NIPER JEE Pharmacy Subjects

Sample Paper – 4

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. Magnesium hydroxide $Mg(OH)_2$ has a solubility product $K_{sp} = 4 \times 10^{-12}$ at 25°C. Its molar solubility s in pure water (using $K_{sp} = 4s^3$) is approximately:

(A) 2×10^{-6} mol/L

(B) 1×10^{-4} mol/L

(C) 4×10^{-4} mol/L

(D) 2×10^{-12} mol/L

Q2. A drug with an ether/water partition coefficient $P = 3$ (concentration ratio) is extracted once from 100 mL of its aqueous solution using 100

mL of ether (equal volumes). The fraction of drug remaining in the water layer after this single extraction is:

(A) $3/4$

(B) $1/3$

(C) $3/5$

(D) $1/4$

Q3. According to Stokes' law, the sedimentation velocity of suspended particles in a dilute pharmaceutical suspension is directly proportional to:

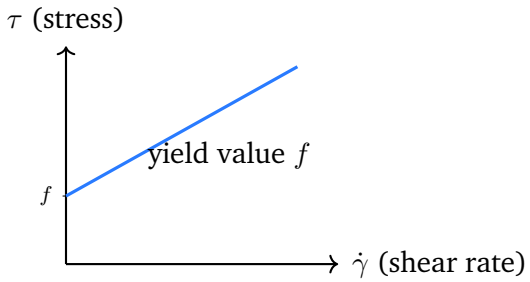
(A) the square of the particle diameter

(B) the viscosity of the medium

(C) the reciprocal of the density difference

(D) the cube of the particle radius

Q4. The flow curve below is a straight line that does not pass through the origin but intercepts the shear-stress axis at a positive value f before flow begins. This behaviour is:



(A) Newtonian flow

(B) dilatant flow

(C) Bingham plastic flow

(D) pseudoplastic flow

Q5. For most simple Newtonian liquids, how does the dynamic viscosity change as temperature is raised (other factors constant)?

(A) it increases exponentially with temperature

(B) it decreases, following an Arrhenius-type relation $\eta = Ae^{E_v/RT}$

(C) it remains exactly constant

(D) it becomes zero at body temperature

Q6. When a liquid completely wets a solid surface, the contact angle θ measured through the liquid is:

(A) exactly 90°

(B) between 90° and 180°

(C) exactly 180°

(D) zero (or approaching 0°)

Q7. A directly compressible blend has a bulk density of 0.48 g/mL and a tapped density of 0.60 g/mL. Its Carr's compressibility index and the corresponding flow rating are:

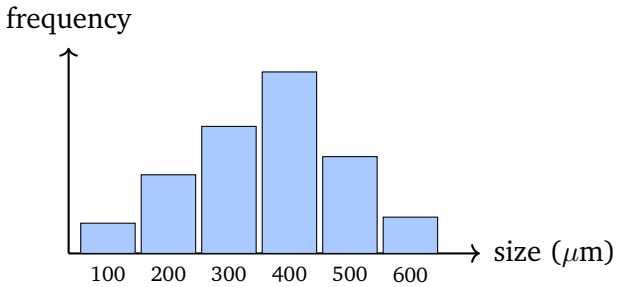
(A) 20%, passable flow

(B) 12%, good flow

(C) 25%, poor flow

(D) 80%, free flowing

Q8. The number-frequency histogram of a granulated powder is shown. The modal particle-size interval (in μm) is:



(A) 100 – 200

(B) 200 – 300

(C) 300 – 400

(D) 500 – 600

Q9. A powder shows a Hausner ratio of 1.45. This value indicates that the powder has:

(A) excellent flow

(B) very poor (cohesive) flow

(C) good flow suitable for high-speed compression

(D) no measurable flow problem

Q10. A boric acid–borate buffer is prepared so that the salt-to-acid ratio is $10:1$ (pK$_a$ of boric acid $= 9.2$, $\log 10 = 1$). The pH of this buffer is approximately:

(A) 8.2

(B) 9.2

(C) 9.0

(D) 10.2

Q11. A drug has a sodium-chloride equivalent (E value) of 0.20. To make 50 mL of a 1% w/v solution of this drug isotonic, the total amount of "tonicity equivalent" NaCl already contributed by the drug is:

(A) 0.10 g

(B) 0.50 g

(C) 0.20 g

(D) 0.45 g

Q12. According to the Stokes–Einstein relation, the diffusion coefficient D of a spherical solute molecule in a liquid is inversely proportional to:

(A) the absolute temperature

(B) the square of the molecular radius

(C) the viscosity of the medium and the molecular radius

(D) Boltzmann's constant

Q13. A drug in solution degrades by first-order kinetics with a rate constant $k = 0.0231$ day^{-1}. Its half-life $t_{1/2} = 0.693/k$ is approximately:

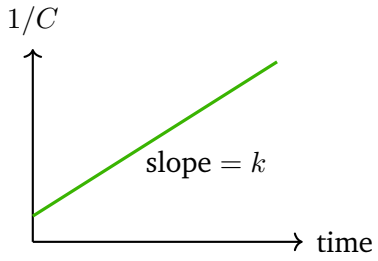
(A) 15 days

(B) 30 days

(C) 3 days

(D) 300 days

Q14. For a degrading drug, a straight line is obtained only when the reciprocal of concentration $(1/C)$ is plotted against time (figure). The reaction therefore follows:



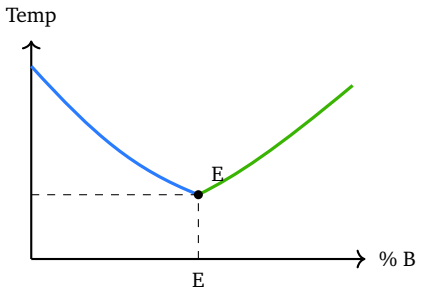
(A) zero-order kinetics

(B) first-order kinetics

(C) pseudo-first-order kinetics

(D) second-order kinetics

Q15. The binary temperature–composition diagram below shows two descending liquidus curves meeting at the lowest point E, below which only solid A plus solid B coexist. The point E is the:



(A) eutectic point

(B) triple point

(C) critical solution temperature

(D) inversion temperature

Q16. The Langmuir adsorption isotherm $\dfrac{x}{m} = \dfrac{abC}{1+bC}$ is linearised by plotting:

(A) $\log(x/m)$ versus $\log C$

(B) x/m versus C

(C) $C/(x/m)$ versus C

(D) x/m versus $1/C^2$

Q17. In the Noyes–Whitney equation $dC/dt = \dfrac{DA}{h}(C_s - C)$, vigorous stirring of the dissolution medium increases the dissolution rate mainly because it:

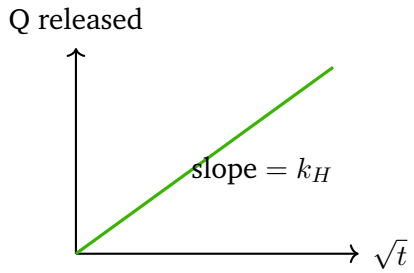
(A) raises the saturation solubility C_s

(B) reduces the diffusion-layer thickness h

(C) lowers the diffusion coefficient D

(D) decreases the surface area A

Q18. For a swellable-insoluble matrix tablet, the cumulative amount of drug released (Q) is plotted against the square root of time and gives a straight line through the origin (figure). The release obeys the:



(A) zero-order model

(B) first-order model

(C) Hixson–Crowell cube-root model

(D) Higuchi (matrix-diffusion) model

Q19. For an orally administered immediate-release tablet, the time T_{max} at which the plasma drug concentration reaches its peak (C_{max}) corresponds to the instant when:

(A) the rate of absorption equals the rate of elimination

(B) the drug is completely eliminated

(C) absorption has not yet started

(D) the AUC becomes zero

Q20. A drug that has both *low aqueous solubility* and *low intestinal permeability* (the most problematic for oral delivery) is classified under the Biopharmaceutics Classification System as:

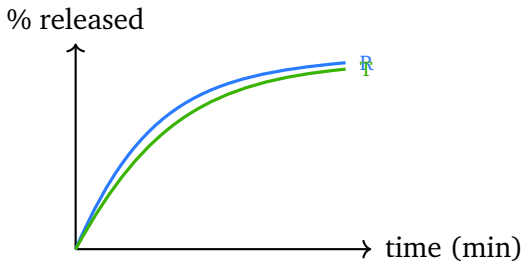
(A) Class I

(B) Class II

(C) Class IV

(D) Class III

Q21. Two cumulative-dissolution profiles (reference R and test T) are shown nearly superimposed. The similarity factor f_2 is computed to compare them; the profiles are accepted as *similar* when f_2 lies in the range:



(A) 0 – 25

(B) 50 – 100

(C) less than 50

(D) exactly 0

Q22. Colloidal silicon dioxide (colloidal silica, Aerosil) is added in small amounts to a tablet/capsule blend mainly to function as a:

(A) binder

(B) disintegrant

(C) sweetener

(D) glidant (flow promoter)

Q23. In tablet compaction studies, a Heckel plot is constructed by plotting $\ln\left(\frac{1}{1-D}\right)$ (where D is relative density) against the applied compression pressure. The reciprocal of the slope of its linear portion gives the:

(A) mean yield pressure of the material

(B) friability of the tablet

(C) disintegration time

(D) moisture content

Q24. Among the standard hard-gelatin capsule shells used for human oral products, the size with the *smallest* fill volume is:

(A) size 000

(B) size 5

(C) size 0

(D) size 1

Q25. A suppository mould delivers 1 g of cocoa-butter base per cavity. A drug with a displacement value of 2 (2 parts of drug displace 1 part of base) is to be incorporated at 0.2 g per suppository. The mass of base required per suppository is:

(A) 1.0 g

(B) 0.80 g

(C) 0.90 g

(D) 0.20 g

Q26. A water-soluble dye (e.g. amaranth) is added to an emulsion and the whole emulsion becomes uniformly coloured under the microscope. The emulsion is therefore:

(A) a water-in-oil (w/o) emulsion

(B) a non-aqueous emulsion

(C) impossible to determine

(D) an oil-in-water (o/w) emulsion

Q27. Apart from sterility, the single most important physiological requirement for a well-tolerated eye-drop formulation intended for the conjunctival sac is that it should be:

(A) isotonic and buffered near the tear pH

(B) strongly hypertonic

(C) adjusted to pH 2 for stability

(D) free of any viscosity-building agent

Q28. For low-dose tablets where the active ingredient is a small fraction of the total weight, the more discriminating and appropriate pharmacopoeial quality test is:

(A) weight-variation test alone

(B) content-uniformity test

(C) friability test

(D) disintegration test alone

Q29. In a typical pharmaceutical aerosol, the function of the propellant is to:

(A) act as the therapeutic active ingredient

(B) sterilise the contents of the can

(C) provide the pressure that expels and atomises the product on actuation

(D) neutralise the pH of the formulation

Q30. Hydrophilic petrolatum (containing wool fat / cholesterol) is able to absorb water to form a w/o system. It is therefore classified as which type of ointment base?

(A) absorption base

(B) oleaginous (hydrocarbon) base

(C) water-soluble (PEG) base

(D) water-removable (o/w) base

Q31. In sieve analysis, as the mesh number of a standard sieve increases, the aperture (opening) size of the sieve:

(A) increases proportionally

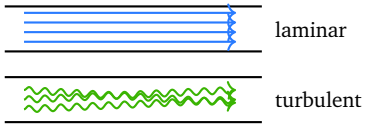
(B) stays constant

(C) first increases then decreases

(D) decreases (finer powder passes)

Q32. The two pipe-flow sketches below contrast smooth parallel streamlines (upper) with chaotic swirling eddies (lower). For Newtonian flow through

a circular pipe, the lower (turbulent) regime is observed when the Reynolds number (Re) is:



(A) less than 2100

(B) exactly 2100

(C) greater than 4000

(D) less than 1.0

Q33. In a conventional tray (hot-air) drier used for wet granules, the rate of drying during the *constant-rate period* is controlled mainly by:

(A) the rate of evaporation of free surface moisture (heat and mass transfer at the surface)

(B) internal diffusion of bound water through the solid

(C) the size of the laser-drilled orifice

(D) the osmotic pressure inside the granule

Q34. Niosomes, used as a novel vesicular drug-delivery carrier, are best described as:

(A) solid lipid nanoparticles with no bilayer

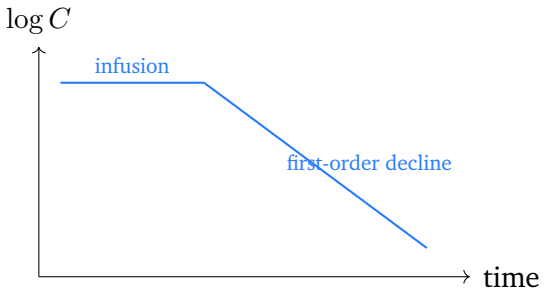
(B) vesicles formed from non-ionic surfactants (with cholesterol) enclosing an aqueous core

