contain no fat or hydrocarbon, and are completely washable with water. **Reasoning:** A blend of liquid (PEG 400) and solid (PEG 4000) PEGs gives a smooth, water-soluble base, classified as a water-soluble (PEG) ointment base. **Why the other options are wrong:**

- (A) Oleaginous bases are hydrocarbons (e.g. petrolatum), not water-washable.
- (B) Absorption bases take up water but remain greasy (e.g. wool fat).
- (C) Water-removable bases are o/w creams containing both oil and water phases.

Final Answer: PEG blend = water-soluble base $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Liquefied-gas propellant: In a sealed canister, liquid propellant is in equilibrium with its vapour; the vapour pressure depends only on temperature, not on the amount of liquid left. **Reasoning:** As long as some liquid propellant remains, the headspace pressure stays constant, giving a uniform spray (constant delivery) throughout the canister's use. **Why the other options are wrong:**

- (B) The vapour pressure stays constant (does not rise) while liquid remains.
- (C) Compressed-gas systems do show falling pressure; the constant-spray advantage belongs to liquefied gases.
- (D) A headspace vapour phase is essential to the mechanism.

Final Answer: constant vapour pressure while liquid remains $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Colloid mill: A colloid mill has a high-speed conical rotor running close to a fixed stator; the very narrow gap subjects the fluid to intense shear. **Reasoning:** It is used for *wet* milling to make fine emulsions, suspensions and ointments, reducing droplet/particle size by shear rather than impact. **Why the other options are wrong:**

- (A) A ball mill grinds dry/wet solids by impact and attrition of balls.
- (B) A hammer mill reduces size by high-speed impact of hammers (dry).
- (D) A fluid energy mill micronises dry powders by air-jet collision.

Final Answer: rotor–stator shear (wet milling) $=$ colloid mill $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Reynolds number: $\text{Re} = \dfrac{\rho v d}{\eta}$ classifies the flow regime: < 2100 laminar, 2100–4000 transitional, > 4000 turbulent. **Reasoning:** The chaotic, swirling sketch (ii) is turbulent flow, which corresponds to $\text{Re} > 4000$. **Why the other options are wrong:**

- (A) $\text{Re} < 2100$ is the smooth laminar pattern (i).
- (C) $\text{Re} = 2100$ is the lower edge of the transitional zone, not fully turbulent.
- (D) Re between 1 and 100 is firmly laminar.

Final Answer: turbulent flow $\Rightarrow \text{Re} > 4000 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Equilibrium moisture content (EMC): The moisture a solid retains when in equilibrium with the air's temperature and humidity; it sets the lower limit of drying. **Reasoning:** No further water can be removed below the EMC under those conditions; the removable moisture above it is the "free moisture". **Why the other options are wrong:**

- (B) Free moisture is the *removable* water (total minus equilibrium).
- (C) Unbound moisture exerts full vapour pressure and is readily removed.
- (D) Critical moisture content is the point where drying changes from constant-rate to falling-rate, not the irreducible residue.

Final Answer: irreducible residue = equilibrium moisture content $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q31

Q32.

Solution

Concept — Sterilising-grade filtration: A membrane is sterilising-grade if it reliably removes bacteria (*Brevundimonas diminuta*) from the fluid. **Reasoning:** The recognised nominal pore size for sterilising filtration is 0.22 μm (often quoted as 0.2 μm), used for heat-labile parenterals. **Why the other options are wrong:**

- (A) 5.0 μm and (B) 1.2 μm are clarifying/prefilter grades.
- (C) 0.45 μm removes most bacteria but is a bioburden-reduction grade, not sterilising.

Final Answer: sterilising-grade membrane = 0.22 μm $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Solid lipid nanoparticles (SLNs): Colloidal carriers (50–1000 nm) made from lipids that are *solid* at room/body temperature, dispersed in water and stabilised by surfactant. **Reasoning:** The solid lipid core entraps drug and controls its release, combining advantages of emulsions, liposomes and polymeric nanoparticles while avoiding organic-solvent residues. **Why the other options are wrong:**

- (A) A phospholipid bilayer around an aqueous core describes liposomes.
- (B) Non-ionic surfactant bilayer vesicles describe niosomes.
- (D) Cross-linked polymer microspheres are a different (polymeric) carrier.

Final Answer: solid-lipid matrix stabilised by surfactant = SLN $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept — Elementary osmotic pump (EOP): An osmotic core is surrounded by a rigid semipermeable membrane with a small laser-drilled orifice. **Reasoning:** Water osmoses in through the membrane, dissolving the core and generating pressure that pushes saturated drug solution out through the orifice at a constant (zero-order) rate, independent of gastrointestinal pH or motility. **Why the other options are wrong:**

- (B) The coat is semipermeable to water but not freely permeable to drug by diffusion.
- (C) The tablet does not disintegrate; the coat stays intact.
- (D) Matrix swelling/erosion describes hydrophilic-matrix systems, not osmotic pumps.

Final Answer: osmotic influx expels drug through the orifice $\Rightarrow$ A

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Absolute bioavailability: F is the fraction of an administered dose that reaches the systemic circulation unchanged; an IV dose is fully available ($F = 1$) and serves as the reference. **Reasoning:** Because total drug exposure is measured by the area under the concentration-time curve (AUC), for equal doses $F = \mathrm{AUC}_{oral}/\mathrm{AUC}_{IV}$. The peak height and t_{max} reflect absorption *rate*, not the total amount absorbed. **Why the other options are wrong:**

- (A), (B) C_{max} depends on rate of absorption and distribution, not total fraction absorbed.
- (D) t_{max} is a timing parameter, unrelated to extent of absorption.

Final Answer: $F = \mathrm{AUC}_{oral}/\mathrm{AUC}_{IV} \Rightarrow$ C

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Loading dose: A loading dose immediately fills the apparent volume of distribution to reach the target concentration: Loading dose $= (V_d \times C_{target})/F$. **Reasoning:** With $V_d = 40$ L, $C_{target} = 5$ mg/L and $F = 1$, the loading dose $= 40 \times 5 = 200$ mg. Unlike the maintenance dose, the loading dose depends on the volume of distribution, not on clearance. **Why the other options are wrong:**

- (B) 8 mg divides instead of multiplying (C/V_d).
- (C) 45 mg has no rational basis.
- (D) 0.125 mg is off by orders of magnitude.

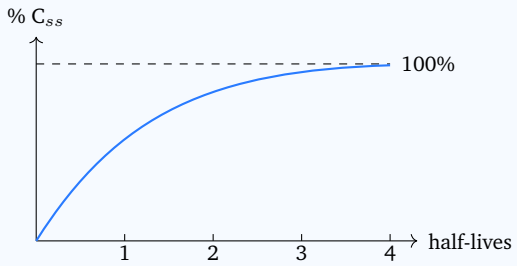
Final Answer: $40 \times 5 = 200$ mg $\Rightarrow$ A

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — Approach to steady state: During a constant infusion the plasma level rises exponentially toward steady state, gaining one half of the remaining gap each half-life. **Reasoning:** After 1 $t_{1/2}$ the level is 50%, after 2 it is 75%, after 3 it is 87.5%, and after 4 half-lives it is about 93.75% ($\approx 94\%$) of steady state. Practically, steady state is regarded as reached in 4–5 half-lives.



Why the other options are wrong:

- (A) One half-life gives only 50%.
- (B) Two give 75%.
- (C) Three give 87.5%, not 94%.

Final Answer: About 94% is reached in 4 half-lives $\Rightarrow$ D

Answer: (D) Go Back to Q37

Q38.

Solution

Concept — Therapeutic index: The therapeutic index measures drug safety as the separation between the toxic/lethal and effective dose populations. **Reasoning:** The standard TI $= \mathrm{LD}_{50}/\mathrm{ED}_{50}$ (or $\mathrm{TD}_{50}/\mathrm{ED}_{50}$ in humans). A larger ratio means a wider safety margin. A more conservative "certain safety factor" uses $\mathrm{LD}_{1}/\mathrm{ED}_{99}$, but the classic TI is option (B). **Why the other options are wrong:**

- (A) Inverts the ratio, giving a number < 1 for safe drugs.
- (C) $\mathrm{LD}_{1}/\mathrm{ED}_{99}$ is the stricter certain safety factor, not the standard TI.
- (D) A difference of dose values is not the defined index.

Final Answer: TI $= \mathrm{LD}_{50}/\mathrm{ED}_{50} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Phases of drug metabolism: Phase I reactions (oxidation, reduction, hydrolysis) introduce or expose a functional group; Phase II reactions conjugate the drug or metabolite with an endogenous moiety. **Reasoning:** Glucuronidation, sulfation and acetylation (and glutathione, glycine and methyl conjugation) are Phase II synthetic reactions that generally raise water solubility and promote renal or biliary excretion. Glucuronidation is the most common. **Why the other options are wrong:**

- (A) P450 oxidation is Phase I, not conjugation.
- (B) Tubular secretion is an excretory transport process, not metabolism.
- (D) Enterohepatic recirculation is a disposition pattern, not a conjugation reaction.

Final Answer: Conjugations are Phase II reactions $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Enzyme induction: An inducer increases the synthesis (or reduces degradation) of a metabolising enzyme, raising metabolic capacity over days to weeks. **Reasoning:** A CYP3A4 inducer (e.g. rifampicin, carbamazepine) speeds metabolism of a CYP3A4 substrate, lowering its plasma concentration and possibly causing therapeutic failure (a key reason oral contraceptives can fail with rifampicin). **Why the other options are wrong:**

- (B) Raised levels and toxicity describe an *inhibitor*.
- (C) Induction clearly changes substrate exposure.
- (D) Induction does not switch the order of kinetics.

Final Answer: Induction increases metabolism and lowers substrate level $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q40

Q41.

Solution

Concept — Acetylator polymorphism: N-acetyltransferase-2 (NAT2) activity is bimodally distributed; slow acetylators accumulate drugs cleared by acetylation. **Reasoning:** Isoniazid is acetylated by NAT2. Slow acetylators reach higher isoniazid levels and have a greater risk of dose-related peripheral neuropathy (preventable with pyridoxine). Hydralazine and procainamide are other NAT2 substrates. **Why the other options are wrong:**

- (A) Amlodipine is metabolised by CYP3A4, not acetylation.
- (C) Atorvastatin is a CYP3A4 substrate.
- (D) Metformin is excreted unchanged by the kidney.

Final Answer: Isoniazid toxicity rises in slow acetylators $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept — Autonomic transmitters: All preganglionic fibres and postganglionic parasympathetic fibres release acetylcholine; most postganglionic sympathetic fibres release noradrenaline. **Reasoning:** The postganglionic sympathetic neuron releases noradrenaline acting on α- and β-adrenoceptors of the effector. The notable exceptions are sympathetic sweat glands (cholinergic, muscarinic) and the adrenal medulla (nicotinic, releasing adrenaline). **Why the other options are wrong:**

- (A) Nicotinic transmission occurs at the ganglion, not at most sympathetic effectors.
- (B) Muscarinic effectors are the parasympathetic (and sweat-gland) pattern.
- (C) Dopamine is not the general postganglionic sympathetic transmitter.

Final Answer: Noradrenaline on adrenergic receptors $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept — Choline esters: Bethanechol is a synthetic choline ester with a beta-methyl group and a carbamate, making it resistant to acetylcholinesterase and selective for muscarinic receptors. **Reasoning:** Because it is not hydrolysed by AChE, bethanechol has a longer action and selectively stimulates smooth muscle of the gut and bladder, treating post-operative and neurogenic urinary retention and abdominal distension. **Why the other options are wrong:**

- (B) Acetylcholine is rapidly destroyed by AChE and is non-selective.
- (C) Nicotine acts at nicotinic, not muscarinic, receptors.
- (D) Hexamethonium is a ganglion blocker, not a muscarinic agonist.

Final Answer: Bethanechol is the AChE-resistant muscarinic agonist $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept — β-blocker subtypes: Nebivolol is a highly β_1-selective blocker with an additional endothelial action. **Reasoning:** Nebivolol combines β_1 cardioselectivity (relatively airway-sparing) with stimulation of nitric-oxide release, producing vasodilation and a favourable haemodynamic profile in hypertension. **Why the other options are wrong:**

- (A) Carvedilol is non-selective with α_1 blockade, not β_1-selective NO-mediated dilation.
- (B) Sotalol is non-selective and a Class III antiarrhythmic.
- (D) Pindolol is non-selective with intrinsic sympathomimetic activity.