(C) crosslinked albumin microspheres

(D) simple oil droplets stabilised by phospholipid

Part B: Pharmacology & Toxicology

Q35. A drug is given by constant IV infusion at 30 mg/h and reaches a steady-state plasma concentration of 6 mg/L. The semi-log plot of the post-infusion decline (a straight line, first-order) is shown for reference. Its total body clearance is:



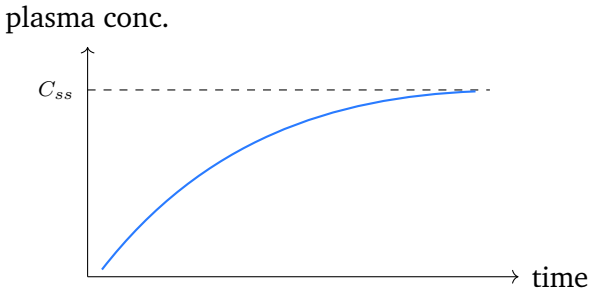
(A) 180 L/h

(B) 5 L/h

(C) 0.2 L/h

(D) 36 L/h

Q36. The plasma concentration-time profile below shows the rise to steady state during a constant-rate IV infusion. For a drug with a half-life of 8 hours, the time taken to reach approximately 94% of steady state (about four half-lives) is:



(A) 8 h

(B) 16 h

(C) 48 h

(D) 32 h

Q37. A drug with a high hepatic extraction ratio (E $\approx$ 0.9) given orally will most characteristically show:

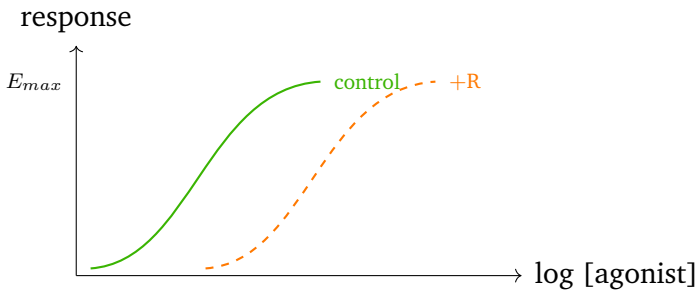
(A) Extensive first-pass metabolism and low oral bioavailability, with clearance that is sensitive to changes in hepatic blood flow

(B) Negligible first-pass effect and complete oral bioavailability

(C) Clearance limited only by enzyme capacity and independent of blood flow

(D) Zero hepatic clearance with exclusively renal elimination

Q38. The agonist log dose-response curves below were recorded alone (control) and after adding antagonist R, which shifts the curve to the right in parallel and does not lower the maximum. Increasing the agonist concentration fully restores the original response. Antagonist R is therefore:



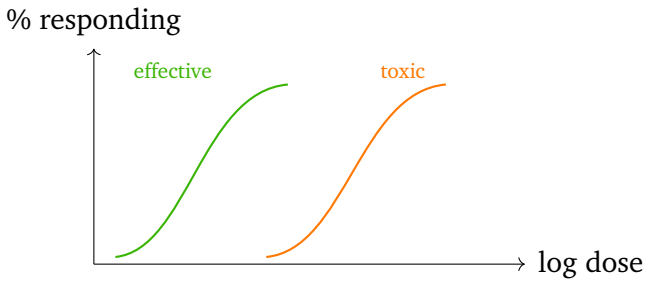
(A) A non-competitive (irreversible) antagonist

(B) An inverse agonist

(C) A reversible competitive antagonist (surmountable), lowering apparent agonist potency but not efficacy

(D) A partial agonist

Q39. For the quantal curves below, ED_{50} = 4 mg/kg, the dose toxic in 1% (TD_1) = 8 mg/kg and the dose effective in 99% (ED_{99}) = 16 mg/kg. The certain safety factor (margin of safety, TD_1/ED_{99}) indicates that:



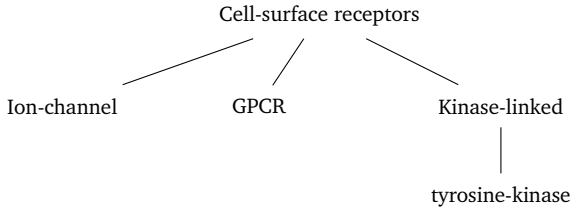
(A) The drug is very safe because the ratio exceeds 1

(B) The toxic and effective ranges overlap (ratio = 0.5 < 1), so a dose effective in 99% may already be toxic in some, signalling a narrow margin

(C) The therapeutic index is exactly 2 and fully reassuring

(D) The margin of safety cannot be defined from quantal data

Q40. In the receptor superfamily tree below, the highlighted branch ends in "intrinsic/associated tyrosine-kinase → autophosphorylation → SH2-domain signalling". A physiological ligand acting through this branch is:



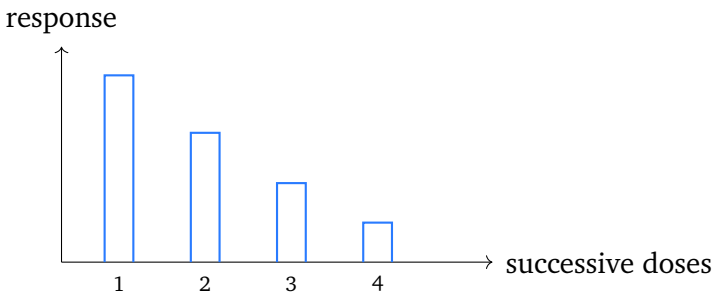
(A) Acetylcholine at the nicotinic receptor

(B) Adrenaline at the β_2 receptor

(C) Cortisol at the cytosolic receptor

(D) Insulin at the insulin receptor

Q41. In the trace below, equal repeated doses of an indirectly acting sympathomimetic give a progressively smaller response. This rapid loss of response, attributable to depletion of releasable transmitter stores, is best termed:



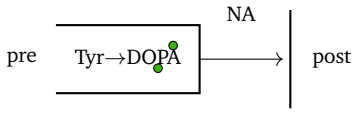
(A) Tachyphylaxis (acute, rapidly developing tolerance)

(B) Idiosyncrasy

(C) Competitive antagonism

(D) Drug-induced enzyme induction

Q42. At the adrenergic varicosity depicted, the rate-limiting step in the synthesis of noradrenaline from its amino-acid precursor is catalysed by:



(A) Dopamine β-hydroxylase

(B) Aromatic L-amino-acid decarboxylase (DOPA decarboxylase)

(C) Tyrosine hydroxylase, converting tyrosine to L-DOPA

(D) Catechol-O-methyltransferase

Q43. Phenoxybenzamine is used to control hypertension before surgery for phaeochromocytoma because it produces:

(A) Reversible, surmountable β_1-receptor blockade

(B) Irreversible (non-competitive) blockade of α-adrenergic receptors by covalent alkylation, giving long-lasting vasodilation

(C) Selective α_2-receptor agonism

(D) Ganglionic stimulation

Q44. Tiotropium is inhaled in chronic obstructive pulmonary disease because it acts as a:

(A) Selective β_2-adrenergic agonist

(B) Methylxanthine phosphodiesterase inhibitor

(C) Leukotriene receptor antagonist

(D) Long-acting muscarinic (M_3) receptor antagonist that reduces vagally mediated bronchoconstriction

Q45. Sugammadex rapidly reverses the neuromuscular block produced by rocuronium because it:

(A) Encapsulates the steroidal blocker in a cyclodextrin cavity, removing free drug from the neuromuscular junction

(B) Inhibits acetylcholinesterase to raise synaptic acetylcholine

(C) Acts as a depolarising agonist at the end-plate

(D) Blocks plasma pseudocholinesterase

Q46. Mirabegron relieves the symptoms of overactive bladder by a mechanism that, unlike antimuscarinics, relaxes the detrusor through:

(A) Blockade of muscarinic M_3 receptors on the detrusor

(B) Inhibition of nicotinic transmission in the pelvic ganglia

(C) Agonism at β_3-adrenergic receptors on detrusor smooth muscle, promoting relaxation and bladder filling

(D) Blockade of α_1-receptors in the bladder neck

Q47. Zolpidem is a useful hypnotic with relatively little of the muscle-relaxant and anticonvulsant profile of a classical benzodiazepine because it:

(A) Directly opens the chloride channel independent of GABA

(B) Acts as a positive allosteric modulator binding preferentially the α_1-subunit-containing GABA-A receptors, giving predominantly sedative-hypnotic effects

(C) Is a melatonin MT_1/MT_2 receptor agonist

(D) Antagonises orexin receptors

Q48. Mirtazapine improves mood and appetite and is sedating because, distinct from reuptake inhibitors, it acts mainly as:

(A) A selective serotonin reuptake inhibitor

(B) An irreversible monoamine oxidase inhibitor

(C) A dopamine D_2 antagonist

(D) An antagonist of presynaptic α_2-autoreceptors (enhancing noradrenaline and serotonin release) plus 5-HT_2/5-HT_3 and H_1 blockade

Q49. Lithium, used in bipolar disorder, is thought to exert its mood-stabilising effect partly by:

(A) Inhibiting inositol monophosphatase and so depleting the phosphatidylinositol second-messenger cycle (and inhibiting GSK-3)

(B) Blocking voltage-gated sodium channels like an anticonvulsant

(C) Agonising the GABA-B receptor

(D) Inhibiting monoamine oxidase irreversibly

Q50. Memantine is used in moderate-to-severe Alzheimer's disease because it acts as a:

(A) Reversible peripheral acetylcholinesterase inhibitor

(B) Selective butyrylcholinesterase inhibitor only

(C) Moderate-affinity, voltage-dependent uncompetitive NMDA-glutamate receptor antagonist that limits excitotoxic calcium entry

(D) Muscarinic M_1 receptor agonist

Q51. Vigabatrin raises brain GABA levels because it is an irreversible inhibitor of:

(A) Glutamic acid decarboxylase

(B) GABA transaminase (GABA-T), the enzyme that degrades GABA

(C) The GABA transporter GAT-1

(D) Carbonic anhydrase

Q52. Baclofen relieves spasticity in spinal and cerebral disorders by acting as an agonist at:

(A) GABA-B receptors, reducing excitatory transmitter release and depressing mono- and polysynaptic reflexes

(B) Nicotinic receptors at the neuromuscular junction

(C) Ryanodine receptors of the sarcoplasmic reticulum

(D) β_2-adrenergic receptors on skeletal muscle

Q53. Ketamine produces dissociative anaesthesia with analgesia and maintained airway reflexes chiefly because it:

(A) Potentiates GABA-A receptor chloride currents like a barbiturate

(B) Is a selective μ-opioid receptor agonist

(C) Non-competitively blocks the NMDA-type glutamate receptor channel

(D) Activates α_2-adrenergic receptors centrally

Q54. Verapamil differs from amlodipine in that, besides vasodilation, it markedly slows AV-nodal conduction and heart rate because it:

(A) Blocks β_1-adrenergic receptors in the SA node

(B) Inhibits the funny current (I_f) selectively

(C) Opens ATP-sensitive potassium channels

(D) Is a phenylalkylamine L-type calcium-channel blocker with prominent cardiac (nodal) as well as vascular action

Q55. Hydralazine lowers blood pressure but commonly causes reflex tachycardia and fluid retention because it:

(A) Is a direct arteriolar smooth-muscle vasodilator that reduces peripheral resistance, triggering a baroreceptor-mediated sympathetic reflex

(B) Blocks β_1-adrenergic receptors

(C) Inhibits angiotensin-converting enzyme

(D) Acts as a thiazide diuretic

Q56. Spironolactone is described as a potassium-sparing diuretic because it:

(A) Inhibits the $Na^+/K^+/2Cl^-$ cotransporter in the loop of Henle

(B) Competitively antagonises the aldosterone (mineralocorticoid) receptor in the collecting duct, reducing Na^+ reabsorption while retaining K^+

(C) Inhibits carbonic anhydrase in the proximal tubule

(D) Blocks the epithelial sodium channel directly like amiloride

Q57. Ezetimibe lowers LDL cholesterol by a mechanism distinct from the statins, namely:

(A) Competitive inhibition of HMG-CoA reductase

(B) Sequestration of bile acids in the intestinal lumen

(C) Inhibition of the intestinal cholesterol-transport protein NPC1L1, reducing absorption of dietary and biliary cholesterol

(D) Activation of PPAR-α to raise lipoprotein lipase activity

Q58. Dabigatran, unlike warfarin, needs no routine INR monitoring because it produces predictable anticoagulation by:

(A) Inhibiting vitamin-K epoxide reductase

(B) Potentiating antithrombin like heparin

(C) Blocking the platelet $P2Y_{12}$ receptor

(D) Directly and reversibly inhibiting thrombin (factor IIa), with its specific reversal agent idarucizumab

Q59. Sumatriptan aborts an acute migraine attack mainly by:

(A) Agonism at 5-$HT_{1B/1D}$ receptors, causing cranial vasoconstriction and inhibiting release of vasoactive neuropeptides from trigeminal nerves

(B) Blockade of 5-HT_3 receptors on vagal afferents

(C) Irreversible inhibition of cyclooxygenase

(D) Antagonism at dopamine D_2 receptors

Q60. Diclofenac differs from aspirin in its action on cyclooxygenase in that diclofenac:

(A) Acetylates COX irreversibly for the life of the cell

(B) Inhibits lipoxygenase rather than cyclooxygenase

(C) Is a reversible competitive inhibitor of COX-1 and COX-2, so its anti-platelet effect is short-lived and recovers as drug is cleared

(D) Selectively spares COX-2 entirely

Q61. Fexofenadine causes far less sedation than chlorpheniramine in treating allergic rhinitis because it:

(A) Blocks H_2 rather than H_1 receptors

(B) Is a second-generation H_1 antihistamine that poorly crosses the blood-brain barrier (and is a P-glycoprotein substrate)

(C) Is a mast-cell stabiliser without receptor blockade

(D) Is a leukotriene receptor antagonist

Q62. Domperidone relieves nausea and promotes gastric emptying with few central extrapyramidal effects because it:

(A) Is a 5-HT_3 receptor antagonist acting on vagal afferents

(B) Is a muscarinic agonist increasing gut tone

(C) Blocks H_1 receptors in the vestibular nuclei

(D) Is a peripheral dopamine D_2 antagonist that poorly crosses the blood-brain barrier, acting at the chemoreceptor trigger zone (outside it) and on gut D_2 receptors

Q63. Vancomycin inhibits Gram-positive cell-wall synthesis by a mechanism different from the β-lactams, namely:

(A) Binding the terminal D-alanyl-D-alanine of peptidoglycan precursors, sterically blocking transglycosylation and transpeptidation

(B) Binding penicillin-binding proteins to inhibit transpeptidase directly

(C) Inhibiting the 30S ribosomal subunit

(D) Inhibiting DNA gyrase

Q64. Doxycycline is bacteriostatic because it:

(A) Binds the 50S subunit and blocks translocation

(B) Inhibits bacterial dihydrofolate reductase

(C) Reversibly binds the 30S ribosomal subunit, blocking attachment of aminoacyl-tRNA to the A site and halting protein synthesis

(D) Forms covalent adducts with bacterial DNA

Q65. Caspofungin treats invasive candidiasis by a target absent from the azoles, namely inhibition of:

(A) Fungal 14-α-demethylase in ergosterol synthesis

(B) β-(1,3)-D-glucan synthase, blocking synthesis of the fungal cell-wall glucan

(C) Fungal DNA polymerase

(D) The fungal 50S-equivalent ribosomal subunit

Q66. Oseltamivir shortens the course of influenza because it:

(A) Is a chain-terminating inhibitor of reverse transcriptase

(B) Blocks the viral M2 ion channel preventing uncoating

(C) Inhibits viral DNA polymerase after phosphorylation

(D) Inhibits the viral neuraminidase, preventing release of new virions from infected cells

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

(A) Inhibiting the sodium-glucose co-transporter-2 in the proximal renal tubule, reducing glucose reabsorption and promoting glycosuria

(B) Closing pancreatic β-cell ATP-sensitive K^+ channels to release insulin

(C) Inhibiting intestinal α-glucosidase

(D) Activating AMP-kinase to suppress hepatic gluconeogenesis

Q68. Which antidote-poison pairing is CORRECT?

(A) Warfarin overdose is treated with protamine sulphate

(B) Digoxin toxicity is treated with flumazenil

(C) Drug-induced methaemoglobinaemia is treated with methylene blue, which reduces ferric haemoglobin back to the ferrous form

(D) Cyanide poisoning is treated with N-acetylcysteine

Part C: Pharmaceutical & Medicinal Chemistry

Q69. Benzenediazonium chloride is treated with cuprous chloride (CuCl) to replace the diazonium group with a chlorine atom, giving chlorobenzene with loss of nitrogen gas. This copper(I)-mediated substitution of a diazonium salt is the:

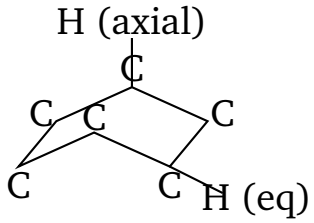
(A) Gattermann–Koch reaction

(B) Rosenmund reduction

(C) Sandmeyer reaction

(D) Kolbe–Schmitt reaction

Q70. The most stable conformation of cyclohexane is the chair form shown below, in which all C–C–C angles are close to the ideal tetrahedral value and adjacent C–H bonds are perfectly staggered.



A bulky substituent on this ring most prefers to occupy which type of position to minimise 1,3-diaxial strain?

(A) an axial position

(B) the position does not matter energetically

(C) it forces the ring into a boat

(D) an equatorial position

Q71. Phenol, when heated with chloroform and aqueous NaOH followed by acidification, is converted mainly to salicylaldehyde (2-hydroxybenzaldehyde) via a dichlorocarbene intermediate. This ortho-formylation of phenols is the:

(A) Reimer–Tiemann reaction

(B) Wurtz reaction

(C) Stephen reduction

(D) Gabriel synthesis

Q72. Among the following para-substituted benzoic acids, which has the *lowest* pK_a (is the strongest acid)?

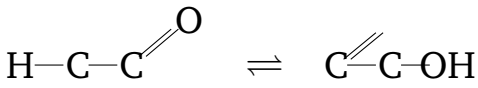
(A) *p*-methoxybenzoic acid

(B) *p*-nitrobenzoic acid

(C) *p*-methylbenzoic acid

(D) *p*-aminobenzoic acid

Q73. The equilibrium drawn below interconverts a carbonyl form and its enol form by migration of an α-hydrogen to oxygen and a shift of the double bond.



This type of constitutional-isomer equilibrium, rapidly interconverting through proton transfer, is called:

(A) conformational isomerism

(B) optical isomerism

(C) keto–enol tautomerism

(D) geometric isomerism

Q74. A carboxylic acid bearing an α-hydrogen, treated with bromine in the presence of a catalytic amount of red phosphorus, is converted to its α-bromo carboxylic acid. This α-halogenation of acids is the:

(A) Finkelstein reaction

(B) Clemmensen reduction

(C) Wolff–Kishner reduction

(D) Hell–Volhard–Zelinsky reaction

Q75. 1-Chloro-2,4-dinitrobenzene reacts readily with ammonia to give 2,4-dinitroaniline, whereas chlorobenzene itself is inert under the same conditions. The two ortho/para nitro groups accelerate this substitution by stabilising the anionic Meisenheimer intermediate. The mechanism is:

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

(B) electrophilic aromatic substitution

(C) a free-radical chain substitution

(D) an E1cb elimination

Q76. A primary alcohol is to be oxidised to the corresponding aldehyde **without** over-oxidation to the carboxylic acid. Which reagent is the appropriate choice?

(A) hot acidic $KMnO_4$

(B) pyridinium chlorochromate (PCC) in dichloromethane

(C) chromic acid (Jones reagent)

(D) alkaline $KMnO_4$ with heating

Q77. Two isomeric butenes are drawn below. Greater alkyl substitution at the double bond confers extra stability through hyperconjugation.

but-2-ene but-1-ene

Which statement is correct regarding their relative thermodynamic stability?

(A) but-1-ene is more stable because the double bond is terminal

(B) both have identical stability

(C) but-2-ene (disubstituted) is more stable than but-1-ene (monosubstituted)

(D) neither alkene is stable at room temperature

Q78. Diethyl ether is prepared in good yield by reacting sodium ethoxide with ethyl bromide via an S_N2 displacement. This general method for unsymmetrical and symmetrical ethers is the:

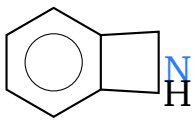
(A) Kolbe electrolysis

(B) Fischer esterification

(C) Hofmann bromamide reaction

(D) Williamson ether synthesis

Q79. The bicyclic aromatic heterocycle drawn below, a benzene ring fused to a pyrrole ring, forms the core of the neurotransmitter serotonin and the amino acid tryptophan.



Identify this ring system.

(A) indole

(B) quinoline

(C) purine

(D) imidazole

Q80. Hydroboration–oxidation of 1-methylcyclohexene (B_2H_6 then H_2O_2/OH^-) places the –OH group on the **less** substituted carbon of the former double bond. This regiochemistry is described as:

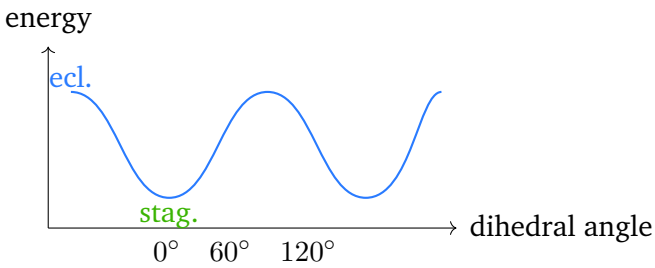
(A) Markovnikov addition

(B) anti-Markovnikov addition (syn, OH to the less substituted carbon)

(C) a free-radical substitution

(D) rearrangement to the more stable carbocation

Q81. The plot below shows the potential energy of ethane as a function of the H–C–C–H dihedral angle during rotation about the C–C bond.



The energy maxima in this curve correspond to which conformation, and what is the approximate barrier to rotation in ethane?

(A) the staggered conformation; about 50 kJ/mol

(B) the staggered conformation; about 1 kJ/mol

(C) the eclipsed conformation; about 12 kJ/mol

(D) there is no barrier; rotation is completely free

Q82. Potassium phthalimide is alkylated with an alkyl halide, and the product is then hydrolysed (or treated with hydrazine) to liberate a pure **primary** amine free of secondary and tertiary contaminants. This selective preparation of primary amines is the:

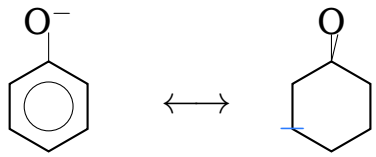
(A) Mannich reaction

(B) Curtius rearrangement

(C) Strecker synthesis

(D) Gabriel synthesis

Q83. The phenoxide ion is stabilised by delocalisation of the negative charge from oxygen into the aromatic ring, as one of the contributing structures below shows.



This delocalisation explains why phenol ($pK_a \approx 10$) is much more acidic than cyclohexanol ($pK_a \approx 16$). The effect responsible is:

(A) steric inhibition of resonance

(B) resonance stabilisation of the phenoxide conjugate base

(C) hyperconjugation only

(D) the inductive effect of hydrogen

Q84. A compound with an active hydrogen (e.g. a ketone) reacts with formaldehyde and a secondary amine to give a β-amino carbonyl compound (a Mannich base). This three-component aminomethylation is the:

(A) Mannich reaction

(B) Knoevenagel condensation

(C) Michael addition

(D) benzoin condensation

Q85. Methotrexate and trimethoprim exert their effects by competitively inhibiting which enzyme of the folate pathway, thereby blocking the regeneration of tetrahydrofolate?

(A) dihydropteroate synthase

(B) thymidylate synthase

(C) dihydrofolate reductase (DHFR)

(D) DNA gyrase

Q86. The cholesterol-lowering statins (e.g. atorvastatin, simvastatin) contain a dihydroxy-acid (or lactone) side chain that mimics the natural substrate and competitively inhibits:

(A) angiotensin-converting enzyme

(B) cyclooxygenase

(C) acetylcholinesterase

(D) HMG-CoA reductase

Q87. Omeprazole is a substituted benzimidazole that is itself inactive but rearranges in the acidic secretory canaliculus of the parietal cell to a reactive sulfenamide, which then covalently inhibits the H^+/K^+-ATPase. This makes omeprazole an example of a:

(A) an acid-activated prodrug that forms an irreversible covalent inhibitor

(B) a reversible competitive antagonist requiring no activation

(C) a chelating agent

(D) an osmotic agent

Q88. Fluoroquinolone antibacterials such as ciprofloxacin and levofloxacin kill bacteria primarily by inhibiting which target enzyme(s)?