Final Answer: Nebivolol is β_1-selective with NO-mediated vasodilation $\Rightarrow$ C

Answer: (C) Go Back to Q44

Q45.

Solution

Concept — α_2-adrenoceptor agonism: Central α_2 agonists reduce sympathetic outflow from the brainstem. **Reasoning:** Dexmedetomidine is a highly selective α_2 agonist that decreases noradrenaline release in the locus coeruleus, producing sedation and analgesia with relatively preserved respiration. Clonidine shares this central α_2 mechanism. **Why the other options are wrong:**

- (A) α_1 stimulation would raise blood pressure, opposite to its main use.
- (C) β_2 agonism is bronchodilation, unrelated.
- (D) Nicotinic action describes neuromuscular agents.

Final Answer: Central α_2 agonism reducing NA release $\Rightarrow$ B

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Non-depolarizing neuromuscular blockers: These competitive nicotinic antagonists differ in onset, duration and elimination route. **Reasoning:** Pancuronium is a long-acting bis-quaternary steroidal blocker that is mainly renally

excreted and blocks cardiac muscarinic receptors, causing a vagolytic tachycardia. Its block is reversed by AChE inhibitors such as neostigmine. **Why the other options are wrong:**

- (A) Succinylcholine is a depolarizing agent, not a competitive blocker.
- (B) Dantrolene acts on the ryanodine receptor in muscle, not the NMJ.
- (C) Cisatracurium is intermediate-acting and is eliminated by Hofmann degradation, not renal excretion, and is not vagolytic.

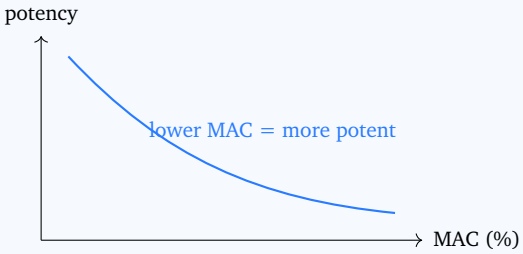
Final Answer: Pancuronium fits the long-acting renally cleared vagolytic NMB $\Rightarrow$ D

Answer: (D) Go Back to Q46

Q47.

Solution

Concept — Minimum alveolar concentration (MAC): MAC is the alveolar concentration of an inhalational anaesthetic that prevents movement to a surgical stimulus in 50% of patients. **Reasoning:** MAC is inversely related to potency. A lower MAC means a smaller concentration suffices, so the agent is more potent. The graded relationship below shows potency rising as the required MAC falls.



Why the other options are wrong:

- (B) Reverses the relationship.
- (C) Speed of induction relates to the blood-gas coefficient, not MAC potency.
- (D) A high blood-gas coefficient slows induction and is a separate property.

Final Answer: Lower MAC means greater potency $\Rightarrow$ A

Answer: (A) Go Back to Q47

Q48.

Solution

Concept — Melatonin-receptor hypnotics: Ramelteon is a selective agonist at MT_1 and MT_2 melatonin receptors. **Reasoning:** By activating melatonin receptors in the suprachiasmatic nucleus it promotes sleep onset and regulates the circadian rhythm, without acting on GABA-A receptors. Hence it lacks the dependence, abuse and next-day impairment associated with benzodiazepines. **Why the other options are wrong:**

- (A) GABA-A modulation is the benzodiazepine/Z-drug mechanism.
- (C) H_1 blockade is the sedating-antihistamine mechanism (e.g. doxylamine).
- (D) Orexin-receptor antagonism describes suvorexant.

Final Answer: MT_1/MT_2 agonism $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — Atypical antipsychotics: Second-generation agents block 5-HT_{2A} more strongly relative to D_2, lowering the risk of extrapyramidal effects. **Reasoning:** Lurasidone is an atypical antipsychotic acting as a D_2 and 5-HT_{2A} antagonist (with 5-HT_{1A} partial agonism), used in schizophrenia and bipolar depression. The serotonin-dopamine balance defines the atypical class. **Why the other options are wrong:**

- (A) Fluphenazine is a typical phenothiazine.
- (B) Trifluoperazine is a typical phenothiazine.
- (D) Pimozide is a typical (diphenylbutylpiperidine) agent.

Final Answer: Lurasidone is the 5-HT_{2A}/D_2 atypical $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q49

Q50.

Solution

Concept — SNRIs vs SSRIs: Serotonin-noradrenaline reuptake inhibitors block both transporters, whereas SSRIs block only the serotonin transporter. **Reasoning:**

Desvenlafaxine (the active metabolite of venlafaxine) inhibits reuptake of both serotonin and noradrenaline, useful in depression and certain pain syndromes. The dual action distinguishes it from the SSRI options. **Why the other options are wrong:**

- (A) Escitalopram is a pure SSRI.
- (B) Fluvoxamine is an SSRI.
- (C) Paroxetine is an SSRI.

Final Answer: Desvenlafaxine is the SNRI $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q50

Q51.

Solution

Concept — Mixed opioid agonist-antagonists: These drugs activate one opioid receptor while blocking another, giving a ceiling on respiratory depression. **Reasoning:** Nalbuphine is a κ-receptor agonist and μ-receptor antagonist. The κ action gives analgesia while the limited μ effect produces a ceiling for respiratory depression, although it can precipitate withdrawal in μ-dependent patients. **Why the other options are wrong:**

- (B) A pure μ full agonist (like morphine) lacks this ceiling.
- (C) SSRI activity is unrelated to opioid analgesia.
- (D) It is not a COX inhibitor.

Final Answer: κ-agonist/μ-antagonist mixed action $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q51

Q52.

Solution

Concept — Sodium-channel antiepileptics: Traditional agents (phenytoin, carbamazepine) bind the fast-inactivated state; lacosamide enhances the slow-inactivated state. **Reasoning:** Lacosamide selectively potentiates the slow inactivation of voltage-gated sodium channels, stabilising hyperexcitable neuronal membranes without affecting physiological firing as much, controlling focal seizures. **Why the other options are wrong:**

- (A) T-type calcium block is the ethosuximide mechanism.
- (C) GABA-transaminase inhibition is the vigabatrin mechanism.
- (D) AMPA antagonism is the perampanel mechanism.

Final Answer: Enhances slow Na^+-channel inactivation $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q52

Q53.

Solution

Concept — Ester vs amide local anaesthetics: Amides (two "i"s in the name, e.g. lidocaine, articaine) are metabolised hepatically; esters are hydrolysed by plasma esterases. **Reasoning:** Articaine is an amide local anaesthetic (it also has an ester side-chain that allows rapid plasma hydrolysis, giving a short half-life), widely used in dentistry. Its amide linkage classifies it with lidocaine. **Why the other options are wrong:**

- (A) Procaine is an ester.
- (B) Tetracaine is an ester.
- (D) Benzocaine is an ester.

Final Answer: Articaine is the amide-type agent $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q53

Q54.

Solution

Concept — MAO-B inhibitors in Parkinson's disease: Selective MAO-B inhibition reduces central dopamine breakdown, prolonging dopaminergic action. **Reasoning:** Rasagiline is a selective, irreversible MAO-B inhibitor used as monotherapy in early disease or as an adjunct to levodopa. Unlike selegiline, it is not metabolised to amphetamine derivatives. **Why the other options are wrong:**

- (A) Apomorphine is a dopamine receptor agonist.
- (B) Entacapone is a COMT inhibitor.
- (C) Trihexyphenidyl is an antimuscarinic.

Final Answer: Rasagiline is the selective MAO-B inhibitor $\Rightarrow$ D

Answer: (D) Go Back to Q54

Q55.

Solution

Concept — Angiotensin receptor blockers (ARBs): ARBs antagonise angiotensin II at the AT_1 receptor, blocking its vasoconstrictor and aldosterone-releasing effects. **Reasoning:** Olmesartan selectively blocks AT_1 receptors, lowering blood pressure. Because it does not inhibit ACE, it does not raise bradykinin, so the dry cough seen with ACE inhibitors is uncommon. **Why the other options are wrong:**

- (B) ACE inhibition describes enalapril, not an ARB.
- (C) Direct renin inhibition describes aliskiren.
- (D) Aldosterone antagonism describes spironolactone/eplerenone.

Final Answer: Selective AT_1 receptor blockade $\Rightarrow$ A

Answer: (A) Go Back to Q55

Q56.

Solution

Concept — Dihydropyridine calcium-channel blockers: Dihydropyridines act mainly on vascular L-type calcium channels, causing arteriolar dilation. **Reasoning:** Lercanidipine blocks vascular smooth-muscle L-type calcium channels, reduc-

ing peripheral resistance and lowering blood pressure with relatively little direct cardiac depression. Its vascular selectivity gives a smooth, gradual effect. **Why the other options are wrong:**

- (A) AV-nodal slowing is the non-dihydropyridine (verapamil/diltiazem) action.
- (C) β_1 blockade is a different class.
- (D) Na^+/K^+-ATPase inhibition is the digoxin mechanism.

Final Answer: Vascular L-type calcium-channel block $\Rightarrow$ B

Answer: (B) Go Back to Q56

Q57.

Solution

Concept — Class III antiarrhythmics: These prolong the action-potential duration and refractory period by blocking potassium channels. **Reasoning:** Dronedarone is a non-iodinated amiodarone analogue with predominant Class III potassium-channel block plus Class I, II and IV (multichannel) actions. The lack of iodine reduces the thyroid and pulmonary toxicity seen with amiodarone. **Why the other options are wrong:**

- (A), (B), (D) Each names only one class; dronedarone's dominant action is Class III with additional multichannel effects.

Final Answer: Predominant Class III K^+-channel block $\Rightarrow$ C

Answer: (C) Go Back to Q57

Q58.

Solution

Concept — Phosphodiesterase-3 inhibitors: PDE-3 inhibitors raise cAMP, increasing cardiac contractility and relaxing vascular smooth muscle (inodilators). **Reasoning:** Milrinone inhibits PDE-3, slowing cAMP breakdown. In the heart the higher cAMP raises intracellular calcium and contractile force, while in vessels it causes vasodilation, lowering afterload. This is useful in acute decompensated heart failure. **Why the other options are wrong:**

- (A) Na^+/K^+-ATPase inhibition is the digoxin mechanism.

- (B) It does not directly activate β_1 receptors (that is dobutamine).
- (C) It does not block angiotensin receptors.

Final Answer: PDE-3 inhibition raising cAMP $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q58

Q59.

Solution

Concept — Direct oral anticoagulants (DOACs): Factor Xa inhibitors directly block activated factor X without needing antithrombin. **Reasoning:** Apixaban is an oral, reversible direct factor Xa inhibitor given at a fixed dose with a predictable response, so routine INR or aPTT monitoring is not required. This contrasts with warfarin (INR) and unfractionated heparin (aPTT). **Why the other options are wrong:**

- (B) Vitamin-K epoxide reductase inhibition and INR monitoring describe warfarin.
- (C) Antithrombin potentiation and aPTT monitoring describe heparin.
- (D) DOACs have a rapid onset; warfarin is the slow-loading agent.

Final Answer: Oral direct factor Xa inhibitor, no routine monitoring $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q59

Q60.

Solution

Concept — Second-generation H_1 antihistamines: These are poorly lipophilic, P-glycoprotein substrates that cross the blood-brain barrier minimally, so they cause little sedation. **Reasoning:** Bilastine is a non-sedating second-generation H_1 antagonist for allergic rhinitis and urticaria. Its limited CNS penetration avoids the drowsiness of first-generation agents like chlorpheniramine. **Why the other options are wrong:**

- (A) It blocks H_1, not H_2 receptors.
- (C) It is a receptor antagonist, not a mast-cell stabiliser.
- (D) Acetylating COX is the aspirin mechanism.

Final Answer: Non-sedating second-generation H_1 blocker $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q60

Q61.

Solution

Concept — Leukotriene-receptor antagonists: Cysteinyl leukotrienes ($LTC_4/LTD_4/LTE_4$) cause bronchoconstriction, mucus secretion and inflammation via the $CysLT_1$ receptor. **Reasoning:** Montelukast competitively blocks the $CysLT_1$ receptor, reducing bronchoconstriction and airway inflammation. It is taken orally as add-on therapy, especially in aspirin-sensitive and exercise-induced asthma and allergic rhinitis. **Why the other options are wrong:**

- (A) β_2 stimulation is the salbutamol mechanism.
- (B) PDE inhibition describes theophylline.
- (D) 5-Lipoxygenase inhibition is the zileuton mechanism.

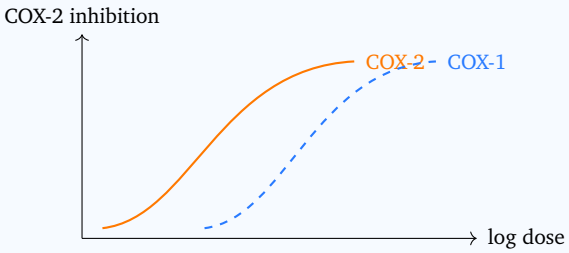
Final Answer: $CysLT_1$ receptor antagonism $\Rightarrow$ C

Answer: (C) Go Back to Q61

Q62.

Solution

Concept — Selective COX-2 inhibitors: COX-2 is the inducible isoenzyme responsible for inflammatory prostaglandins; COX-1 is constitutive and gastroprotective. **Reasoning:** Etoricoxib selectively inhibits COX-2, providing anti-inflammatory and analgesic effects while largely sparing gastric COX-1, so it causes fewer peptic ulcers than non-selective NSAIDs (though with cardiovascular caution). The dose-response below contrasts selective and non-selective inhibition.



Why the other options are wrong:

- (A) Irreversible platelet COX-1 acetylation is the aspirin mechanism.
- (B) It inhibits cyclooxygenase, not lipoxygenase.

- (C) It does not block bradykinin receptors.

Final Answer: Selective COX-2 inhibition sparing COX-1 $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q62

Q63.

Solution

Concept — Urate-lowering strategies: Urate can be lowered by reducing production (xanthine-oxidase inhibitors) or increasing excretion (uricosurics). **Reasoning:** Lesinurad is a uricosuric that inhibits the URAT1 (and OAT4) transporters in the proximal tubule, blocking urate reabsorption and increasing urinary uric-acid excretion. It is used with a xanthine-oxidase inhibitor for inadequate control. **Why the other options are wrong:**

- (B) Febuxostat inhibits xanthine oxidase (reduces production).
- (C) Allopurinol inhibits xanthine oxidase.
- (D) Colchicine treats acute inflammation, not urate level.

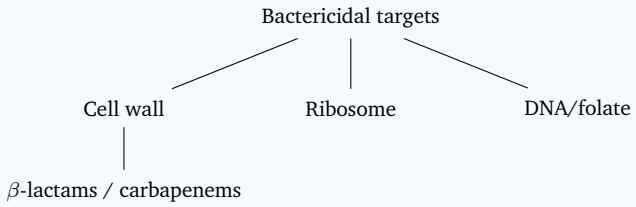
Final Answer: Lesinurad is the URAT1-inhibiting uricosuric $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q63

Q64.

Solution

Concept — Carbapenems: Carbapenems are β-lactam antibiotics with a very broad spectrum and high stability to many β-lactamases. **Reasoning:** Meropenem binds penicillin-binding proteins (transpeptidases) and inhibits peptidoglycan cross-linking, the same cell-wall target as penicillins, leading to bactericidal lysis. The receptor tree below places it among cell-wall-active agents.



Why the other options are wrong:

- (A) 50S inhibition describes macrolides/chloramphenicol.

- (C) DNA-gyrase inhibition describes fluoroquinolones.
- (D) Folate disruption describes sulfonamides.

Final Answer: PBP binding and cell-wall inhibition $\Rightarrow$ B

Answer: (B) Go Back to Q64

Q65.

Solution

Concept — Fluoroquinolones: These bactericidal agents target the bacterial enzymes that manage DNA topology. **Reasoning:** Moxifloxacin inhibits DNA gyrase (topoisomerase II) and topoisomerase IV, preventing the supercoiling and separation of DNA needed for replication and transcription, which is lethal to the bacterium. **Why the other options are wrong:**

- (A) The 30S subunit is the aminoglycoside/tetracycline target.
- (B) Dihydropteroate synthase is the sulfonamide target.
- (D) RNA polymerase is the rifampicin target.

Final Answer: DNA gyrase and topoisomerase IV inhibition $\Rightarrow$ C

Answer: (C) Go Back to Q65

Q66.

Solution

Concept — Macrolides and ketolides: These bind the 50S ribosomal subunit and block protein elongation. **Reasoning:** Telithromycin, a ketolide, binds two sites on the 50S subunit (domains II and V of 23S rRNA), obstructing the polypeptide exit tunnel and inhibiting translocation. The dual binding restores activity against some macrolide-resistant strains. **Why the other options are wrong:**

- (A) DNA gyrase is the fluoroquinolone target.
- (B) PBPs are the β-lactam target.
- (C) The 30S subunit is the aminoglycoside/tetracycline target.

Final Answer: Binds the 50S subunit blocking the exit tunnel $\Rightarrow$ D

Answer: (D) Go Back to Q66

Q67.

Solution

Concept — SGLT2 inhibitors: The sodium-glucose cotransporter-2 reabsorbs most filtered glucose in the proximal tubule. **Reasoning:** Dapagliflozin inhibits SGLT2, reducing renal glucose reabsorption and increasing urinary glucose loss, which lowers blood glucose independently of insulin. The class also gives modest weight and blood-pressure reduction and cardiorenal benefit. **Why the other options are wrong:**

- (B) Sulfonylurea-receptor stimulation describes glipizide/glimepiride.
- (C) Hepatic gluconeogenesis suppression is the metformin mechanism.
- (D) Intestinal α-glucosidase inhibition describes acarbose.

Final Answer: Renal SGLT2 inhibition causing glucosuria $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q67

Q68.

Solution

Concept — Specific antidotes: Effective poisoning management often relies on a matched antidote that targets the toxic mechanism. **Reasoning:** Hydroxocobalamin binds cyanide to form cyanocobalamin (vitamin B_{12}), which is renally excreted, making it a first-line antidote in cyanide poisoning (e.g. smoke inhalation). Option (B) is the correct pairing. **Why the other options are wrong:**

- (A) Iron overdose is treated with deferoxamine, not flumazenil.
- (C) β-blocker overdose is treated with glucagon (and high-dose insulin), not naloxone.
- (D) Methanol poisoning is treated with fomepizole or ethanol, not atropine.

Final Answer: Cyanide $\rightarrow$ hydroxocobalamin is correct $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q68

Q69.

Solution

Concept — Pd-catalysed cross-coupling: Different organometallic partners define each named coupling. **Reasoning:** Coupling of an aryl/vinyl **boronic acid** (or ester) with an aryl halide under a Pd(0) catalyst and base is the Suzuki–Miyaura coupling, the standard route to biaryls in drug synthesis. **Why the other options are wrong:**

- (A) Heck couples an alkene with an aryl halide, not a boronic acid.
- (B) Stille uses an organostannane (toxic tin reagent).
- (D) Sonogashira couples a terminal alkyne (with Cu co-catalyst).

Final Answer: Suzuki–Miyaura coupling $\Rightarrow$ C

Answer: (C) Go Back to Q69

Q70.

Solution

Concept — Fused N-heterocycles: Benzene fused to a six-membered N-ring gives quinoline or isoquinoline depending on the nitrogen position. **Reasoning:** A benzene ring fused to a pyridine ring with the nitrogen at position 1 (adjacent to the ring fusion) is quinoline, the scaffold of chloroquine and the fluoroquinolones. **Why the other options are wrong:**

- (A) Indole is benzene fused to a five-membered pyrrole, not pyridine.
- (C) Isoquinoline has the nitrogen at position 2 (a different isomer).
- (D) Quinazoline has two nitrogens in the six-membered ring.

Final Answer: The ring system is quinoline $\Rightarrow$ B

Answer: (B) Go Back to Q70

Q71.

Solution

Concept — Conformational strain in butane: Eclipsing bonds raises torsional strain; close bulky groups add steric (van der Waals) strain. **Reasoning:** When the two methyls eclipse each other (dihedral 0°, the syn/fully eclipsed form), bonds are eclipsed (maximum torsional strain) and the methyls are closest (maximum

steric strain), so this is the highest-energy conformation. **Why the other options are wrong:**

- (A) It has steric strain too, not torsional alone.
- (B) Strain is maximal here, not absent.
- (C) The global minimum is the anti (staggered) form, not this one.

Final Answer: Both maximal torsional and steric strain $\Rightarrow$ D

Answer: (D) Go Back to Q71

Q72.

Solution

Concept — Elimination mechanisms: E1 is stepwise via a carbocation; E2 is concerted and bimolecular. **Reasoning:** A tertiary alcohol forms a stable tertiary carbocation after protonation/loss of water; loss of a β-proton then gives the alkene. The rate depends only on substrate (first order), so it is E1. **Why the other options are wrong:**

- (B) E2 is concerted with no carbocation and is second order.
- (C) E1cb proceeds via a carbanion, favoured by acidic β-H and a poor leaving group.
- (D) S_N2 is substitution, not elimination.

Final Answer: E1 (unimolecular elimination) $\Rightarrow$ A

Answer: (A) Go Back to Q72

Q73.

Solution

Concept — Diazine heterocycles: Three isomeric six-membered rings with two nitrogens differ by their relative positions. **Reasoning:** Nitrogens at the 1- and 3-positions (*meta*) define pyrimidine, the core of cytosine, thymine and uracil. **Why the other options are wrong:**

- (A) Pyridazine has the nitrogens at 1,2 (*ortho*).
- (B) Pyrazine has the nitrogens at 1,4 (*para*).
- (D) Pyridine has only one nitrogen.

Final Answer: The heterocycle is pyrimidine $\Rightarrow$ C

Answer: (C) Go Back to Q73

Q74.

Solution

Concept — S_NAr (addition–elimination): Electron-poor aryl halides react with nucleophiles via a stabilised carbanion. **Reasoning:** Strong electron-withdrawing nitro groups *ortho/para* to the leaving chloride stabilise the anionic Meisenheimer intermediate, allowing hydroxide to substitute. This is nucleophilic aromatic substitution (S_NAr). **Why the other options are wrong:**

- (A) EAS involves an electrophile attacking an electron-rich ring.
- (C) Free-radical substitution needs initiators/light, not this pathway.
- (D) E2 is an elimination, not aromatic substitution.

Final Answer: Nucleophilic aromatic substitution (S_NAr) $\Rightarrow$ B

Answer: (B) Go Back to Q74

Q75.

Solution

Concept — Tautomerism: Tautomers are constitutional isomers interconverting by migration of a hydrogen and a double bond. **Reasoning:** The keto form (C=O with α-CH) and the enol form (C=C–OH) differ only in the position of one H and the double bond, so the equilibrium is keto–enol tautomerism. **Why the other options are wrong:**

- (B) Geometric isomers do not interconvert by H migration.
- (C) Resonance forms share identical atomic positions; only electrons move.
- (D) Optical isomerism involves chirality, not a moving H.

Final Answer: Keto–enol tautomerism $\Rightarrow$ A

Answer: (A) Go Back to Q75

Q76.

Solution

Concept — Five-membered ring synthesis: A 1,4-diketone is the key precursor in the Paal–Knorr route. **Reasoning:** The Paal–Knorr synthesis cyclises a 1,4-diketone to a furan (acid), a pyrrole (primary amine/ammonia) or a thiophene (P_2S_5/Lawesson's reagent). **Why the other options are wrong:**

- (A) Fischer indole uses an arylhydrazone, not a 1,4-diketone.
- (B) Knorr pyrrole uses an α-aminoketone plus a β-ketoester.
- (C) Hantzsch thiazole uses an α-haloketone plus a thioamide.

Final Answer: Paal–Knorr synthesis $\Rightarrow$ D

Answer: (D) Go Back to Q76

Q77.

Solution

Concept — Chair cyclohexane: Equatorial positions point outward and avoid 1,3-diaxial clashes. **Reasoning:** A bulky group placed axial suffers 1,3-diaxial steric strain with the two axial hydrogens on the same face; placing it equatorial avoids this, so the equatorial conformer is favoured. **Why the other options are wrong:**

- (A) Axial is destabilised by 1,3-diaxial interactions.
- (C) The two positions are not energetically equal for a bulky group.
- (D) The boat form is higher in energy than the chair.