(A) the bacterial 30S ribosomal subunit

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

(C) the β-lactam transpeptidase

(D) dihydrofolate reductase

Q89. Acyclovir is selectively activated in herpes-infected cells. After viral thymidine kinase performs the first phosphorylation, the resulting acyclovir triphosphate acts as a:

(A) competitive inhibitor of neuraminidase

(B) reverse-transcriptase activator

(C) chain-terminating inhibitor of viral DNA polymerase

(D) proton-pump inhibitor

Q90. In the development of the H_2-antihistamine cimetidine, the imidazole-containing chain of histamine was retained while the terminal basic amine was replaced by a polar, non-basic cyanoguanidine group. The principal reason for removing the strongly basic amine was to:

(A) increase the molecular weight

(B) make the molecule a better oxidising agent

(C) introduce a chiral centre

(D) achieve H_2 antagonism without the agonist activity associated with a protonated basic amine

Q91. Captopril was rationally designed as an inhibitor of angiotensin-converting enzyme (a zinc metalloprotease). The structural feature responsible for binding the active-site zinc ion is its:

(A) sulfhydryl (–SH) group

(B) aromatic benzene ring

(C) quaternary ammonium centre

(D) nitro group

Q92. For a series of analogues, biological activity often shows a parabolic dependence on $\log P$, rising to a maximum and then falling. The $\log P$ value giving maximum activity is termed $\log P_0$. The fall in activity **beyond** $\log P_0$ is best explained because the most lipophilic members:

(A) are too water-soluble to cross membranes

(B) become trapped in lipid membranes / poorly distributed to the aqueous biophase

(C) ionise completely at physiological pH

(D) are too small to bind the receptor

Q93. Selective COX-2 inhibitors such as celecoxib were designed to spare gastric COX-1 and reduce ulcer risk. Their selectivity arises chiefly because

the COX-2 active site has an extra side pocket that accommodates a bulky:

(A) carboxylic acid group present in all NSAIDs

(B) simple methyl group

(C) sulfonamide (or sulfone) substituent

(D) halogen atom alone

Q94. Which type of intermolecular interaction contributes the **largest** individual binding energy in a typical reversible drug–receptor complex (when present), although it is rarer than van der Waals or hydrogen-bonding contacts?

(A) dispersion (London) forces

(B) a single hydrogen bond

(C) dipole–dipole interaction

(D) an ionic (electrostatic) interaction

Q95. According to Lipinski's "Rule of Five" for predicting good oral absorption, a candidate is likely to be poorly absorbed if it violates more than one of the limits. Which set of limits is correct?

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

(B) MW ≤ 1000, log$P \leq 10$, donors ≤ 10, acceptors ≤ 20

(C) MW ≤ 250, log$P \leq 2$, donors ≤ 2, acceptors ≤ 4

(D) there are no molecular-weight or log$P$ limits in the rule

Q96. Among pharmaceutical inorganic agents, which compound is used as a topical antiseptic and astringent owing to its strong **oxidising** action (it liberates nascent oxygen on contact with tissue)?

(A) sodium bicarbonate

(B) potassium permanganate

(C) magnesium sulfate

(D) calcium gluconate

Q97. In nuclear medicine, the radionuclide most widely used for diagnostic imaging (e.g. bone and organ scans), owing to its 6-hour half-life and pure 140 keV gamma emission, is:

(A) iodine-131

(B) cobalt-60

(C) technetium-99m

(D) radium-226

Q98. β-Cyclodextrin is a cyclic oligosaccharide with a hydrophilic outer surface and a lipophilic central cavity. In pharmaceutical formulation it is used mainly to:

(A) act as a strong oxidising preservative

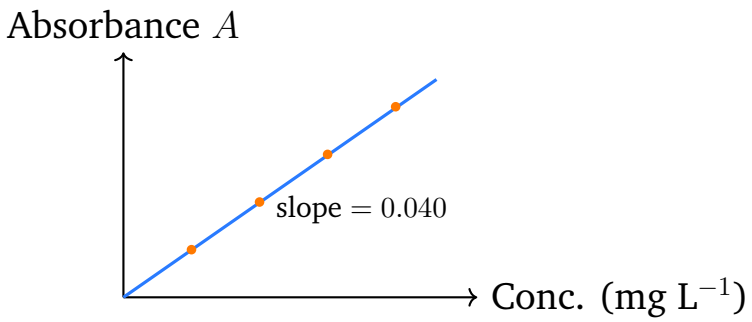
(B) lower the pH of injectable solutions

(C) provide radio-opacity for imaging

(D) form inclusion complexes that enhance the aqueous solubility and stability of poorly soluble drugs

Part D: Pharmaceutical Analysis & Quality Assurance

Q99. The Beer–Lambert calibration line below was prepared for a drug at its λ_{max} in a 1.0 cm cell; the straight line through the origin has slope 0.040 L mg^{-1}. A sample solution gives an absorbance of 0.36. Using the calibration, the concentration of the sample is:



(A) 9.0 mg L^{-1}

(B) 0.0144 mg L^{-1}

(C) 14.4 mg L^{-1}

(D) 0.11 mg L^{-1}

Q100. A drug solution transmits 10% of the incident monochromatic light through a spectrophotometer cell. The absorbance ($A = -\log_{10} T$) of this solution is:

(A) 0.10

(B) 1.0

(C) 0.90

(D) 2.0

Q101. Potassium hydrogen phthalate (KHP, molar mass 204.2 g mol^{-1}) is a common primary standard for standardising sodium hydroxide. Because KHP behaves as a *monoprotic* acid, its equivalent weight is:

(A) 102.1 g eq^{-1}

(B) 408.4 g eq^{-1}

(C) 204.2 g eq^{-1}

(D) 68.1 g eq^{-1}

Q102. In ascending paper chromatography of amino acids, the cellulose paper holds adsorbed water that acts as the stationary phase and the organic solvent acts as the mobile phase. The separation mechanism is therefore primarily:

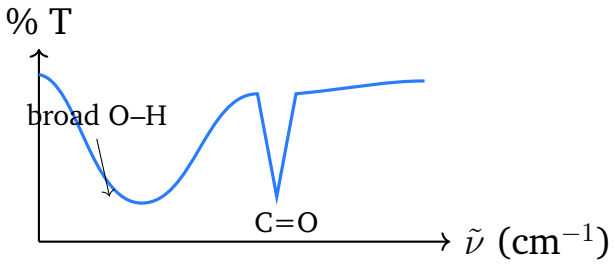
(A) Adsorption onto bare cellulose

(B) Ion exchange between charged sites

(C) Size exclusion by pore filtration

(D) Partition between the bound aqueous phase and the moving organic phase

Q103. The schematic IR spectrum below shows a very **broad** absorption spreading from about 3300 down to 2500 cm^{-1}, overlapping the C–H region, together with a carbonyl band. This broad envelope is most characteristic of which functional group?



(A) A simple ketone

(B) An ether

(C) A tertiary amine

(D) A carboxylic acid (bonded O–H plus C=O)

Q104. The Karl Fischer titration is the pharmacopoeial method of choice for determining which quantity in a drug substance?

(A) Total ash content

(B) Water (moisture) content

(C) Heavy-metal impurities

(D) Optical rotation

Q105. On a silica TLC plate, the solvent front travels 9.0 cm from the origin while a drug spot is centred 6.3 cm from the origin. The R_f value of the drug is:

(A) 0.70

(B) 1.43

(C) 0.30

(D) 0.63

Q106. In molecular fluorescence, the emitted (fluorescence) light almost always appears at a *longer* wavelength than the absorbed (excitation) light. This wavelength difference between excitation and emission maxima is called the:

(A) Bathochromic shift

(B) Doppler shift

(C) Stokes shift

(D) Chemical shift

Q107. Potassium dichromate ($K_2Cr_2O_7$) is a useful primary-standard oxidant in redox titrimetry because, among other reasons, it:

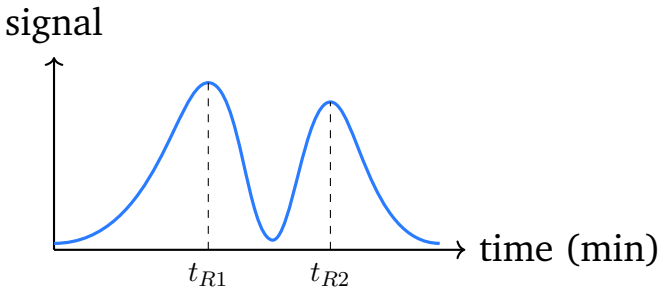
(A) Is a reducing agent that liberates oxygen

(B) Must be standardised fresh each day against arsenic

(C) Decomposes readily on storage and absorbs water

(D) Is stable, obtainable in high purity, and non-hygroscopic so it can be weighed directly

Q108. For the two peaks in the chromatogram, $t_{R1} = 5.0$ min, $t_{R2} = 6.0$ min, and both baseline widths equal 0.50 min. Using $R_s = 2(t_{R2} - t_{R1})/(w_1 + w_2)$, the resolution is:



(A) 1.0

(B) 2.0

(C) 0.5

(D) 4.0

Q109. In ^{1}H NMR spectroscopy, tetramethylsilane (TMS) is used as the internal reference standard and assigned $\delta = 0$ ppm chiefly because its protons are:

(A) Strongly deshielded, appearing far downfield

(B) Paramagnetic and broaden the signal

(C) Highly shielded (giving a single sharp upfield signal) and chemically inert

(D) Coupled to many neighbours, giving a complex multiplet

Q110. In HPLC the retention (capacity) factor is defined as $k' = (t_R - t_0)/t_0$, where t_0 is the void time. For a solute with $t_R = 8.0$ min and $t_0 = 2.0$ min, k' equals:

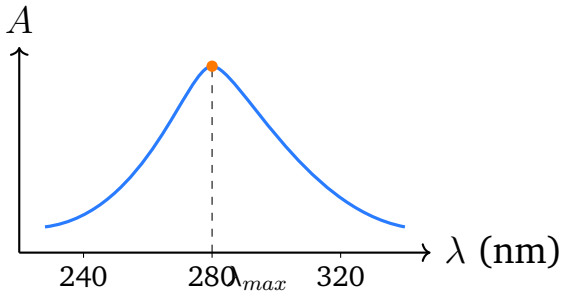
(A) 3.0

(B) 0.25

(C) 4.0

(D) 6.0

Q111. The UV curve below shows the absorption spectrum of a drug recorded against wavelength. For a routine assay, the analyst should select the wavelength marked on the figure for measurements because it is the absorption maximum. That wavelength is read as approximately:



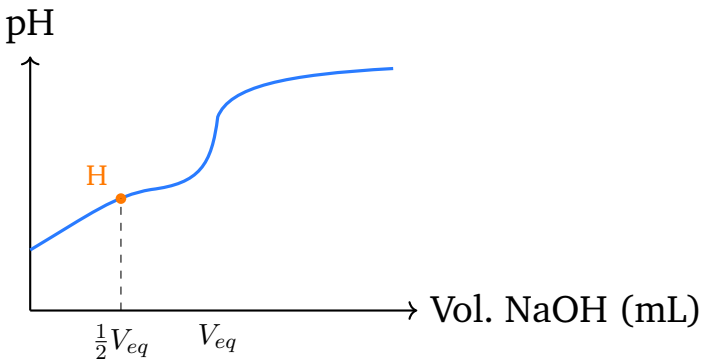
(A) 240 nm

(B) 280 nm

(C) 320 nm

(D) 200 nm

Q112. The curve shows the titration of a weak acid with NaOH. At the point marked **H**, exactly half the acid has been neutralised. At this half-equivalence point the solution is a buffer and:



(A) The pH equals 7 regardless of the acid

(B) All of the acid has been converted to its salt

(C) The pH equals the pK_a of the conjugate base

(D) The pH equals the pK_a of the weak acid (since $[HA] = [A^-]$)

Q113. A pH glass electrode is an example of an ion-selective potentiometric sensor. At $25\,^\circ$C the electrode potential changes by approximately how many millivolts per unit change in pH (one decade change in H^+ activity), following the Nernst equation?

(A) 9 mV

(B) 100 mV

(C) 59 mV

(D) 1000 mV

Q114. An organic compound shows a molecular-ion peak at an *odd* value of m/z (e.g. $M^{+\bullet} = 121$). According to the nitrogen rule, this odd molecular mass implies the molecule contains:

(A) An odd number of nitrogen atoms

(B) No nitrogen atoms at all

(C) Only chlorine and bromine atoms

(D) An even number of nitrogen atoms

Q115. In gas–liquid chromatography (GLC), the carrier gas (e.g. nitrogen, helium) functions as the:

(A) Stationary liquid phase coated on the support

(B) Detector reference reagent

(C) Sample derivatising agent

(D) Mobile phase that transports the volatilised sample through the column

Q116. Atomic absorption spectroscopy (AAS) requires a sharp-line radiation source matched to the analyte element. The source normally used, which emits the characteristic narrow lines of that very element, is the:

(A) Deuterium continuum lamp

(B) Hollow-cathode lamp

(C) Tungsten–halogen lamp

(D) Nernst glower

Q117. EDTA forms complexes with metal ions in a fixed mole ratio, irrespective of the charge on the metal. That stoichiometric ratio of EDTA to metal ion in the complex is:

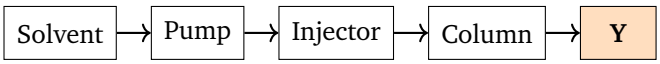
(A) 1 : 1

(B) 2 : 1

(C) 1 : 2

(D) 3 : 1

Q118. In the liquid-chromatograph block diagram below, identify the component labelled **Y**, which is placed *after* the column and generates the electrical signal recorded as the chromatogram.