Final Answer: The equatorial position is favoured $\Rightarrow$ B

Answer: (B) Go Back to Q77

Q78.

Solution

Concept — α-Amino-acid synthesis: The Strecker route builds an α-aminonitrile then hydrolyses it. **Reasoning:** An aldehyde + NH_3 + HCN gives an α-aminonitrile, which on acid hydrolysis yields the α-amino acid. This is the Strecker synthesis. **Why the other options are wrong:**

- (A) Gabriel synthesis makes primary amines from phthalimide, not amino

acids this way.

- (B) Hofmann degradation shortens amides to amines.
- (D) Curtius rearranges an acyl azide to an isocyanate/amine.

Final Answer: Strecker synthesis $\Rightarrow$ C

Answer: (C) Go Back to Q78

Q79.

Solution

Concept — Carbocation stabilisation: Adjacent C–H σ bonds can overlap with an empty p-orbital. **Reasoning:** More α C–H bonds means more hyperconjugative donation into the empty p-orbital (reinforced by the +I inductive effect), so tertiary > secondary > primary > methyl in stability, matching the falling energies in the diagram. **Why the other options are wrong:**

- (A) $-$I withdrawal would destabilise, not stabilise, the cation.
- (B) The trend is electronic, not steric strain relief.
- (C) These are acyclic alkyl cations, not aromatic systems.

Final Answer: Hyperconjugation (with +I) $\Rightarrow$ D

Answer: (D) Go Back to Q79

Q80.

Solution

Concept — C–N cross-coupling: Pd with bulky phosphine ligands enables arylamine bond formation. **Reasoning:** The Buchwald–Hartwig amination couples an aryl halide with an amine using a Pd catalyst, a bulky phosphine ligand and a base to form an aryl C–N bond. **Why the other options are wrong:**

- (B) Ullmann (classical) is Cu-mediated and makes diaryl ethers/amines under harsher conditions.
- (C) Mitsunobu couples an alcohol and a nucleophile via DEAD/PPh_3, not Pd.
- (D) Chichibabin aminates pyridine with sodamide, a different reaction.

Final Answer: Buchwald–Hartwig amination $\Rightarrow$ A

Answer: (A) Go Back to Q80

Q81.

Solution

Concept — Specific rotation: A standardised measure of optical activity independent of path length and concentration. **Reasoning:** Specific rotation $[\alpha]_{\lambda}^{T} = \alpha/(l \cdot c)$ normalises the observed rotation to 1 dm path length and 1 g/mL concentration at a stated wavelength/temperature. **Why the other options are wrong:**

- (A) Optical density is an absorbance term, not rotation.
- (B) Molar absorptivity relates to UV/Vis absorption.
- (D) A dihedral angle is a conformational descriptor.

Final Answer: Specific rotation $[\alpha] \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q81

Q82.

Solution

Concept — Amide-to-amine degradation: Treatment with Br_2/NaOH removes the carbonyl carbon. **Reasoning:** The Hofmann bromamide reaction converts $RCONH_2$ to RNH_2 (one fewer carbon) through an N-bromoamide, then migration to an isocyanate, which hydrolyses to the amine. **Why the other options are wrong:**

- (A) Gabriel synthesis builds amines from phthalimide, not by C-loss.
- (C) Reductive amination forms C–N bonds from carbonyls and amines.
- (D) Mannich gives β-aminoketones, not this degradation.

Final Answer: Hofmann bromamide degradation $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q82

Q83.

Solution

Concept — ACE-inhibitor SAR: ACE is a zinc metallopeptidase; inhibitors anchor to the active-site Zn^{2+}. **Reasoning:** Captopril uniquely carries a sulfhydryl (–SH) group that coordinates the catalytic zinc strongly, giving its potency (and also its thiol-related side effects such as rash/taste disturbance). **Why the other options are wrong:**

- (A) A carboxylate is the zinc-binding group in enalapril/lisinopril, not captopril.
- (B) A phosphinate is used in fosinopril, not captopril.
- (C) Hydroxamic acids chelate metals but are not captopril's group.

Final Answer: The sulfhydryl (–SH) group $\Rightarrow$ D

Answer: (D) Go Back to Q83

Q84.

Solution

Concept — Antihistamine generations: CNS penetration governs the sedative effect of H_1 blockers. **Reasoning:** Second-generation agents are more polar / are P-glycoprotein substrates, so they poorly cross the blood–brain barrier and cause little central H_1 blockade, hence minimal sedation. **Why the other options are wrong:**

- (B) They are still effective peripheral H_1 antagonists.
- (C) Most are given orally.
- (D) They are active drugs, not unactivated prodrugs.

Final Answer: They poorly cross the blood–brain barrier $\Rightarrow$ A

Answer: (A) Go Back to Q84

Q85.

Solution

Concept — Pharmacophore: The essential 3D feature pattern recognised by the target. **Reasoning:** The pharmacophore is the spatial arrangement of H-bond donors/acceptors, charged/hydrophobic features necessary for molecular recognition and activity; it is central to rational design and virtual screening. **Why the other options are wrong:**

- (A) An auxophore modulates but is not essential for activity.
- (C) A chromophore confers colour/absorption, not target binding per se.
- (D) A metabolite is a transformation product.

Final Answer: The pharmacophore $\Rightarrow$ B

Answer: (B) Go Back to Q85

Q86.

Solution

Concept — Targeted prodrugs: An azo linkage cleaved only by colonic bacteria delivers the drug locally. **Reasoning:** Sulfasalazine's azo bond survives the upper gut and is reduced by colonic bacterial azoreductase, releasing 5-ASA at the inflamed colon, i.e. site-specific (colon-targeted) delivery. **Why the other options are wrong:**

- (A) It is not designed for CNS entry.
- (B) The rationale is local targeting, not half-life prolongation.
- (D) It is not a transdermal lipophilicity strategy.

Final Answer: Site-specific (colon-targeted) delivery $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q86

Q87.

Solution

Concept — Competitive antagonism: A reversible competitive antagonist is surmountable by more agonist. **Reasoning:** It shifts the agonist dose–response curve to the right in a parallel manner while the maximal response ($E_{\max}$) is preserved, because excess agonist can outcompete the antagonist. **Why the other options are wrong:**

- (A) A reduced $E_{\max}$ is the hallmark of non-competitive/irreversible antagonism.
- (B) An antagonist does change the curve.
- (C) An antagonist reduces, not increases, agonist potency.

Final Answer: Parallel rightward shift, $E_{\max}$ unchanged $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q87

Q88.

Solution

Concept — Lipinski's Rule of Five: Empirical limits predicting oral drug-likeness. **Reasoning:** Poor absorption is likely if more than one of: MW > 500, $\log P > 5$, H-bond donors > 5, H-bond acceptors > 10. Option (A) states these limits correctly.

Why the other options are wrong:

- (B) The thresholds are far too low.
- (C) The thresholds are far too high.
- (D) The inequalities are reversed (drug-likeness needs values *below* the cut-offs).

Final Answer: MW$\leq$500, log$P$ $\leq$5, donors$\leq$5, acceptors$\leq$10 $\Rightarrow$ A

Answer: (A) Go Back to Q88

Q89.

Solution

Concept — QSAR methods: Hansch uses physicochemical parameters; Free–Wilson uses additive group contributions. **Reasoning:** Free–Wilson (de novo) analysis assigns each substituent at each position a constant additive activity increment using indicator (0/1) variables, requiring no measured physicochemical descriptors. **Why the other options are wrong:**

- (A) Hansch uses log$P$, σ, E_s (a linear free-energy approach).
- (C) Docking scores model 3D binding, not additive group increments.
- (D) The Topliss tree is a manual analogue-selection scheme, not an additive model.

Final Answer: Free–Wilson (de novo) analysis $\Rightarrow$ B

Answer: (B) Go Back to Q89

Q90.

Solution

Concept — Statin mechanism: Statins are competitive inhibitors of the rate-limiting step of cholesterol synthesis. **Reasoning:** Their HMG-like dihydroxy-acid moiety mimics the substrate and inhibits HMG-CoA reductase, lowering hepatic cholesterol and up-regulating LDL receptors. **Why the other options are wrong:**

- (A) COX is the target of NSAIDs.
- (B) ACE is inhibited by "-pril" antihypertensives.
- (D) Acetylcholinesterase is targeted by anticholinesterases.

Final Answer: HMG-CoA reductase $\Rightarrow$ C

Answer: (C) Go Back to Q90

Q91.

Solution

Concept — Fluoroquinolone target: They block bacterial DNA supercoiling enzymes. **Reasoning:** Fluoroquinolones inhibit DNA gyrase (topoisomerase II, the main target in Gram-negatives) and topoisomerase IV (in Gram-positives), blocking DNA replication and causing bacterial death. **Why the other options are wrong:**

- (A) Dihydropteroate synthase is the sulfonamide target.
- (B) The 50S subunit is targeted by macrolides/chloramphenicol.
- (C) Transpeptidase (PBP) is the β-lactam target.

Final Answer: DNA gyrase and topoisomerase IV $\Rightarrow$ D

Answer: (D) Go Back to Q91

Q92.

Solution

Concept — Saturated O,N-heterocycle: One oxygen and one N–H placed 1,4 define morpholine. **Reasoning:** Morpholine is the six-membered saturated ring with O at position 1 and N–H at position 4; it is a common weakly basic, water-solubilising substituent in drug molecules. **Why the other options are wrong:**

- (A) Piperazine has two nitrogens (1,4), no oxygen.
- (C) Piperidine has one nitrogen, no oxygen.
- (D) Tetrahydropyran has one oxygen and no nitrogen.

Final Answer: The ring is morpholine $\Rightarrow$ B

Answer: (B) Go Back to Q92

Q93.

Solution

Concept — Stereochemistry and toxicity: Enantiomers may differ markedly in pharmacology, and *in vivo* racemisation can negate single-enantiomer use. **Reasoning:** For thalidomide one enantiomer is sedative and the other teratogenic; crucially the enantiomers interconvert (racemise) in the body, so administering a single "safe" enantiomer would not have prevented toxicity. **Why the other options are wrong:**

- (B) Thalidomide is chiral with a stereocentre.
- (C) The enantiomers are not both inactive.
- (D) It is not a covalent DNA inhibitor.

Final Answer: Enantiomers differ (sedative vs teratogenic) and racemise *in vivo* $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q93

Q94.

Solution

Concept — Antifolate mechanism: Methotrexate is a tight-binding DHFR inhibitor. **Reasoning:** Methotrexate (a folate analogue) binds dihydrofolate reductase (DHFR) with very high affinity, blocking the regeneration of tetrahydrofolate and thus thymidylate/purine synthesis in dividing cells. **Why the other options are wrong:**

- (A) Thymidylate synthase is the target of 5-fluorouracil's active form.
- (C) Dihydropteroate synthase is a bacterial (sulfonamide) target.
- (D) Ribonucleotide reductase is targeted by hydroxyurea.

Final Answer: Dihydrofolate reductase (DHFR) $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q94

Q95.

Solution

Concept — Saturated N-heterocycle: A fully saturated six-membered ring with one nitrogen is piperidine. **Reasoning:** Piperidine is the saturated analogue of pyridine (no ring double bonds), a ubiquitous basic scaffold in haloperidol, raloxifene and many opioids. **Why the other options are wrong:**

- (A) Pyridine is aromatic (unsaturated), not saturated.
- (B) Pyrrolidine is a five-membered ring.
- (C) Morpholine also contains an oxygen.

Final Answer: The ring is piperidine $\Rightarrow$ D

Answer: (D) Go Back to Q95

Q96.

Solution

Concept — Diagnostic radiopharmaceuticals: An ideal imaging nuclide is a pure γ-emitter with a short half-life. **Reasoning:** Technetium-99m ($t_{1/2} \approx 6$ h, 140 keV γ) is eluted as pertechnetate from a ^{99}Mo/^{99m}Tc generator and is the workhorse of nuclear-medicine imaging. **Why the other options are wrong:**

- (A) Iodine-131 is a β/γ emitter used therapeutically (thyroid), not the general imaging agent.
- (B) Cobalt-60 is a high-energy source for radiotherapy/sterilisation.
- (D) Radium-226 is an alpha emitter, unsuitable for imaging.