(A) The mobile-phase reservoir

(B) The detector

(C) The high-pressure pump

(D) The injection valve

Q119. When the same compound is run on a 300 MHz and then a 600 MHz ^{1}H NMR spectrometer, the spin–spin coupling constant J (measured in Hz) for a given pair of protons:

(A) Doubles, because it scales with field strength

(B) Halves, because it is inversely proportional to field

(C) Becomes zero at high field

(D) Stays the same, because J (in Hz) is independent of the applied field

Q120. A back-titration is preferred over a direct titration when:

(A) The analyte reacts slowly or gives no sharp end point directly, so a measured excess of reagent is added and the unreacted excess is titrated

(B) The analyte is a strong acid reacting instantly with a strong base

(C) The titrant is itself a self-indicating primary standard

(D) No standard solutions are available at all

Q121. In size-exclusion (gel-permeation) chromatography, the order in which molecules leave the column is:

(A) Smallest molecules elute first, largest last

(B) Largest molecules elute first, smallest last

(C) Elution order depends only on charge

(D) All molecules elute together at one volume

Q122. In analytical method validation, the deliberate study of how small, intentional variations in method parameters (e.g. mobile-phase pH, flow rate, column temperature) affect the result is the validation characteristic known as:

(A) Linearity

(B) Accuracy

(C) Robustness

(D) Specificity

Part E: Pharmacognosy & Natural Products

Q123. Unorganized crude drugs are cell-free direct products of plant or animal metabolism (exudates, secretions, extracts), whereas organized drugs are entire plant organs with a cellular structure. Which of the following sets contains **only unorganized** crude drugs?

(A) Vasaka leaf, Quassia wood, Cardamom fruit

(B) Belladonna root, Cinnamon bark, Saffron stigma

(C) Colophony, Catechu, Agar

(D) Ergot sclerotium, Coca leaf, Senega root

Q124. A reference text lists crude drugs under the headings carbohydrates, glycosides, alkaloids, volatile oils, tannins and resins, paying no regard to the botanical family or the therapeutic use of each drug. This basis of grouping crude drugs is termed:

(A) Chemical classification

(B) Morphological classification

(C) Pharmacological classification

(D) Alphabetical classification

Q125. Placing *Cymbopogon*, *Saccharum* and *Triticum* together because all three are members of the grass family Poaceae (Gramineae), without reference

to the constituents or the part used, is an example of which classification of crude drugs?

(A) Morphological classification

(B) Taxonomical (botanical) classification

(C) Chemical classification

(D) Pharmacological classification

Q126. Scopolamine (hyoscine), a tropane alkaloid bearing a 6,7-epoxide bridge and used as an anti-emetic for motion sickness, is obtained chiefly from the leaves and flowering tops of which plant?

(A) *Rauwolfia serpentina*

(B) *Catharanthus roseus*

(C) *Withania somnifera*

(D) *Datura metel / Datura stramonium*

Q127. The dried seeds of *Theobroma cacao* contain a bitter purine base that is the chief xanthine of cocoa, acts as a mild diuretic and myocardial stimulant, and is classified as a purine pseudo-alkaloid. This alkaloid is:

(A) Theobromine

(B) Reserpine

(C) Vinblastine

(D) Quinidine

Q128. The dried aerial parts of *Lobelia inflata* yield a piperidine alkaloid with nicotine-like respiratory-stimulant action that was formerly used as a smoking deterrent. This chief alkaloid of lobelia is:

(A) Sparteine

(B) Lobeline

(C) Coniine

(D) Arecoline

Q129. Sanguinarine is a benzophenanthridine isoquinoline alkaloid present in *Sanguinaria canadensis*. When an acidic alkaloidal extract is treated with a solution of iodine in potassium iodide and produces a **reddish-brown precipitate**, the colour reaction being performed is:

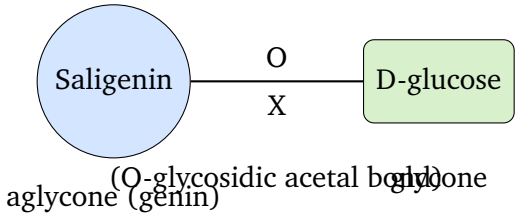
(A) Mayer's test (cream precipitate)

(B) Dragendorff's test (orange precipitate)

(C) Wagner's test (reddish-brown precipitate)

(D) Bornträger's test

Q130. The schematic below shows the phenolic glycoside salicin from *Salix* (willow) bark, in which an alcoholic aglycone is joined to a sugar through the linkage marked "X".



The aglycone saligenin (salicyl alcohol) and the sugar are joined through carbon-1 of glucose. The linkage "X" and the sugar portion are, respectively:

(A) An ester bond; the aglycone

(B) A peptide bond; the genin

(C) A C-glycosidic bond; the aglycone

(D) An O-glycosidic (acetal) bond; the glycone

Q131. Squill (the dried bulb of *Urginea indica / Drimia maritima*) contains cardioactive glycosides such as scillaren A and the rodenticidal scilliroside. Unlike the cardenolides of *Digitalis*, the steroidal aglycone of squill glycosides bears a **six-membered doubly-unsaturated lactone** ring, classifying them as:

(A) Bufadienolides

(B) Cardenolides

(C) Saponins

(D) Anthraquinones

Q132. Cascara sagrada, the dried bark of *Rhamnus purshiana*, owes its laxative action to anthraquinone C-glycosides. Which structural feature distinguishes the cascarosides of cascara from the O-glycosides of senna?

(A) The cascarosides are nitrogen-containing alkaloidal glycosides

(B) The cascarosides are C-glycosides (sugar linked through a carbon atom) and are therefore resistant to simple acid hydrolysis

(C) The cascarosides contain a steroidal cardenolide aglycone

(D) The cascarosides are cyanogenetic glycosides releasing HCN

Q133. Ginseng, the dried root of *Panax ginseng*, is valued as an adaptogen because of a group of triterpenoid (dammarane-type) saponin glycosides. These characteristic saponins of ginseng are called:

(A) Sennosides

(B) Cascarosides

(C) Ginsenosides (panaxosides)

(D) Cardenolides

Q134. Young shoots of *Sorghum* (great millet) accumulate a cyanogenetic glycoside whose aglycone is derived from tyrosine (p-hydroxymandelonitrile). On enzymatic hydrolysis this glycoside liberates glucose, p-hydroxybenzaldehyde and hydrocyanic acid. This cyanogenetic glycoside is:

(A) Sinigrin

(B) Glycyrrhizin

(C) Barbaloin

(D) Dhurrin

Q135. Nutmeg, the dried kernel of the seed of *Myristica fragrans*, yields a volatile oil whose aromatic ether constituent is also a weak hallucinogen and the chief toxic principle of the spice. This characteristic phenylpropanoid constituent of nutmeg is:

(A) Myristicin

(B) Menthol

(C) Carvone

(D) Citral

Q136. Anise fruit (*Pimpinella anisum*) yields a sweet carminative volatile oil whose chief constituent (about 80–90%) is a phenylpropene ether responsible for its characteristic liquorice-like odour. This principal constituent is:

(A) Eugenol

(B) Anethole

(C) Thymol

(D) Cinnamaldehyde

Q137. Valerian (the dried rhizome and roots of *Valeriana officinalis*) is used as a mild sedative. Its characteristic odour on storage and part of its activity are attributed to the volatile oil together with a group of unstable iridoid esters present in the drug. These iridoid ester sedative principles of valerian are the:

(A) Sennosides

(B) Ginsenosides

(C) Valepotriates (valtrate group)

(D) Cardenolides

Q138. Which of the following statements correctly distinguishes colophony (rosin) from sodium alginate?

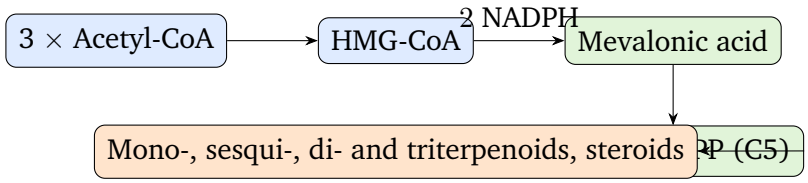
(A) Both are polysaccharide gums obtained from seaweed

(B) Both are solid resins obtained from coniferous trees

(C) Colophony is a water-soluble alginic-acid salt, while sodium alginate is a turpentine resin

(D) Colophony is the solid resin left after distilling turpentine oil from pine oleoresin, whereas sodium alginate is a polysaccharide salt of alginic acid from brown seaweed

Q139. Identify the biosynthetic pathway summarised in the scheme below and the class of secondary metabolites it primarily generates.



(A) Acetate–mevalonate (mevalonic acid) pathway giving terpenoids and steroids

(B) Shikimic acid pathway giving aromatic amino acids

(C) Acetate–malonate pathway giving fatty acids

(D) Pentose phosphate pathway giving sugars

Q140. Simple coumarins such as umbelliferone arise from cinnamic acid derivatives by ortho-hydroxylation and lactonisation. The cinnamic acid precursor is itself formed by deamination of phenylalanine, an aromatic amino acid produced through which biosynthetic pathway?

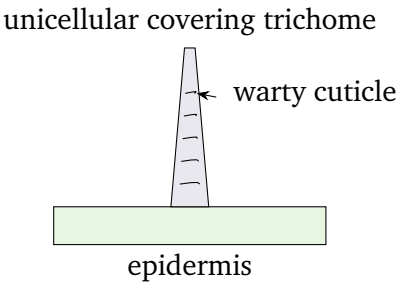
(A) Acetate–mevalonate pathway

(B) Shikimic acid pathway (via chorismate and prephenate)

(C) Acetate–malonate pathway

(D) Glyoxylate cycle

Q141. The microscopical sketch below shows a diagnostic epidermal appendage of a powdered leaf drug: an elongated, pointed, unicellular outgrowth of the epidermis with a warty cuticle and no glandular head.



This diagnostic powder element is correctly identified as a:

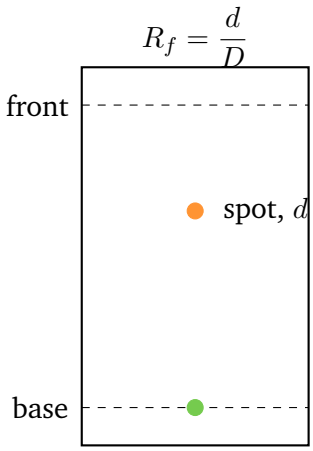
(A) Glandular (capitate) trichome

(B) Anomocytic stoma

(C) Unicellular covering (clothing) trichome

(D) Raphide of calcium oxalate

Q142. The TLC plate below is a chromatographic fingerprint of a herbal extract, showing the baseline (spotting line), a resolved spot at distance d, and the solvent front at distance D measured from the baseline.



If the spot migrates a distance $d = 2.6$ cm while the solvent front D moves 4.0 cm from the baseline, the R_f value of the spot is:

(A) 0.65

(B) 1.54

(C) 0.26

(D) 0.40

Part F: Pharmaceutical Biotechnology & Microbiology

Q143. A restriction endonuclease can leave a 5′ overhang, a 3′ overhang, or a blunt end depending on where it cuts within its palindrome. Which one of the following enzymes cleaves its recognition site to leave a **3′ single-stranded overhang**?

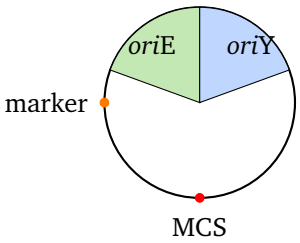
(A) *Bam*HI, which cuts G↓GATCC leaving a 5′ overhang

(B) *Eco*RV, which cuts GAT↓ATC leaving a blunt end

(C) *Kpn*I, which cuts GGTAC↓C leaving a 3′ overhang

(D) *Hpa*I, which cuts GTT↓AAC leaving a blunt end

Q144. The circular vector shown below carries **two** origins of replication, one functional in *E. coli* (*ori*E) and one functional in yeast (*ori*Y), together with a selectable marker and a multiple cloning site (MCS). A vector that can replicate and be selected in two different host species like this is called a:



(A) Shuttle vector

(B) Single-stranded M13 phage vector

(C) Cosmid

(D) Bacterial artificial chromosome (BAC)

Q145. T4 DNA ligase joins an insert to a vector by forming a phosphodiester bond between an adjacent 3′-OH and 5′-phosphate. Unlike a simple nuclease, this sealing reaction additionally requires an energy cofactor, namely:

(A) Free magnesium ions only, with no nucleotide cofactor

(B) A primer RNA molecule

(C) Inorganic phosphate released from the nick

(D) ATP (the bacterial enzyme uses NAD^+ instead)

Q146. Recombinant human deoxyribonuclease I (dornase alfa), produced in Chinese-hamster-ovary cells, is given by inhalation to patients with cystic fibrosis. Its therapeutic action is to:

(A) Stimulate red-cell formation in the bone marrow

(B) Digest the extracellular DNA that thickens airway mucus, lowering its viscosity

(C) Replace a missing clotting factor in the plasma

(D) Dissolve fibrin clots in coronary arteries

Q147. Recombinant granulocyte colony-stimulating factor (G-CSF, filgrastim), expressed in *E. coli*, is used clinically chiefly to:

(A) Stimulate production of neutrophils to treat chemotherapy-induced neutropenia