Final Answer: Technetium-99m $\Rightarrow$ C

Answer: (C) Go Back to Q96

Q97.

Solution

Concept — Radio-opaque contrast media: Barium's high atomic number makes it X-ray opaque, but soluble Ba^{2+} is toxic. **Reasoning:** Barium sulfate is used for GI contrast precisely because it is essentially insoluble, so almost no toxic Ba^{2+} is absorbed while the dense Ba opacifies the gut to X-rays. **Why the other options are wrong:**

- (B) Barium chloride is soluble and poisonous, never given internally.
- (C) Sodium chloride is not radio-opaque.
- (D) Calcium carbonate is an antacid, not a GI contrast agent.

Final Answer: Barium sulfate ($BaSO_4$) $\Rightarrow$ A

Answer: (A) Go Back to Q97

Q98.

Solution

Concept — Henderson–Hasselbalch: $pH = pK_a + \log([A^-]/[HA])$; the log term controls the offset from pK_a. **Reasoning:** When $[A^-] = [HA]$, the ratio is 1 and $\log(1) = 0$, so $pH = pK_a$. This is also the point of maximum buffer capacity. **Why the other options are wrong:**

- (A) A 10:1 ratio gives $pH = pK_a + 1$.
- (C) A 1:10 ratio gives $pH = pK_a - 1$.
- (D) Full ionisation is not a buffer condition.

Final Answer: $[A^-] = [HA] \Rightarrow$ B

Answer: (B) Go Back to Q98

Q99.

Solution

Concept — Karl Fischer titration: a coulometric/volumetric method that reacts water with iodine and sulphur dioxide in the presence of a base. **Reasoning:** The Karl Fischer reagent consumes water stoichiometrically ($I_2 + SO_2 + 2H_2O \rightarrow$ products), so the volume or charge needed gives the moisture content directly. It is the standard pharmacopoeial assay for water in drugs and excipients. **Why the other options are wrong:**

- (A) Total ash is found by ignition, not titration.
- (B) Free acidity of an oil uses an acid–base titration, not Karl Fischer.
- (D) Saponification value is a separate alkali back-titration.

Final Answer: Karl Fischer determines water content $\Rightarrow$ C

Answer: (C) Go Back to Q99

Q100.

Solution

Concept — Beer's law calibration: $A = (\text{slope})\,c$, so $c = A/\text{slope}$. **Reasoning:** The fitted line is $A = 0.040\,c$. For the sample, $A = 0.30$, hence $c = 0.30/0.040 = 7.5\ \mu\text{g mL}^{-1}$. **Why the other options are wrong:**

- (A) 1.2 multiplies wrongly (0.30×4).
- (C) 0.012 is $A\times$ slope, the wrong operation.
- (D) 75 uses a slope of 0.0040 (a factor-of-ten error).

Final Answer: $c = 0.30/0.040 = 7.5\ \mu\text{g mL}^{-1} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q100

Q101.

Solution

Concept — Size-exclusion chromatography: separation by molecular size, larger molecules cannot enter the gel pores. **Reasoning:** Large molecules are excluded from the pores, take the shortest path through the column, and elute first; small molecules enter the pores, travel a longer effective path, and elute last. So elution is largest-first, smallest-last. **Why the other options are wrong:**

- (A) Reverses the correct order for SEC.
- (B) Charge governs ion-exchange, not size exclusion.
- (C) Hydrophobicity governs reverse-phase, not SEC.

Final Answer: Largest elute first, smallest last $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q101

Q102.

Solution

Concept — Diazotisation titration: a free primary aromatic amine reacts with nitrous acid (from sodium nitrite + HCl) to form a diazonium salt. **Reasoning:** The titrant is standard sodium nitrite. In acidic medium it generates HNO_2, which converts $-NH_2$ to $-N_2^+$ (a diazonium salt). The end point is detected with starch–iodide paste or electrometrically. **Why the other options are wrong:**

- (B) Potassium bromate is used in bromatometry, not diazotisation.

- (C) Silver nitrate is for argentometry (halide assay).
- (D) Ceric sulphate is a cerimetric oxidant, not a diazotising agent.

Final Answer: Sodium nitrite, forming a diazonium salt $\Rightarrow$ A

Answer: (A) Go Back to Q102

Q103.

Solution

Concept — Stokes shift: emitted photons have lower energy (longer wavelength) than absorbed photons. **Reasoning:** After excitation, vibrational relaxation loses some energy before emission, so the emission band sits at a longer wavelength than the absorption band. This gap is the Stokes shift, which lets emission be measured free of scattered excitation light. **Why the other options are wrong:**

- (A) There is no "Beer shift"; Beer's law concerns absorbance vs concentration.
- (B) Doppler shift relates to motion, not fluorescence relaxation.
- (D) Bathochromic shift is a general red shift of an absorption band, not the absorption–emission gap.

Final Answer: The absorption–emission gap is the Stokes shift $\Rightarrow$ C

Answer: (C) Go Back to Q103

Q104.

Solution

Concept — Resolution: $R_s = \dfrac{2(t_{R2} - t_{R1})}{w_1 + w_2}$. **Reasoning:** Here $t_{R2} - t_{R1} = 7.2 - 6.0 = 1.2$ min and $w_1 + w_2 = 0.80 + 0.80 = 1.6$ min. So $R_s = \dfrac{2 \times 1.2}{1.6} = \dfrac{2.4}{1.6} = 1.5$. **Why the other options are wrong:**

- (A) 0.75 omits the factor of 2.
- (C) 3.0 forgets to add both widths (uses one width).
- (D) 0.50 uses the reciprocal-type slip.

Final Answer: $R_s = 2(1.2)/1.6 = 1.5$ (baseline resolution) $\Rightarrow$ B

Answer: (B) Go Back to Q104

Q105.

Solution

Concept — Cerimetry end point: ferroin is the classic redox indicator for ceric titrations. **Reasoning:** Ferroin (the ferrous 1,10-phenanthroline complex) is red in its reduced form and pale blue when oxidised. At the end point the slight excess of Ce^{4+} oxidises ferroin, giving a sharp red-to-blue colour change. **Why the other options are wrong:**

- (A) Methyl orange is an acid–base indicator.
- (B) Potassium chromate is the Mohr argentometric indicator.
- (C) Eriochrome Black T is a metallochromic indicator for EDTA titrations.

Final Answer: Ferroin is the cerimetric indicator $\Rightarrow$ D

Answer: (D) Go Back to Q105

Q106.

Solution

Concept — IR group frequencies: a hydrogen-bonded O–H stretch is broad and appears near 3200–3550 cm^{-1}. **Reasoning:** The broad, intense band centred about 3350 cm^{-1} is the textbook O–H stretch of a hydrogen-bonded hydroxyl group; hydrogen bonding spreads the band over a wide range, giving its characteristic breadth. **Why the other options are wrong:**

- (B) Ester C=O is a sharp band near 1735 cm^{-1}, not 3350.
- (C) Nitrile C≡N is a sharp band near 2240 cm^{-1}.
- (D) C–Cl stretch lies near 600–800 cm^{-1}.

Final Answer: Broad 3350 cm^{-1} band is a hydrogen-bonded O–H stretch $\Rightarrow$ A

Answer: (A) Go Back to Q106

Q107.

Solution

Concept — Ion-exchange resins: a strong cation exchanger carries fixed negative groups that bind cations. **Reasoning:** A strong cation-exchange resin bears sulphonic acid ($-SO_3^-$) groups, which are fully ionised across a wide pH range and exchange mobile cations from the sample. The fixed anionic site retains positively

charged analytes. **Why the other options are wrong:**

- (A) Quaternary ammonium ($-NR_3^+$) is a strong *anion* exchanger.
- (B) Diethylaminoethyl (DEAE) is a weak *anion* exchanger.
- (D) Octadecyl (C18) chains are a reverse-phase, not ion-exchange, ligand.

Final Answer: Sulphonic acid ($-SO_3^-$) is the strong cation-exchange group $\Rightarrow$ C

Answer: (C) Go Back to Q107

Q108.

Solution

Concept — Henderson–Hasselbalch at half-neutralisation: $\mathrm{pH} = \mathrm{p}K_a + \log\dfrac{[\mathrm{A}^-]}{[\mathrm{HA}]}$. **Reasoning:** At point H exactly half the acid is neutralised, so $[\mathrm{A}^-] = [\mathrm{HA}]$ and $\log(1) = 0$. Therefore $\mathrm{pH} = \mathrm{p}K_a = 4.8$. The half-equivalence point is the centre of the buffer region. **Why the other options are wrong:**

- (A) 7.0 would be neutral, not the buffer mid-point of a weak acid.
- (C) 9.2 ($14 - \mathrm{p}K_a$) confuses the value with pOH/conjugate behaviour at the equivalence point.
- (D) 2.4 (half the $\mathrm{p}K_a$) has no theoretical basis.

Final Answer: At half-equivalence, $\mathrm{pH} = \mathrm{p}K_a = 4.8 \Rightarrow$ B

Answer: (B) Go Back to Q108

Q109.

Solution

Concept — HPLC flow path: solvent $\rightarrow$ pump $\rightarrow$ injector $\rightarrow$ column $\rightarrow$ detector. **Reasoning:** The component placed immediately after the column that senses the separated bands and produces an electrical signal is the detector (commonly a UV–visible flow cell). Its output is plotted as the chromatogram. **Why the other options are wrong:**

- (A) The reservoir holds mobile phase at the start of the path.
- (B) The pump delivers solvent before the injector.
- (C) The injector introduces the sample before the column, not after.

Final Answer: Y is the detector $\Rightarrow$ D

Answer: (D) Go Back to Q109

Q110.

Solution

Concept — AAS principle: ground-state free atoms absorb their own resonance-line radiation. **Reasoning:** In AAS the sample is atomised in a flame (or furnace); a hollow-cathode lamp emits the element's characteristic resonance line, and the ground-state atoms absorb it. The attenuation, governed by Beer's law, is proportional to the metal concentration. **Why the other options are wrong:**

- (B) Measuring emitted light describes flame emission/AES, not absorption.
- (C) Mass-to-charge measurement is mass spectrometry.
- (D) Fluorescence of a complex is fluorimetry, a different technique.

Final Answer: Absorption of resonance radiation by ground-state atoms $\Rightarrow$ A

Answer: (A) Go Back to Q110

Q111.

Solution

Concept — Potentiometry: an indicator electrode responds to the analyte ion; a reference electrode holds a fixed potential. **Reasoning:** The glass electrode develops a potential across its thin glass membrane that varies (Nernstian) with H^+ activity, so it is the indicator electrode for pH. It is paired with a constant reference (e.g. Ag/AgCl). **Why the other options are wrong:**

- (A) The reference electrode, not the glass electrode, holds the fixed potential.
- (C) Potentiometry draws essentially no current; there is no current-supplying counter electrode.
- (D) The salt bridge or junction connects half-cells; it is not the glass electrode.

Final Answer: The glass electrode is the H^+-sensitive indicator electrode $\Rightarrow$ B

Answer: (B) Go Back to Q111

Q112.

Solution

Concept — GLC separation: partitioning between an inert carrier gas and a liquid stationary phase. **Reasoning:** Components separate according to how much they partition into (and how volatile they are out of) the liquid stationary film. More volatile, less-retained analytes elute first; less volatile, strongly partitioning ones elute later. **Why the other options are wrong:**

- (A) Charge governs electrophoresis/ion exchange, not GLC.
- (B) UV absorptivity is irrelevant to GC retention.
- (D) Refractive index is a detection property, not the separation basis.

Final Answer: Volatility and partitioning into the liquid phase $\Rightarrow$ C

Answer: (C) Go Back to Q112

Q113.

Solution

Concept — Back (residual) titration: add a measured excess of reagent, then titrate the leftover. **Reasoning:** When the analyte reacts slowly, is insoluble, or gives no sharp direct end point, a known excess of standard reagent is added to drive the reaction, and the unreacted excess is titrated with a second standard solution. The analyte is found by difference. **Why the other options are wrong:**

- (A) A fast, sharp direct reaction needs no back titration.
- (B) Titrant and analyte are never the same species.
- (D) Even when a direct indicator is awkward, the defining reason for back titration is slow/insoluble reaction, not a universal lack of indicators.