(B) Lower blood glucose in diabetes mellitus

(C) Activate plasminogen as a thrombolytic agent

(D) Promote longitudinal bone growth in children

Q148. In the production of certain fungal enzymes and organic acids, the microorganism is grown on a moist solid substrate (such as wheat bran) in the near-absence of free flowing water. This mode of cultivation is termed:

(A) Continuous (chemostat) culture

(B) Submerged batch culture in a stirred tank

(C) Solid-state fermentation

(D) Dialysis culture

Q149. Before charging a 50,000-litre production fermenter, the organism is grown through a series of progressively larger vessels (shake flask $\rightarrow$ seed tank $\rightarrow$ pre-fermenter) to build up an active, log-phase cell mass. This preparatory stage is known as:

(A) Downstream processing

(B) Inoculum development (scale-up of the seed culture)

(C) Strain improvement by mutation

(D) Sterility testing of the medium

Q150. Vigorous aeration of a protein-rich fermentation broth causes excessive foaming that can block exhaust filters and cause contamination. The most direct chemical measure to control this foam is to:

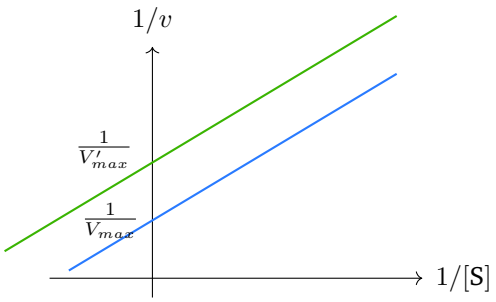
(A) Increase the impeller speed to shear the foam

(B) Raise the temperature of the broth

(C) Close the air sparger completely during the run

(D) Add a small amount of a silicone or vegetable-oil antifoam agent

Q151. An **uncompetitive** inhibitor binds only to the enzyme–substrate complex, not to free enzyme. The Lineweaver–Burk plot below shows the uninhibited line and the inhibited line. The pair of **parallel** lines is diagnostic because uncompetitive inhibition:



(A) Lowers both V_{max} and K_m by the same factor, leaving the slope unchanged

(B) Raises K_m but leaves V_{max} unchanged

(C) Lowers V_{max} but leaves K_m unchanged

(D) Has no effect on either parameter

Q152. Two isoenzymes act on the same substrate. Isoenzyme P has $K_m = 0.1$ mM and isoenzyme Q has $K_m = 2.0$ mM, with equal V_{max}. At low substrate concentrations the isoenzyme that works **more efficiently**, because it has the higher affinity for the substrate, is:

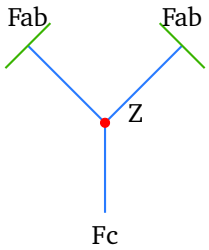
(A) Q, because a larger K_m means tighter binding

(B) Both equally, since K_m does not affect efficiency

(C) P, because a smaller K_m indicates higher affinity

(D) Neither, because affinity depends only on V_{max}

Q153. The IgG monomer is drawn below as a Y. The flexible segment labelled Z, which lies between the two Fab arms and the Fc stem and allows the two antigen-binding arms to move and adjust their angle, is the:



(A) Antigen-binding paratope

(B) Hinge region

(C) Variable region of the light chain

(D) Fc effector region

Q154. The hepatitis B vaccine in current use is made by cloning the gene for the viral surface antigen (HBsAg) and expressing it in yeast, so that the preparation contains only the purified antigenic protein and no viral nucleic acid. This is best classified as a:

(A) Live attenuated viral vaccine

(B) Whole killed (inactivated) viral vaccine

(C) Toxoid vaccine

(D) Recombinant subunit vaccine

Q155. In a haemolytic transfusion reaction, IgG or IgM antibodies bind to antigens on the surface of mismatched red blood cells and cause their destruction through complement activation and phagocytosis. In the Gell and Coombs classification this is:

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

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

(C) Type III (immune-complex) hypersensitivity

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

Q156. The tuberculin (Mantoux) skin-test reaction, in which an induration develops 48–72 hours after intradermal injection of tuberculin and is mediated by sensitised T lymphocytes and macrophages rather than antibody, is an example of:

(A) Type II (cytotoxic) hypersensitivity

(B) Type IV (delayed, T-cell-mediated) hypersensitivity

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

(D) Type III (immune-complex) hypersensitivity

Q157. A radioimmunoassay (RIA) for measuring a hormone in serum is a competitive binding assay. In it, the unknown unlabelled antigen and a fixed amount of radiolabelled antigen compete for a limited number of specific antibody sites, so that the measured radioactivity bound to the antibody is:

(A) Directly proportional to the amount of unlabelled antigen present

(B) Independent of the amount of unlabelled antigen

(C) Inversely related to the amount of unlabelled antigen in the sample

(D) Equal to the total radioactivity added, regardless of antigen

Q158. *Mycobacterium tuberculosis* resists ordinary Gram staining and is instead demonstrated by the Ziehl–Neelsen (acid-fast) method, in which the cells retain the primary stain even after washing with acid-alcohol. This property is due to the presence in the cell wall of:

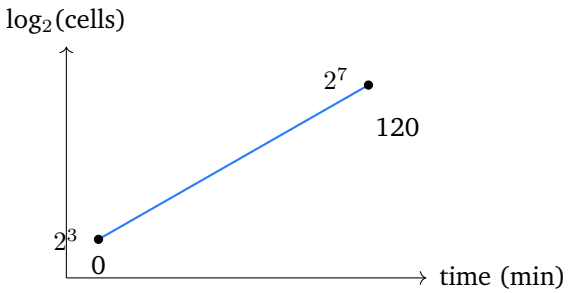
(A) A thick waxy layer of mycolic acids that resists acid decolourisation

(B) A thick outer layer of peptidoglycan only

(C) An outer membrane of lipopolysaccharide

(D) A complete absence of any cell wall

Q159. The exponential portion of a bacterial growth curve is shown on a $\log_2$(cell number) scale. The viable count rises from 2^3 to 2^7 cells over a period of 120 minutes during balanced exponential growth. The generation (doubling) time of this organism is:



(A) 60 minutes

(B) 24 minutes

(C) 40 minutes

(D) 30 minutes

Q160. To validate a moist-heat sterilisation cycle, a biological indicator carrying a known population of highly heat-resistant bacterial spores is processed and then tested for survivors. The organism normally used as the biological indicator for a steam (autoclave) cycle is:

(A) *Escherichia coli*

(B) *Geobacillus stearothermophilus*

(C) *Staphylococcus aureus*

(D) *Saccharomyces cerevisiae*

Detailed Solutions

Q1.

Solution

Concept — Solubility product (1:2 salt): For $Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$, $K_{sp} = [Mg^{2+}][OH^-]^2 = (s)(2s)^2 = 4s^3$. **Reasoning:** $4s^3 = 4 \times 10^{-12} \Rightarrow s^3 = 1 \times 10^{-12} \Rightarrow s = 1 \times 10^{-4}$ mol/L. **Why the other options are wrong:**

- (A) 2×10^{-6} misuses s^2 logic for a 1:1 salt.
- (C) 4×10^{-4} forgets to divide K_{sp} by 4 before the cube root.
- (D) 2×10^{-12} confuses solubility with half of K_{sp}.

Final Answer: $s = (K_{sp}/4)^{1/3} = 1 \times 10^{-4}$ mol/L $\Rightarrow$ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Fraction remaining after extraction: For equal volumes ($V_w = V_o$), the fraction left in water after one extraction is $\frac{V_w}{V_w + P\,V_o} = \frac{1}{1+P}$. **Reasoning:** With $P = 3$ and equal volumes, fraction remaining $= \frac{1}{1+3} = \frac{1}{4}$. **Why the other options are wrong:**

- (A) $3/4$ is the fraction extracted into ether, not the fraction left.
- (B) $1/3$ wrongly uses $1/P$.
- (C) $3/5$ does not arise from the correct formula.

Final Answer: fraction in water $= 1/(1+P) = 1/4 \Rightarrow$ D

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Stokes' law: Sedimentation velocity $v = \frac{d^2(\rho_s - \rho_o)g}{18\eta}$, where d is particle diameter. **Reasoning:** v is directly proportional to the *square* of the particle diameter, so reducing particle size markedly slows settling and improves suspension stability. **Why the other options are wrong:**

- (B) v is inversely proportional to viscosity η, not directly.
- (C) v is directly proportional to the density difference, not its reciprocal.
- (D) v scales with d^2, not r^3.

Final Answer: $v \propto d^2 \Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Bingham plastic flow: A plastic (Bingham) material does not flow until the applied stress exceeds a yield value f; beyond f the plot is linear. **Reasoning:** The straight line intercepting the stress axis at f (not the origin) is the signature of Bingham plastic flow (e.g. concentrated flocculated suspensions, certain ointments). **Why the other options are wrong:**

- (A) Newtonian lines pass through the origin with no yield value.
- (B) Dilatant curves bow toward the shear-rate axis and have no yield value.
- (D) Pseudoplastic curves bow toward the stress axis and pass through the origin.

Final Answer: linear with a positive yield intercept $\Rightarrow$ Bingham plastic $\Rightarrow$ C

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Viscosity vs temperature: For liquids, viscosity falls with rising temperature; it follows an Arrhenius-type expression $\eta = Ae^{E_v/RT}$ (E_v is the activation energy of flow). **Reasoning:** Higher thermal energy lets molecules slip past one another more easily, so η decreases (unlike gases, whose viscosity rises with temperature). **Why the other options are wrong:**

- (A) Viscosity of a liquid decreases, not increases, with temperature.
- (C) It is not temperature-independent.
- (D) It does not become zero at body temperature.

Final Answer: η decreases with T (Arrhenius-type) $\Rightarrow$ B

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Contact angle and wetting: The contact angle θ measures how well a liquid spreads on a solid; complete wetting means the liquid spreads fully. **Reasoning:** Complete (spontaneous) wetting corresponds to $\theta = 0^\circ$ (or approaching it); larger angles mean poorer wetting, and $\theta > 90^\circ$ indicates non-wetting. **Why the other options are wrong:**

- (A) 90° is the boundary of partial wetting.
- (B) 90–180° denotes poor/non-wetting.
- (C) 180° is complete non-wetting (the liquid beads up).

Final Answer: complete wetting $\Rightarrow \theta \approx 0^\circ \Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Carr's index: Carr's % $= \dfrac{\rho_{tapped} - \rho_{bulk}}{\rho_{tapped}} \times 100$. **Reasoning:** $= \dfrac{0.60 - 0.48}{0.60} \times 100 = \dfrac{0.12}{0.60} \times 100 = 20\%$, which falls in the fair/passable flow band (16–25%). **Why the other options are wrong:**

- (B) 12% would need a smaller density difference.
- (C) 25% over-estimates the difference.
- (D) 80% wrongly takes the ratio of densities, not the normalised difference.

Final Answer: $(0.12/0.60) \times 100 = 20\%$, passable $\Rightarrow$ A

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Particle-size mode: The modal size class is the histogram bar of greatest frequency. **Reasoning:** The tallest bar (height 3.0) is the fourth one, covering the 300–400 μm interval (peaking at the 400 class label), so the modal interval is 300–400 μm. **Why the other options are wrong:**

- (A) 100–200 is a low early bar.

- (B) 200–300 is shorter than the peak.
- (D) 500–600 is a small descending bar.

Final Answer: tallest bar lies in 300–400 μm $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Hausner ratio: HR $= \rho_{tapped}/\rho_{bulk}$; < 1.25 good, 1.25–1.34 passable, 1.35–1.45 poor, > 1.45 very poor. **Reasoning:** HR $= 1.45$ lies at the very-poor/cohesive end of the scale, signalling that a glidant or wet granulation is needed before compression. **Why the other options are wrong:**

- (A) Excellent flow needs HR near 1.0–1.11.
- (C) Good flow corresponds to HR ≤ 1.18.
- (D) HR $= 1.45$ certainly indicates a flow problem.

Final Answer: HR $= 1.45 \Rightarrow$ very poor (cohesive) flow $\Rightarrow$ B

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Henderson–Hasselbalch: $\text{pH} = \text{pK}_a + \log \dfrac{[\text{salt}]}{[\text{acid}]}$. **Reasoning:** With salt:acid $= 10:1$, $\log 10 = 1$, so pH $= 9.2 + 1 = 10.2$. **Why the other options are wrong:**

- (A) 8.2 wrongly subtracts 1.
- (B) 9.2 ignores the $10:1$ ratio (would need a $1:1$ ratio).
- (C) 9.0 has no basis in the calculation.

Final Answer: pH $= 9.2 + \log 10 = 10.2 \Rightarrow$ D

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Sodium-chloride equivalent (E): The E value is the mass of NaCl that produces the same osmotic effect as 1 g of drug. The NaCl equivalent contributed by a drug $=$ (mass of drug) $\times$ E. **Reasoning:** A 1% w/v solution in 50 mL contains 0.5 g of drug. NaCl equivalent $= 0.5 \times 0.20 = 0.10$ g. **Why the other options are wrong:**

- (B) 0.50 g is the drug mass, not its NaCl equivalent.
- (C) 0.20 g uses the E value as if it were grams directly.
- (D) 0.45 g is the NaCl needed for full isotonicity of 50 mL, a different quantity.

Final Answer: $0.5\,\text{g} \times 0.20 = 0.10$ g NaCl equivalent $\Rightarrow$ A

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Stokes–Einstein relation: $D = \dfrac{k_B T}{6\pi\eta r}$, where η is medium viscosity and r the molecular (hydrodynamic) radius. **Reasoning:** D is inversely proportional to the product of viscosity η and radius r (and directly proportional to absolute temperature). **Why the other options are wrong:**

- (A) D is directly (not inversely) proportional to temperature.
- (B) $D \propto 1/r$, not $1/r^2$.
- (D) D is directly proportional to k_B, not inversely.

Final Answer: $D \propto 1/(\eta r) \Rightarrow$ C

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — First-order half-life: $t_{1/2} = \dfrac{0.693}{k}$, independent of initial concentration. **Reasoning:** $t_{1/2} = \dfrac{0.693}{0.0231} = 30$ days. **Why the other options are wrong:**

- (A) 15 days halves the correct answer.

- (C) 3 days mis-places the decimal in k.
- (D) 300 days mis-divides by 0.00231.

Final Answer: $t_{1/2} = 0.693/0.0231 = 30$ days $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Order by linear plot: Second-order: $\frac{1}{C} = \frac{1}{C_0} + kt$, so $1/C$ versus t is linear with slope $+k$. **Reasoning:** A straight $1/C$ vs t plot uniquely identifies second-order kinetics. **Why the other options are wrong:**

- (A) Zero-order gives a linear C vs t plot.
- (B) First-order gives a linear $\ln C$ vs t plot.
- (C) Pseudo-first-order also linearises as $\ln C$ vs t.

Final Answer: linear $1/C$ vs $t \Rightarrow$ second-order $\Rightarrow$ D

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Eutectic point: In a binary system fully miscible as liquid but immiscible as solid, the two liquidus curves meet at the lowest melting temperature. **Reasoning:** That intersection (E) is the eutectic point, where a liquid of fixed composition freezes to a fine mechanical mixture of both solids at one temperature. **Why the other options are wrong:**

- (B) The triple point applies to a single pure substance.
- (C) The critical solution temperature is for partially miscible liquids.
- (D) Inversion temperature relates to emulsion type, not phase diagrams.

Final Answer: lowest-melting intersection = eutectic point $\Rightarrow$ A

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Langmuir isotherm linearisation: Rearranging $\frac{x}{m} = \frac{abC}{1+bC}$ gives $\frac{C}{x/m} = \frac{1}{ab} + \frac{C}{a}$. **Reasoning:** Hence a plot of $C/(x/m)$ versus C is a straight line, yielding the Langmuir constants a and b. **Why the other options are wrong:**

- (A) $\log(x/m)$ vs $\log C$ linearises the Freundlich, not Langmuir, isotherm.
- (B) x/m vs C is curved for Langmuir.
- (D) x/m vs $1/C^2$ has no theoretical basis here.

Final Answer: $C/(x/m)$ vs C is linear $\Rightarrow$ C

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Noyes–Whitney: $dC/dt = \frac{DA}{h}(C_s - C)$; h is the stagnant diffusion-layer thickness. **Reasoning:** Stirring thins the stagnant boundary layer (reduces h), so DA/h rises and dissolution speeds up. **Why the other options are wrong:**

- (A) Stirring does not change the intrinsic saturation solubility C_s.
- (C) Stirring does not lower D.
- (D) Stirring does not reduce the solid surface area A.

Final Answer: stirring reduces h, raising dissolution rate $\Rightarrow$ B

Answer: (B) Go Back to Q17

Q18.

Solution

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

- (A) Zero-order plots Q linearly against t (not $\sqrt{t}$).
- (B) First-order plots $\log(\%\,\text{remaining})$ against t.

- (C) Hixson–Crowell plots the cube root of remaining mass against t.

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

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — T_{max} and C_{max}: On a plasma-concentration–time curve, the peak occurs where the slope is zero, i.e. where absorption and elimination rates momentarily balance. **Reasoning:** At T_{max} the rate of drug entering the systemic circulation (absorption) just equals the rate of removal (elimination), giving the maximum concentration C_{max}. **Why the other options are wrong:**

- (B) At full elimination the concentration approaches zero, not a peak.
- (C) Before absorption starts the concentration is rising from zero, not at peak.
- (D) AUC is the integral of the whole curve and is not zero at the peak.

Final Answer: T_{max} is where absorption rate $=$ elimination rate $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

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:** Both low solubility and low permeability define Class IV, the most challenging class for oral bioavailability. **Why the other options are wrong:**

- (A) Class I is high/high.
- (B) Class II is low solubility/high permeability.
- (D) Class III is high solubility/low permeability.

Final Answer: low solubility + low permeability $\Rightarrow$ Class IV $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Similarity factor f_2: f_2 compares two dissolution profiles; it ranges from 0 to 100, with 100 meaning identical profiles. **Reasoning:** Profiles are accepted as similar when f_2 lies between 50 and 100 (the FDA/ICH criterion); the two near-superimposed curves shown would give such a value. **Why the other options are wrong:**

- (A) 0–25 indicates dissimilar profiles.
- (C) "less than 50" is the rejection (dissimilar) zone.
- (D) $f_2 = 0$ would mean maximally different profiles.

Final Answer: similar when f_2 is 50–$100 \Rightarrow$ B

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Glidants: Glidants improve powder flowability by reducing interparticle friction; colloidal silicon dioxide is the prototype. **Reasoning:** Its very fine particles coat larger granules, reducing cohesion and improving flow into the die, used at 0.1–0.5%. **Why the other options are wrong:**

- (A) Binders (e.g. PVP) impart cohesion, the opposite role.
- (B) Disintegrants break the tablet up after swallowing.
- (C) It is not a sweetener.

Final Answer: colloidal silica is a glidant $\Rightarrow$ D

Answer: (D) Go Back to Q22

Q23.

Solution

Concept — Heckel analysis: The Heckel equation $\ln\left(\frac{1}{1-D}\right) = KP + A$ describes powder densification under pressure; K is the slope. **Reasoning:** The reciprocal of the slope, $1/K$, equals the mean yield pressure P_y, a measure of the material's resistance to plastic deformation. **Why the other options are wrong:**

- (B) Friability is a separate mechanical-strength test.

- (C) Disintegration time is unrelated to the Heckel slope.
- (D) Moisture content is not derived from a Heckel plot.

Final Answer: $1/\text{slope} = \text{mean yield pressure} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept — Capsule sizes: For hard-gelatin capsules the larger the size number, the smaller the volume; the series runs 000, 00, 0, 1, 2, 3, 4, 5. **Reasoning:** Size 5 has the smallest fill volume (about 0.13 mL); size 000 the largest. **Why the other options are wrong:**

- (A) Size 000 is the *largest*, not smallest.
- (C) Size 0 is mid-large.
- (D) Size 1 is larger than size 5.

Final Answer: size 5 is the smallest $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Displacement value (DV): Mass of base displaced by the drug $=$ (mass of drug)/DV. Base required $=$ (mould capacity) $-$ (base displaced). **Reasoning:** Base displaced $= 0.2/2 = 0.1$ g. Base required $= 1.0 - 0.1 = 0.90$ g per suppository. **Why the other options are wrong:**

- (A) 1.0 g ignores the displacement by the drug.
- (B) 0.80 g wrongly subtracts the full drug mass (0.2 g).
- (D) 0.20 g is the drug mass, not the base.

Final Answer: $1.0 - (0.2/2) = 0.90$ g base $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept — Dye-solubility (staining) test: A water-soluble dye colours only the aqueous phase; if that phase is continuous, the whole emulsion is uniformly coloured. **Reasoning:** Uniform colouring by a water-soluble dye means water is the external (continuous) phase, so it is an o/w emulsion. **Why the other options are wrong:**

- (A) In w/o, only dispersed droplets (not the continuum) would be coloured, giving a speckled appearance.
- (B) A non-aqueous emulsion would not take up a water-soluble dye uniformly.
- (C) The test gives a clear answer here.

Final Answer: uniform water-soluble dye $\Rightarrow$ o/w emulsion $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Ophthalmic comfort: Eye drops should match the physiological environment of the tear film to avoid irritation. **Reasoning:** The ideal eye drop is isotonic (equivalent to 0.9% NaCl) and buffered close to the tear pH (about 7.4), minimising stinging and reflex lacrimation. **Why the other options are wrong:**

- (B) Strong hypertonicity draws water from the eye and irritates.
- (C) pH 2 is far too acidic and damaging.
- (D) A viscosity agent is desirable (prolongs contact), not forbidden.

Final Answer: isotonic and buffered near tear pH $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept — Content uniformity vs weight variation: Weight variation assumes the drug is uniformly distributed and is reliable only for high-dose tablets; low-dose tablets need a direct assay of each unit. **Reasoning:** For low-dose (potent)

tablets, the content-uniformity test (assaying individual units) is the discriminating pharmacopoeial requirement. **Why the other options are wrong:**

- (A) Weight variation alone can mask drug maldistribution in low-dose tablets.
- (C) Friability tests mechanical strength, not drug content.
- (D) Disintegration tests breakup time, not content.

Final Answer: low-dose tablets require content-uniformity testing $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept — Aerosol propellant: The propellant supplies the internal pressure that, on valve actuation, forces the product out and atomises it. **Reasoning:** On pressing the actuator, the propellant's vapour pressure expels the formulation through the metering valve and breaks it into a fine spray. **Why the other options are wrong:**

- (A) The propellant is not the active drug.
- (B) It does not sterilise the contents.
- (D) It does not neutralise pH.

Final Answer: propellant provides expulsion pressure and atomisation $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Ointment bases: Absorption bases are anhydrous (or w/o) bases able to take up additional water to form a w/o system; wool fat/cholesterol confers this. **Reasoning:** Hydrophilic petrolatum contains cholesterol and wool fat, allowing it to absorb water, so it is an absorption base. **Why the other options are wrong:**

- (B) Plain (oleaginous) petrolatum absorbs little water.
- (C) Water-soluble bases are PEG-based with no hydrocarbon.
- (D) Water-removable bases are o/w creams.

Final Answer: hydrophilic petrolatum is an absorption base $\Rightarrow$ A

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Sieve mesh number: Mesh number is the count of openings per linear inch; more openings per inch means each opening is smaller. **Reasoning:** As mesh number rises, the aperture size decreases, so a higher-mesh sieve retains/passes finer powder. **Why the other options are wrong:**

- (A) Aperture decreases, it does not increase.
- (B) It does not stay constant.
- (C) The relationship is monotonic, not up-then-down.

Final Answer: higher mesh number $\Rightarrow$ smaller aperture $\Rightarrow$ D

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Reynolds number: $\text{Re} = \dfrac{\rho v d}{\eta}$ classifies pipe-flow regime: < 2100 laminar, 2100–4000 transitional, > 4000 turbulent. **Reasoning:** The lower sketch shows chaotic eddies (turbulent flow), which occurs when Re exceeds about 4000. **Why the other options are wrong:**

- (A) $\text{Re} < 2100$ is laminar (the upper sketch).
- (B) $\text{Re} = 2100$ marks the onset of the transitional zone, not full turbulence.
- (D) $\text{Re} < 1.0$ is creeping (highly laminar) flow.

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

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Constant-rate drying period: While free (unbound) surface moisture is available, the wet solid behaves like a free water surface and dries at a constant rate. **Reasoning:** During this period the rate is governed by surface evaporation, i.e. the rates of heat transfer to and vapour (mass) transfer from the wet surface, not by internal diffusion. **Why the other options are wrong:**

- (B) Internal diffusion of bound water controls the later *falling-rate* period.
- (C) An orifice belongs to osmotic pumps, not tray drying.
- (D) Osmotic pressure is irrelevant to hot-air drying.

Final Answer: surface evaporation (heat/mass transfer) controls the constant-rate period $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Niosomes: Niosomes are bilayer vesicles formed by hydration of non-ionic surfactants, usually with cholesterol, analogous to liposomes but more stable and cheaper. **Reasoning:** The non-ionic surfactant bilayer encloses an aqueous core, so niosomes can entrap hydrophilic drugs (in the core) and lipophilic drugs (in the bilayer). **Why the other options are wrong:**

- (A) Solid lipid nanoparticles have a solid lipid core, not a surfactant bilayer vesicle.
- (C) Albumin microspheres are protein matrix particles, not vesicles.
- (D) Phospholipid-stabilised oil droplets describe an emulsion/lipid nanoemulsion, not niosomes.

Final Answer: non-ionic surfactant bilayer vesicles with an aqueous core $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Clearance at steady state: During a constant-rate infusion, at steady state the rate in equals the rate out, so infusion rate $R_0 = CL \times C_{ss}$. **Reasoning:** Rearranging, $CL = R_0/C_{ss} = 30\,\text{mg/h}/6\,\text{mg/L} = 5$ L/h. **Why the other options are wrong:**

- (A) 180 L/h multiplies instead of dividing.
- (C) 0.2 L/h inverts the ratio.
- (D) 36 L/h has no basis.