Final Answer: Slow or insoluble analyte: add excess, titrate the residue $\Rightarrow$ C

Answer: (C) Go Back to Q113

Q114.

Solution

Concept — NMR reference: chemical shifts are quoted relative to TMS at $\delta = 0$. **Reasoning:** Tetramethylsilane gives a single, sharp, highly shielded signal that is chemically inert and volatile, so it is defined as $\delta = 0.00$ ppm. All other proton

shifts are measured downfield (positive δ) from it. **Why the other options are wrong:**

- (A) $\delta = 7.26$ ppm is the residual $CHCl_3$ solvent peak, not TMS.
- (B) $\delta = 10$ ppm is a typical aldehyde proton region.
- (C) $\delta = 2.5$ ppm is the residual DMSO peak, not the reference zero.

Final Answer: TMS is set at $\delta = 0.00$ ppm $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q114

Q115.

Solution

Concept — Polarity and R_f on silica: on a polar stationary phase with a non-polar mobile phase, less polar solutes move farther. **Reasoning:** Polar compounds adsorb strongly to the polar silica and lag behind (low R_f); less polar compounds interact weakly with silica, partition into the mobile phase, and travel farther (high R_f). With $R_f(\text{X}) = 0.65 > R_f(\text{Y}) = 0.20$, X is the less polar of the two. **Why the other options are wrong:**

- (B) Reverses the polarity–R_f relationship.
- (C) Different R_f values mean different polarities, not identical.
- (D) R_f legitimately ranges from 0 to 1, so values above 0.5 are perfectly possible.

Final Answer: Higher R_f means less polar, so X is less polar $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q115

Q116.

Solution

Concept — Nitrogen rule: relates molecular mass parity to the number of nitrogen atoms. **Reasoning:** For compounds of C, H, N, O (and halogens), an *odd* nominal molecular mass implies an *odd* number of nitrogen atoms; an even mass implies zero or an even number. This follows from nitrogen's even mass but odd valence. **Why the other options are wrong:**

- (A) A C, H, O-only compound has an even molecular mass.
- (C) "No heteroatoms" also gives an even molecular mass.

- (D) An even number of nitrogens gives an even mass, contradicting the odd value observed.

Final Answer: Odd molecular mass means an odd number of N atoms $\Rightarrow$ B

Answer: (B) Go Back to Q116

Q117.

Solution

Concept — Primary standard: must be pure, stable, non-hygroscopic and of high equivalent weight. **Reasoning:** Potassium hydrogen phthalate (KHP) is a stable, non-hygroscopic solid of accurately known high equivalent weight, so it is weighed directly and dissolved to standardise NaOH. Its single acidic proton gives a clean end point with phenolphthalein. **Why the other options are wrong:**

- (A) NaOH itself is hygroscopic and absorbs CO_2, so it is a secondary standard.
- (C) Concentrated HCl is volatile and of uncertain concentration.
- (D) Sodium thiosulphate is not stable enough to serve as a primary standard.

Final Answer: KHP is the ideal primary standard for NaOH $\Rightarrow$ B

Answer: (B) Go Back to Q117

Q118.

Solution

Concept — Capacity factor: $k' = \dfrac{t_R - t_0}{t_0}$. **Reasoning:** With $t_R = 5.0$ min and $t_0 = 1.0$ min, $k' = \dfrac{5.0 - 1.0}{1.0} = \dfrac{4.0}{1.0} = 4.0$. A k' between about 1 and 10 is generally considered ideal. **Why the other options are wrong:**

- (A) 5.0 uses t_R/t_0 and forgets to subtract t_0.
- (B) 1.0 equals t_0, not the capacity factor.
- (D) 0.25 is the reciprocal $t_0/(t_R - t_0)$.

Final Answer: $k' = (5.0 - 1.0)/1.0 = 4.0 \Rightarrow$ C

Answer: (C) Go Back to Q118

Q119.

Solution

Concept — Fluorimetric linearity: F is linear in c only while the solution absorbs little excitation light. **Reasoning:** At high concentration, inner-filter effects (re-absorption of emitted light and self-quenching) reduce the measured emission, so the curve bends below the ideal straight line. Fluorimetry is therefore quantified in the dilute, linear region. **Why the other options are wrong:**

- (B) Detector failure at low light would affect the low-concentration end, not the high end.
- (C) Quantum yield is an intrinsic property and does not rise with concentration to cause this bend.
- (D) The Stokes shift does not become negative; it is unrelated to this curvature.

Final Answer: Inner-filter / self-quenching effects cause the high-c deviation $\Rightarrow$ A

Answer: (A) Go Back to Q119

Q120.

Solution

Concept — Indicator transition range: an indicator is suitable only if its colour change spans the pH jump at the equivalence point. **Reasoning:** Phenolphthalein changes from colourless to pink over about pH 8.3–10.0. This range coincides with the sharp jump in a strong-acid/strong-base or weak-acid/strong-base titration, but a weak-acid/weak-base titration has only a gradual pH change with no sharp jump in this window, so phenolphthalein gives a poor end point there. **Why the other options are wrong:**

- (A) 1.2–2.8 is the range of thymol blue (first change), not phenolphthalein.
- (B) 3.1–4.4 is the methyl orange range.
- (C) 6.0–7.6 is roughly the bromothymol blue range.

Final Answer: Phenolphthalein changes over pH 8.3–10.0 $\Rightarrow$ D

Answer: (D) Go Back to Q120

Q121.

Solution

Concept — ICH Q2 robustness: resistance of a method to small deliberate parameter changes. **Reasoning:** Robustness measures whether the analytical result stays reliable when method conditions (mobile-phase pH, flow rate, column temperature, etc.) are varied slightly on purpose. A robust method tolerates these changes, indicating reliability during normal use. **Why the other options are wrong:**

- (B) Linearity is the proportionality of response to concentration.
- (C) Specificity is the ability to measure the analyte amid interferents.
- (D) Detection limit is the lowest detectable amount, not parameter tolerance.

Final Answer: Tolerance of small deliberate changes = robustness $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q121

Q122.

Solution

Concept — Absorbance–transmittance relation: $A = -\log_{10} T$. **Reasoning:** With $T = 0.10$, $A = -\log_{10}(0.10) = -(-1) = 1.0$. A solution transmitting 10% of the light therefore has an absorbance of exactly 1.0. **Why the other options are wrong:**

- (A) 0.10 confuses absorbance with the transmittance value itself.
- (B) 0.90 uses $(1 - T)$, which is not the definition of absorbance.
- (D) 2.0 corresponds to $T = 0.01$ (1% transmittance), not 10%.

Final Answer: $A = -\log_{10}(0.10) = 1.0 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q122

Q123.

Solution

Concept — Alphabetical classification: Crude drugs are listed simply in the alphabetical order of their Latin or English names, without regard to source, chemistry or action. **Reasoning:** Acacia, Belladonna, Cinchona, Digitalis, Ergot fol-

low strict alphabetical order; this is the arrangement adopted by several pharmacopoeias and dictionaries for quick reference. **Why the other options are wrong:**

- (A) Pharmacological grouping is by therapeutic action.
- (C) Chemical grouping is by constituent class.
- (D) Taxonomical grouping is by botanical family/genus.

Final Answer: A name-order listing is alphabetical classification $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q123

Q124.

Solution

Concept — Taxonomical classification: Here crude drugs are arranged according to the botanical position (family, genus, species) of the source plant. **Reasoning:** Placing all Solanaceae drugs (belladonna, stramonium, hyoscyamus) together is grouping by botanical taxonomy, which is the basis of taxonomical (phylogenetic) classification. **Why the other options are wrong:**

- (B) Chemical grouping is by constituent class.
- (C) Pharmacological grouping is by therapeutic action.
- (D) Morphological grouping is by the plant part used.

Final Answer: Grouping by botanical family/genus is taxonomical classification $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q124

Q125.

Solution

Concept — Morphological (organized) drugs: Organized drugs are subdivided into aerial parts (leaves, flowers, fruits, seeds, barks) and subterranean parts (roots, rhizomes, tubers, bulbs). **Reasoning:** Ginger is a rhizome and ipecacuanha is a root; both are underground (subterranean) organized organs, so option (C) is the correct pair. **Why the other options are wrong:**

- (A) Leaf and flower bud are aerial.
- (B) Bark and seed are aerial parts.
- (D) Fruit is aerial and ergot is a fungal sclerotium, not a subterranean organ.

Final Answer: Ginger rhizome and ipecac root are both subterranean ⇒ C

Answer: (C) Go Back to Q125

Q126.

Solution

Concept — Galantamine: Galantamine is an Amaryllidaceae alkaloid and reversible acetylcholinesterase inhibitor used in Alzheimer's disease. **Reasoning:** It was first isolated from the bulbs of the snowdrop *Galanthus nivalis* (and related *Narcissus/Leucojum* species), all of family Amaryllidaceae. **Why the other options are wrong:**

- (B) *Vinca minor* yields vincamine.
- (C) *Colchicum autumnale* yields colchicine.
- (D) *Lupinus albus* yields lupin (quinolizidine) alkaloids.

Final Answer: Galantamine comes from the snowdrop *Galanthus nivalis* ⇒ A

Answer: (A) Go Back to Q126

Q127.

Solution

Concept — Hyoscine source: Hyoscine (scopolamine) is a tropane alkaloid with a 6,7-epoxide; the richest commercial source is *Duboisia* species (Solanaceae) of Australia. **Reasoning:** *Duboisia myoporoides* and its hybrids accumulate very high levels of hyoscine in their leaves and are the principal industrial source of scopolamine. **Why the other options are wrong:**

- (A) *Erythroxylum coca* yields cocaine.
- (B) *Lobelia inflata* yields lobeline.
- (C) *Papaver somniferum* yields morphine.

Final Answer: Highest-yield hyoscine source is *Duboisia myoporoides* ⇒ D

Answer: (D) Go Back to Q127

Q128.

Solution

Concept — Quinolizidine alkaloids: The quinolizidine (lupin) alkaloids are derived from lysine and contain a bicyclic quinolizidine nucleus of two fused piperidine rings sharing one nitrogen. **Reasoning:** Sparteine from *Cytisus scoparius* has exactly this fused-piperidine (quinolizidine) framework, placing it among the lupin alkaloids. **Why the other options are wrong:**

- (A) Tropane alkaloids have a bridged azabicyclo nucleus (atropine).
- (C) Indole alkaloids contain an indole ring (reserpine).
- (D) Purine alkaloids contain a purine ring (caffeine).

Final Answer: Sparteine is a quinolizidine (lupin) alkaloid $\Rightarrow$ B

Answer: (B) Go Back to Q128

Q129.

Solution

Concept — Steroidal alkaloids: Steroidal alkaloids carry their nitrogen on a modified steroid (C_{27}) skeleton; because the nitrogen is introduced late and not from a precursor amino acid, they are grouped with pseudo-alkaloids. **Reasoning:** Jervine and cyclopamine from *Veratrum* are jerveratrum steroidal alkaloids; the nitrogen is built into the modified cholestane skeleton, so they are steroidal (pseudo-) alkaloids. **Why the other options are wrong:**

- (A) Isoquinoline alkaloids have an isoquinoline nucleus (papaverine).
- (B) Tropane alkaloids have a tropane nucleus.
- (D) Imidazole alkaloids contain an imidazole ring (pilocarpine).

Final Answer: Jervine/cyclopamine are steroidal alkaloids $\Rightarrow$ C

Answer: (C) Go Back to Q129

Q130.

Solution

Concept — Origin of cardenolide aglycones: The steroidal aglycones of cardiac glycosides are built from cholesterol, which is itself a triterpene-derived sterol assembled through the acetate–mevalonate pathway. **Reasoning:** Acetyl-CoA $\rightarrow$

mevalonate → isoprenoid units → squalene → cholesterol → cardenolide aglycone (strophanthidin). Hence the C_{23} cardenolide skeleton arises from a sterol made by the mevalonate route. **Why the other options are wrong:**

- (A) Shikimate gives aromatic amino acids/phenylpropanoids.
- (B) Acetate–malonate gives fatty acids and polyketides.
- (C) The pentose phosphate pathway gives sugars and NADPH.

Final Answer: The aglycone derives from cholesterol via the acetate–mevalonate pathway ⇒ D

Answer: (D) Go Back to Q130

Q131.

Solution

Concept — Frangulin: Frangulin is an anthraquinone glycoside of frangula (alder buckthorn) bark in which the aglycone is emodin and the sugar is rhamnose (frangulin A). **Reasoning:** On hydrolysis frangulin yields emodin (1,6,8-trihydroxy-3-methylanthraquinone) and L-rhamnose, accounting for the purgative anthraquinone action of the bark. **Why the other options are wrong:**

- (B) Digitoxigenin/digitoxose belong to cardiac glycosides of digitalis.
- (C) Quercetin/rutinose is the flavonol glycoside rutin.
- (D) Hesperetin/glucose relates to citrus flavanones, not frangula.

Final Answer: Frangulin = emodin (anthraquinone) + rhamnose ⇒ A

Answer: (A) Go Back to Q131

Q132.

Solution

Concept — Sennidin: Sennosides are dianthrone glycosides; the aglycone of sennoside A/B is sennidin, formed from two anthrone (rhein-anthrone) units joined at C-10/C-10′. **Reasoning:** Hydrolysis of sennoside A removes two glucose units to give sennidin A, a dimeric (di)anthrone aglycone responsible for the purgative effect. **Why the other options are wrong:**

- (A) Barbaloin is a C-glycoside of aloe, not the senna aglycone.
- (C) Aloe-emodin is a single anthraquinone, not the dianthrone.

- (D) Chrysophanol is a simple anthraquinone of rhubarb/senna, not the dimer.

Final Answer: The dimeric anthrone aglycone of senna is sennidin $\Rightarrow$ B

Answer: (B) Go Back to Q132

Q133.

Solution

Concept — Diosmin: Diosmin is diosmetin 7-O-rutinoside, i.e. a flavone aglycone (diosmetin) bearing the disaccharide rutinose; it is therefore a flavonoid glycoside. **Reasoning:** As a glycoside of a flavone, diosmin belongs to the flavonoid glycoside class, used (often with hesperidin) as a venotonic in chronic venous insufficiency. **Why the other options are wrong:**

- (A) Cardiac glycosides have steroidal aglycones.
- (B) Anthraquinone glycosides have anthraquinone aglycones (senna).
- (D) Cyanogenetic glycosides release HCN on hydrolysis (amygdalin).

Final Answer: Diosmin is a flavonoid glycoside $\Rightarrow$ C

Answer: (C) Go Back to Q133

Q134.

Solution

Concept — Indican: Indican is the glucoside of indoxyl; in *Indigofera tinctoria* hydrolysis by the enzyme *indimulsin* liberates glucose and indoxyl. **Reasoning:** The freed indoxyl (3-hydroxyindole) undergoes air oxidation and dimerisation to the blue pigment indigotin (indigo), explaining the use of the plant as a dye source. **Why the other options are wrong:**

- (A) Hydroquinone is the aglycone of arbutin.
- (B) Coumarin relates to coumarin glycosides (melilot).
- (C) Salicyl alcohol (saligenin) is the aglycone of salicin.

Final Answer: Indican releases indoxyl, which oxidises to indigo $\Rightarrow$ D

Answer: (D) Go Back to Q134

Q135.

Solution

Concept — Star anise oil: The volatile oil of *Illicium verum* fruit is dominated by the phenylpropene *trans*-anethole. **Reasoning:** *trans*-Anethole makes up about 80–90% of star-anise oil and gives the characteristic sweet anise odour, the same constituent found in aniseed and fennel. **Why the other options are wrong:**

- (B) Eugenol is the chief constituent of clove oil.
- (C) Carvone characterises caraway/spearmint oils.
- (D) Citral is the lemon-scented aldehyde of lemongrass.

Final Answer: Chief constituent of star-anise oil is *trans*-anethole $\Rightarrow$ A

Answer: (A) Go Back to Q135

Q136.

Solution

Concept — Basil oil: Sweet-basil oil (*Ocimum basilicum*) is characterised by linalool and methyl chavicol (estragole), the latter being an isomer of anethole. **Reasoning:** Methyl chavicol (4-allylanisole, estragole) is the para-allyl isomer of the para-propenyl anethole and is a principal odour constituent of many basil chemotypes. **Why the other options are wrong:**

- (A) Menthone is a peppermint ketone.
- (C) Thymol is the phenol of thyme/ajowan.
- (D) Cinnamaldehyde is from cinnamon bark.

Final Answer: The anethole isomer in basil oil is methyl chavicol (estragole) $\Rightarrow$ B

Answer: (B) Go Back to Q136

Q137.

Solution

Concept — Vetiver oil: Vetiver (khus) oil from the roots of *Vetiveria zizanioides* is a complex mixture dominated by sesquiterpene alcohols and ketones. **Reasoning:** Its principal constituents are sesquiterpenoids such as khusimol, vetiverol and vetivone, which give the heavy, woody fixative odour valued in perfumery. **Why the other options are wrong:**

- (A) Monoterpene hydrocarbons are light and volatile, not characteristic here.
- (B) Phenylpropanoids dominate anise/clove, not vetiver.
- (D) Diterpene alcohols are not the chief constituents of vetiver oil.

Final Answer: Vetiver oil is rich in sesquiterpenes $\Rightarrow$ C

Answer: (C) Go Back to Q137

Q138.

Solution

Concept — Benzoin types: Siam benzoin (*Styrax tonkinensis*) contains chiefly benzoic acid esters (coniferyl benzoate) and is essentially free of cinnamic acid, whereas Sumatra benzoin (*Styrax benzoin*) contains both cinnamic and benzoic acids. **Reasoning:** The distinguishing feature of Siam benzoin is the predominance of benzoic acid derivatives and the near-absence of cinnamic acid, used to differentiate the two pharmacopoeial grades. **Why the other options are wrong:**

- (A) Cinnamic acid predominates in Sumatra, not Siam, benzoin.
- (B) Gallic acid is a hydrolysable-tannin component, not a benzoin acid.
- (C) Salicylic acid is not the characteristic acid of benzoin.

Final Answer: Siam benzoin yields chiefly benzoic acid esters $\Rightarrow$ D

Answer: (D) Go Back to Q138

Q139.

Solution

Concept — Xanthan gum: Xanthan is a microbial heteropolysaccharide produced by fermentation, not a plant exudate. **Reasoning:** It is biosynthesised by the aerobic bacterium *Xanthomonas campestris* on a carbohydrate medium and recovered as a suspending/thickening agent for pharmaceutical and food use. **Why the other options are wrong:**

- (B) *Astragalus gummifer* yields tragacanth.
- (C) *Acacia senegal* yields gum arabic (acacia).
- (D) *Cyamopsis tetragonoloba* yields guar gum.

Final Answer: Xanthan gum is produced by *Xanthomonas campestris* $\Rightarrow$ A

Answer: (A) Go Back to Q139

Q140.

Solution

Concept — Mevalonate biosynthesis: Two acetyl-CoA condense to acetoacetyl-CoA, which adds a third acetyl-CoA to give HMG-CoA; HMG-CoA is reduced to mevalonate. **Reasoning:** Thus three molecules of acetyl-CoA are required to make one mevalonate, which is then decarboxylated/phosphorylated to one C_5 isoprene unit (IPP). **Why the other options are wrong:**

- (A) Two acetyl-CoA give only acetoacetyl-CoA, not mevalonate.
- (C) Four is too many for a single mevalonate.
- (D) Six acetyl-CoA would give two IPP units, not one.

Final Answer: Three acetyl-CoA form one mevalonate (one IPP) $\Rightarrow$ B

Answer: (B) Go Back to Q140

Q141.

Solution

Concept — Retardation factor (R_f): R_f equals the distance moved by the spot divided by the distance moved by the solvent front, both measured from the base-line. **Reasoning:** For P, $R_f = 2.0/5.0 = 0.40$; for Q, $R_f = 4.0/5.0 = 0.80$. Both values are dimensionless and lie between 0 and 1. **Why the other options are wrong:**

- (A) 1.00 would require Q to reach the front, which it does not.
- (B) 0.20 and 0.40 halve the true values.
- (D) 0.25 and 0.50 use a wrong solvent-front distance.

Final Answer: $R_f(\text{P}) = 0.40$ and $R_f(\text{Q}) = 0.80 \Rightarrow$ C

Answer: (C) Go Back to Q141

Q142.

Solution

Concept — Stomatal index: The stomatal index is the percentage of stomata relative to the total of stomata plus epidermal cells in a given leaf area, $I = \dfrac{S}{S+E} \times 100$. **Reasoning:** Unlike the stomatal number (count per unit area, which varies with leaf age and position), the stomatal index is essentially con-

stant for a species and is therefore a reliable diagnostic constant. **Why the other options are wrong:**

- (A) Palisade ratio counts palisade cells under one epidermal cell.
- (B) Vein-islet number counts islets per mm^2.
- (C) Stomatal number is the count per unit area and is not constant with maturity.

Final Answer: The ratio $S/(S+E) \times 100$ is the stomatal index $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q142

Q143.

Solution

Concept — Blunt vs cohesive cutters: A restriction enzyme that cleaves both strands at the exact centre of its palindrome leaves flush (blunt) ends; staggered cuts give 5′ or 3′ overhangs. **Reasoning:** *Eco*RV recognises GATATC and cuts GAT↓ATC on each strand at the centre, so the two ends are flush with no single-stranded overhang. It is a classic blunt-end enzyme. **Why the other options are wrong:**

- (B) *Hin*dIII cuts A↓AGCTT, a staggered cut giving 5′-AGCT overhangs.
- (C) *Sal*I cuts G↓TCGAC, leaving 5′ overhangs.
- (D) *Kpn*I cuts GGTAC↓C, leaving 3′ overhangs.

Final Answer: *Eco*RV cuts centrally to give blunt ends $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q143

Q144.

Solution

Concept — Cloning-vector capacity: Insert size sets the choice of vector: plasmids (∼10 kb), cosmids (∼45 kb), BACs (∼300 kb), and YACs (hundreds of kb to a few Mb). **Reasoning:** A yeast artificial chromosome carries a yeast centromere (CEN), two telomeres (TEL), and an autonomously replicating sequence (ARS), so it behaves like a real chromosome and propagates megabase inserts in yeast. It is the vector for the very largest fragments. **Why the other options are wrong:**

- (A) A cosmid holds only about 45 kb.

- (C) A phagemid carries small inserts for sequencing/display.
- (D) pBR322-type plasmids take only a few kb.

Final Answer: Megabase inserts in yeast require a YAC $\Rightarrow$ B

Answer: (B) Go Back to Q144

Q145.

Solution

Concept — Threshold cycle in qPCR: In real-time PCR, fluorescence rises with each cycle; C_t is the cycle at which signal first crosses a set threshold. More starting template crosses sooner, so C_t falls as template rises (inverse relationship). **Reasoning:** With SYBR Green binding double-stranded product, a sample rich in target reaches the threshold in fewer cycles (low C_t); a dilute sample needs more cycles (high C_t). A standard curve of C_t versus log(copy number) is linear with negative slope, allowing quantitation. **Why the other options are wrong:**

- (A) Annealing temperature is set by the primers, not by template amount.
- (B) Amplicon length is fixed by the primer design.
- (D) T_m reflects product sequence, used only for melt-curve specificity.

Final Answer: Template amount is read from the threshold cycle C_t $\Rightarrow$ C

Answer: (C) Go Back to Q145

Q146.

Solution

Concept — Recombinant peptide therapeutics: Several rDNA-derived peptides treat distinct conditions; matching the molecule to its physiology is key. **Reasoning:** Teriparatide is recombinant human parathyroid hormone residues 1–34 (hPTH 1–34). Given once daily, intermittent PTH exposure has a net **anabolic** effect, stimulating osteoblasts and new bone formation, which is why it is used in severe osteoporosis. **Why the other options are wrong:**

- (A) Becaplermin is recombinant PDGF for diabetic foot ulcers.
- (B) Urokinase is a thrombolytic (plasminogen activator).
- (C) Somatropin is recombinant growth hormone, not a PTH fragment.

Final Answer: hPTH 1–34 anabolic bone agent is teriparatide $\Rightarrow$ D

Answer: (D) Go Back to Q146

Q147.

Solution

Concept — Ti plasmid and T-DNA: *Agrobacterium tumefaciens* naturally transfers a defined segment of its Ti plasmid, the T-DNA bounded by left (LB) and right (RB) border repeats, into the plant genome; the *vir* genes encode the transfer machinery but are not themselves transferred. **Reasoning:** Only the T-DNA between the borders integrates into plant chromosomes. In engineered (disarmed) Ti vectors, the tumour genes are replaced by the gene of interest plus a marker, placed between LB and RB, so that the desired DNA is what enters the plant. **Why the other options are wrong:**

- (A) The *vir* genes act in *trans* and stay in the bacterium.
- (B) The origin maintains the plasmid in *Agrobacterium* only.
- (C) The whole plasmid is not transferred, only the T-DNA.

Final Answer: The T-DNA between LB and RB is transferred $\Rightarrow$ D

Answer: (D) Go Back to Q147

Q148.

Solution

Concept — ABE solvent fermentation: The acetone–butanol–ethanol fermentation is a classic anaerobic process producing organic solvents from sugars or starch. **Reasoning:** *Clostridium acetobutylicum* is a strict anaerobe and spore-former that ferments carbohydrates first to acids, then shifts (solventogenesis) to acetone, butanol and ethanol. It underpinned industrial solvent supply before petrochemical routes. **Why the other options are wrong:**

- (A) *Gluconobacter* performs oxidative (vinegar/sorbose) conversions.
- (C) *Xanthomonas* makes the polysaccharide xanthan gum.
- (D) *Propionibacterium* produces propionic acid and vitamin B_{12}.

Final Answer: ABE solvents come from *Clostridium acetobutylicum* $\Rightarrow$ B

Answer: (B) Go Back to Q148

Q149.

Solution

Concept — Amino-acid fermentation: L-glutamic acid (the basis of MSG) is overproduced when membrane permeability is altered, classically by biotin limitation, allowing the amino acid to leak out. **Reasoning:** *Corynebacterium glutamicum* is the workhorse for glutamate production. Under biotin-deficient conditions its membrane becomes leaky, glutamate is excreted instead of feedback-inhibiting its own synthesis, and high yields accumulate in the broth. **Why the other options are wrong:**

- (A) *Aspergillus niger* is used for citric/gluconic acid.
- (B) *Saccharomyces* produces ethanol.
- (D) *Lactobacillus* makes lactic acid.

Final Answer: Glutamic acid is produced by *Corynebacterium glutamicum* $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q149

Q150.

Solution

Concept — Microbial plant hormones: Gibberellins are diterpenoid plant-growth regulators first isolated from a fungal rice pathogen and now made by fermentation. **Reasoning:** *Gibberella fujikuroi* (anamorph *Fusarium moniliforme*) causes the "foolish seedling" (bakanae) disease of rice through excess gibberellin, and is the production organism for commercial gibberellic acid by submerged fermentation. **Why the other options are wrong:**

- (B) *Ashbya gossypii* overproduces riboflavin.
- (C) *Penicillium griseofulvum* yields the antifungal griseofulvin.
- (D) *Rhizopus arrhizus* is used for steroid biotransformation/fumaric acid.

Final Answer: Gibberellic acid is from *Gibberella fujikuroi* $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q150

Q151.

Solution

Concept — Allosteric (cooperative) kinetics: Allosteric enzymes have multiple subunits; binding of substrate to one site raises the affinity of the others, giving a sigmoidal v–[S] curve and a Hill coefficient $n_H > 1$ (positive cooperativity). **Reasoning:** Curve A is S-shaped because the first substrate molecules bind weakly, then binding becomes progressively easier, steepening the response over a narrow [S] range. This switch-like behaviour is positive cooperativity among the substrate-binding subunits, in contrast to the hyperbolic single-site curve B. **Why the other options are wrong:**

- (A) A single Michaelis–Menten site gives a hyperbola, not a sigmoid.
- (B) Substrate is the substrate, not an inhibitor here.
- (D) V_{max} is still the asymptote approached at high [S].

Final Answer: The sigmoidal curve shows positive cooperativity $\Rightarrow$ C

Answer: (C) Go Back to Q151

Q152.

Solution

Concept — Immobilization by covalent binding: Here the enzyme is anchored to a carrier through genuine covalent bonds between its side-chain groups (amino, carboxyl, hydroxyl) and reactive groups on an activated support. **Reasoning:** An activated matrix (e.g. CNBr-activated agarose or glutaraldehyde-treated resin) forms strong covalent linkages with the enzyme. This gives the firmest attachment with least leakage, though care is needed to keep the active site free. **Why the other options are wrong:**

- (A) Entrapment cages the enzyme in a gel without bonding it.
- (B) Encapsulation traps it inside a membrane capsule.
- (C) Adsorption relies on weak physical forces, not covalent bonds.

Final Answer: Bonding to an activated matrix is covalent immobilization $\Rightarrow$ D

Answer: (D) Go Back to Q152

Q153.

Solution

Concept — IgE and immediate hypersensitivity: IgE binds via its Fc region to FcεRI receptors on mast cells and basophils, sensitising them; re-exposed allergen cross-links the bound IgE and triggers degranulation. **Reasoning:** Cross-linking of cell-bound IgE releases histamine and other mediators, producing the immediate (Type I) allergic reaction. IgE is present at very low serum levels but is central to allergy and anti-parasite defence. **Why the other options are wrong:**

- (A) IgG does not arm mast cells through FcεRI.
- (C) IgM is a pentamer for early/complement responses.
- (D) IgA guards mucosal surfaces.

Final Answer: The mast-cell-sensitising antibody is IgE $\Rightarrow$ B

Answer: (B) Go Back to Q153

Q154.

Solution

Concept — ADCC: In antibody-dependent cell-mediated cytotoxicity, IgG bridges a target cell and an effector cell: its Fab arms (region X) bind antigen on the target, while its Fc stem is recognised by Fcγ receptors (CD16) on NK cells, which then kill the coated target. **Reasoning:** The NK cell does not see antigen directly; it engages the constant Fc portion of the bound antibody. FcγRIII binding activates the NK cell to release perforin and granzymes onto the antibody-coated target. **Why the other options are wrong:**

- (B) The variable region at X binds the target antigen, not the NK cell.
- (C) The hinge gives flexibility; it does not insert into membranes.
- (D) FcγR recognises the assembled heavy-chain Fc, not a lone light chain.

Final Answer: NK cells engage the antibody's Fc region in ADCC $\Rightarrow$ A

Answer: (A) Go Back to Q154

Q155.

Solution

Concept — Monoclonal-antibody source sub-stems: The sub-stem before `-mab` encodes origin: `-o-` murine, `-xi-` chimeric, `-zu-` humanised, `-u-` fully human. **Reasoning:** A chimeric antibody keeps the mouse variable domains but uses human constant regions, lowering immunogenicity while retaining specificity; it carries the `-ximab` sub-stem, as in rituximab and infliximab. **Why the other options are wrong:**

- (A) `-omab` is fully murine.
- (B) `-umab` is fully human.
- (C) `-zumab` is humanised (only the CDRs are murine).

Final Answer: A chimeric mAb is named with `-ximab` ⇒ D

Answer: (D) Go Back to Q155

Q156.

Solution

Concept — Gell and Coombs classification: Type I is IgE-mediated immediate allergy, Type II antibody-mediated cytotoxicity, Type III immune-complex disease, and Type IV delayed, T-cell-mediated reactions. **Reasoning:** The tuberculin reaction and nickel contact dermatitis appear after 24–72 hours and depend on sensitised T cells and recruited macrophages, with no antibody involvement. This is the hallmark of **Type IV** (delayed) hypersensitivity. **Why the other options are wrong:**

- (B) Type I is rapid (minutes) and IgE-driven.
- (C) Type II targets cell-surface antigens with antibody.
- (D) Type III involves deposited immune complexes, not T cells.

Final Answer: Delayed T-cell reactions are Type IV ⇒ A

Answer: (A) Go Back to Q156

Q157.

Solution

Concept — Sporulation and the growth curve: Endospores are dormant survival forms made when growth conditions deteriorate. They form chiefly when nutrients run low, i.e. at the stationary phase (Phase III), not during active growth. **Reasoning:** In Phase III the population stops net growth as nutrients are depleted and wastes accumulate, triggering sporulation in genera like *Bacillus* and *Clostridium*. In the Schaeffer–Fulton stain these endospores retain malachite green (appearing **green**) while the vegetative cell counterstains **red** with safranin. **Why the other options are wrong:**

- (A) Phase I cells are adapting, not sporulating.
- (C) Phase II is rapid growth, when spores are not formed.
- (D) Sporulation is closely tied to the stationary phase of the curve.

Final Answer: Sporulation occurs in stationary Phase III; green spore, red cell $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q157

Q158.

Solution

Concept — F_0 value: F_0 expresses the lethality of a moist-heat cycle as the number of equivalent minutes delivered at 121°C, taking a reference z-value of 10°C. It lets cycles run at different temperatures be compared on one scale. **Reasoning:** By integrating the lethal effect over the whole heating, holding and cooling profile, F_0 gives the total "121°C-equivalent" minutes. A typical target is $F_0 \geq 8$–12 min to assure sterility of aqueous products. **Why the other options are wrong:**

- (A) The temperature change altering D ten-fold is the z-value.
- (B) Decimal reductions relate to D-values and bioburden, not F_0 itself.
- (D) Initial bioburden is the starting count, a separate quantity.

Final Answer: F_0 is the equivalent lethal time in minutes at 121°C $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q158

Q159.

Solution

Concept — Clean-room air classification: Sterile filling needs HEPA-filtered, unidirectional air of the cleanest grade: ISO Class 5, EU Grade A, historically US Federal Standard 209E "Class 100". **Reasoning:** Class 100 means no more than 100 particles of $\geq$0.5 μm per cubic foot of air, the limit for the critical zone where product is exposed. HEPA filters ($\geq$99.97% efficient at 0.3 μm) deliver this laminar, near particle-free stream. **Why the other options are wrong:**

- (B) Class 100 000 is a much dirtier background zone.
- (C) Class 10 000 is a support area, not the critical zone.
- (D) An uncontrolled area is unsuitable for sterile filling.

Final Answer: The critical filling zone is Class 100 (ISO 5 / Grade A) $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q159

Q160.

Solution

Concept — MIC by broth dilution: A series of tubes contains doubling dilutions of antibiotic, each inoculated with the test organism. After incubation the MIC is the lowest concentration showing no visible growth (no turbidity). **Reasoning:** Growth (turbidity) appears in low-drug tubes; above a certain concentration the broth stays clear. The first clear tube marks the minimum inhibitory concentration, the least drug that inhibits visible growth. **Why the other options are wrong:**

- (A) A tube that still grows is below the MIC, not the endpoint.
- (C) Killing 100% on subculture defines the MBC, not the MIC.
- (D) Zone diameter is the disc-diffusion readout, a different method.

Final Answer: MIC is the lowest concentration giving no visible growth $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q160

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	B	3	A	4	D	5	C
6	B	7	A	8	D	9	C	10	B
11	A	12	D	13	C	14	B	15	A
16	D	17	C	18	B	19	A	20	D
21	C	22	B	23	D	24	A	25	C
26	B	27	D	28	A	29	C	30	B
31	A	32	D	33	C	34	A	35	C
36	A	37	D	38	B	39	C	40	A
41	B	42	D	43	A	44	C	45	B
46	D	47	A	48	B	49	C	50	D
51	A	52	B	53	C	54	D	55	A
56	B	57	C	58	D	59	A	60	B
61	C	62	D	63	A	64	B	65	C
66	D	67	A	68	B	69	C	70	B
71	D	72	A	73	C	74	B	75	A
76	D	77	B	78	C	79	D	80	A
81	C	82	B	83	D	84	A	85	B
86	C	87	D	88	A	89	B	90	C
91	D	92	B	93	A	94	B	95	D
96	C	97	A	98	B	99	C	100	B
101	D	102	A	103	C	104	B	105	D
106	A	107	C	108	B	109	D	110	A
111	B	112	C	113	C	114	D	115	A
116	B	117	B	118	C	119	A	120	D
121	A	122	C	123	B	124	A	125	C
126	A	127	D	128	B	129	C	130	D
131	A	132	B	133	C	134	D	135	A
136	B	137	C	138	D	139	A	140	B
141	C	142	D	143	A	144	B	145	C
146	D	147	D	148	B	149	C	150	A
151	C	152	D	153	B	154	A	155	D
156	A	157	B	158	C	159	A	160	B