Final Answer: $CL = 30/6 = 5$ L/h $\Rightarrow$ B

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — Approach to steady state: During a constant infusion, plasma concentration approaches C_{ss} exponentially; the fraction reached depends only on the number of half-lives elapsed, independent of dose or clearance. **Reasoning:** One half-life reaches 50%, two reach 75%, three reach 87.5% and four reach about 93.75% (≈94%) of C_{ss}. With $t_{1/2} = 8$ h, four half-lives $= 4 \times 8 = 32$ h. **Why the other options are wrong:**

- (A) 8 h is one half-life (50%).
- (B) 16 h is two half-lives (75%).
- (C) 48 h is six half-lives (≈98%), more than asked.

Final Answer: Four half-lives $= 32$ h $\Rightarrow$ D

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Hepatic extraction ratio: A high extraction ratio ($E \to 1$) means the liver removes nearly all drug presented to it; such drugs are "flow-limited". **Reasoning:** An orally absorbed high-extraction drug is largely metabolised on its first pass through the liver, so oral bioavailability is low (roughly $1 - E$). Because

almost everything delivered is extracted, hepatic clearance approaches and varies with hepatic blood flow. **Why the other options are wrong:**

- (B) High extraction means a large first-pass effect, not a negligible one.
- (C) Flow-limited (not capacity-limited) describes high-extraction drugs; capacity-limitation applies to low-extraction drugs.
- (D) High hepatic extraction implies high, not zero, hepatic clearance.

Final Answer: Large first-pass, low oral F, flow-sensitive clearance $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Competitive antagonism: A reversible competitive antagonist competes with the agonist for the same site; adding more agonist overcomes it (surmountable). **Reasoning:** A parallel rightward shift with an unchanged maximum that more agonist can fully overcome is the signature of reversible competitive antagonism. It lowers apparent potency (higher EC_{50}) but leaves efficacy (E_{max}) intact. **Why the other options are wrong:**

- (A) A non-competitive/irreversible antagonist depresses E_{max}, which is not seen here.
- (B) An inverse agonist reduces constitutive activity; it does not merely shift the curve.
- (D) A partial agonist has its own sub-maximal response, not a pure rightward shift.

Final Answer: Parallel shift, same E_{max}, surmountable $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Margin of safety: The certain safety factor (margin of safety) $= TD_1/ED_{99}$ refines the therapeutic index by comparing the dose just beginning to be toxic with the dose effective in nearly everyone. **Reasoning:** Here $TD_1/ED_{99} = 8/16 = 0.5$. A value below 1 means the dose needed to be effective in 99% already exceeds the dose toxic in 1%, so the effective and toxic ranges overlap

and the margin is dangerously narrow. **Why the other options are wrong:**

- (A) The ratio is 0.5, not >1, so it is not reassuring.
- (C) The simple therapeutic index here is LD_{50}-type/ED_{50}; the margin-of-safety ratio asked is 0.5, not 2.
- (D) The margin of safety is specifically derived from such quantal data.

Final Answer: $TD_1/ED_{99} = 0.5 < 1$, overlapping ranges $\Rightarrow$ B

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Kinase-linked receptors: Receptor tyrosine kinases bind ligand, dimerise, autophosphorylate tyrosines and recruit SH2-domain signalling proteins. **Reasoning:** Insulin acts on the insulin receptor, a receptor tyrosine kinase. Ligand binding triggers autophosphorylation and downstream IRS/PI3K and Ras-MAPK cascades, matching the highlighted kinase-linked branch. **Why the other options are wrong:**

- (A) The nicotinic receptor is a ligand-gated ion channel.
- (B) The β_2 receptor is a GPCR.
- (C) Cortisol acts on an intracellular nuclear receptor, not a cell-surface kinase.

Final Answer: Insulin acts via a receptor tyrosine kinase $\Rightarrow$ D

Answer: (D) Go Back to Q40

Q41.

Solution

Concept — Tachyphylaxis: Tachyphylaxis is a rapidly developing tolerance in which the response falls steeply on repeated dosing over a short interval. **Reasoning:** For an indirectly acting sympathomimetic, each dose releases stored noradrenaline; the readily releasable pool is quickly depleted, so successive equal doses give progressively smaller responses, exactly as the trace shows. **Why the other options are wrong:**

- (B) Idiosyncrasy is a genetically determined abnormal response, not progres-

sive loss.

- (C) Competitive antagonism involves a separate blocking drug, not store depletion.
- (D) Enzyme induction develops over days and changes metabolism, not minutes.

Final Answer: Rapid tolerance from store depletion = tachyphylaxis $\Rightarrow$ A

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Catecholamine synthesis: The pathway is tyrosine $\rightarrow$ L-DOPA $\rightarrow$ dopamine $\rightarrow$ noradrenaline, and the first step is rate-limiting. **Reasoning:** Tyrosine hydroxylase converts tyrosine to L-DOPA and is the rate-limiting, regulated enzyme of catecholamine synthesis (subject to end-product feedback inhibition). **Why the other options are wrong:**

- (A) Dopamine β-hydroxylase makes noradrenaline from dopamine, a later step.
- (B) DOPA decarboxylase converts L-DOPA to dopamine, not the rate-limiting step.
- (D) COMT is a degradative enzyme, not a synthetic one.

Final Answer: Tyrosine hydroxylase is rate-limiting $\Rightarrow$ C

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Irreversible α-blockade: Phenoxybenzamine is a haloalkylamine that covalently alkylates α-adrenergic receptors. **Reasoning:** Its irreversible (non-competitive) α-blockade cannot be overcome by surges of catecholamines, making it ideal for controlling the labile hypertension of a catecholamine-secreting phaeochromocytoma before surgery; the effect lasts until new receptors are synthesised. **Why the other options are wrong:**

- (A) It is not a reversible β_1 blocker.
- (C) It is an α-antagonist, not an α_2 agonist.

- (D) It does not stimulate ganglia.

Final Answer: Irreversible covalent α-blockade $\Rightarrow$ B

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Antimuscarinic bronchodilators: Inhaled antimuscarinics block vagal cholinergic tone in the airways. **Reasoning:** Tiotropium is a long-acting muscarinic antagonist (LAMA) that binds airway M_3 receptors with slow dissociation, giving sustained bronchodilation in COPD with minimal systemic absorption from the inhaled route. **Why the other options are wrong:**

- (A) β_2 agonism describes salbutamol/salmeterol, a different class.
- (B) Methylxanthine PDE inhibition describes theophylline.
- (C) Leukotriene antagonism describes montelukast.

Final Answer: Long-acting M_3 antagonist $\Rightarrow$ D

Answer: (D) Go Back to Q44

Q45.

Solution

Concept — Selective relaxant binding: Sugammadex is a modified γ-cyclodextrin designed to bind aminosteroid neuromuscular blockers. **Reasoning:** It encapsulates rocuronium (and vecuronium) in its lipophilic cavity, forming a tight inactive complex. This removes free blocker from plasma and the neuromuscular junction, reversing the block rapidly without relying on acetylcholinesterase inhibition. **Why the other options are wrong:**

- (B) AChE inhibition (neostigmine) is the older, indirect reversal mechanism, not sugammadex.
- (C) It is not a depolarising agonist.
- (D) It does not act on pseudocholinesterase.

Final Answer: Cyclodextrin encapsulation of the steroidal blocker $\Rightarrow$ A

Answer: (A) Go Back to Q45

Q46.

Solution

Concept — β_3-agonists in overactive bladder: The detrusor expresses β_3-adrenergic receptors whose activation relaxes the muscle during filling. **Reasoning:** Mirabegron is a selective β_3-agonist that relaxes the detrusor and increases bladder capacity, treating overactive bladder without the dry mouth and constipation of antimuscarinics. **Why the other options are wrong:**

- (A) M_3 blockade is the antimuscarinic mechanism (e.g. oxybutynin), which the question contrasts against.
- (B) It does not block ganglionic nicotinic transmission.
- (D) α_1 blockade relaxes the bladder neck/prostate, a different target.

Final Answer: β_3-adrenergic agonism relaxing the detrusor $\Rightarrow$ C

Answer: (C) Go Back to Q46

Q47.

Solution

Concept — Z-drug hypnotics: Zolpidem is a non-benzodiazepine that still acts on the GABA-A benzodiazepine site. **Reasoning:** It binds preferentially to GABA-A receptors containing the α_1 subunit, which mediate sedation/hypnosis. This subtype selectivity explains its strong hypnotic action with comparatively little anxiolytic, muscle-relaxant or anticonvulsant effect. **Why the other options are wrong:**

- (A) Like benzodiazepines it needs GABA and does not open the channel directly.
- (C) Melatonin-receptor agonism describes ramelteon.
- (D) Orexin antagonism describes suvorexant.

Final Answer: α_1-preferring positive allosteric modulator of GABA-A $\Rightarrow$ B

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Noradrenergic/specific serotonergic antidepressant (NaSSA): Mirtazapine works by blocking presynaptic α_2-autoreceptors rather than blocking reuptake. **Reasoning:** Antagonising α_2-autoreceptors disinhibits noradrenaline and serotonin release. Additional 5-HT_2/5-HT_3 blockade reduces anxiety, sexual and nausea side effects, while strong H_1 blockade explains its sedation and appetite stimulation. **Why the other options are wrong:**

- (A) It is not an SSRI.
- (B) It is not an MAO inhibitor.
- (C) D_2 antagonism is an antipsychotic action.

Final Answer: α_2-autoreceptor antagonist plus 5-HT_2/5-HT_3/H_1 blockade $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q48

Q49.

Solution

Concept — Lithium mechanism: Lithium's mood-stabilising action is linked to second-messenger and kinase effects. **Reasoning:** Lithium inhibits inositol monophosphatase, dampening the phosphatidylinositol (IP_3/DAG) cycle and depleting free inositol in overactive neurons; it also inhibits glycogen synthase kinase-3 (GSK-3). These effects are thought to underlie its stabilisation of mood. **Why the other options are wrong:**

- (B) Sodium-channel blockade describes anticonvulsant mood stabilisers like valproate/carbamazepine.
- (C) It is not a GABA-B agonist.
- (D) It is not an MAO inhibitor.

Final Answer: Inositol-monophosphatase (and GSK-3) inhibition $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — NMDA antagonism in dementia: Excess glutamatergic NMDA activity contributes to excitotoxicity in Alzheimer's disease. **Reasoning:** Memantine is a moderate-affinity, voltage-dependent, uncompetitive NMDA-receptor channel blocker. It blocks pathological tonic glutamate signalling and calcium entry while allowing physiological synaptic transmission, slowing symptom progression in moderate-to-severe disease. **Why the other options are wrong:**

- (A) Reversible AChE inhibition describes donepezil/rivastigmine, a different class.
- (B) It is not a selective butyrylcholinesterase inhibitor.
- (D) It is not a muscarinic agonist.

Final Answer: Uncompetitive NMDA-receptor antagonist $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q50

Q51.

Solution

Concept — Raising brain GABA: Increasing GABA can be achieved by blocking its breakdown. **Reasoning:** Vigabatrin (vinyl-GABA) is an irreversible suicide inhibitor of GABA transaminase (GABA-T), the enzyme that catabolises GABA. Blocking it raises CNS GABA concentrations and enhances inhibition, controlling seizures. **Why the other options are wrong:**

- (A) Glutamic acid decarboxylase synthesises GABA; inhibiting it would lower GABA.
- (C) GAT-1 inhibition (reuptake block) describes tiagabine.
- (D) Carbonic anhydrase inhibition is unrelated to GABA-T.

Final Answer: Irreversible GABA-transaminase inhibition $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q51

Q52.

Solution

Concept — Central antispastic action: Baclofen is a structural analogue of GABA acting at metabotropic GABA-B receptors. **Reasoning:** By activating spinal GABA-B receptors, baclofen reduces excitatory transmitter release (via decreased Ca^{2+} influx) and increases K^+ conductance, depressing mono- and polysynaptic reflexes and relieving spasticity. **Why the other options are wrong:**

- (B) Nicotinic action at the NMJ describes neuromuscular blockers.
- (C) Ryanodine-receptor block describes dantrolene.
- (D) It is not a β_2-adrenergic agonist.

Final Answer: GABA-B receptor agonist $\Rightarrow$ A

Answer: (A) Go Back to Q52

Q53.

Solution

Concept — Dissociative anaesthesia: Ketamine acts mainly on excitatory glutamate transmission rather than GABA. **Reasoning:** Ketamine is a non-competitive (channel-blocking) NMDA-receptor antagonist. Dissociating thalamocortical from limbic activity, it gives profound analgesia and amnesia while largely preserving airway reflexes and respiration, useful in field and paediatric anaesthesia. **Why the other options are wrong:**

- (A) GABA-A potentiation describes barbiturates/propofol.
- (B) It is not primarily a μ-opioid agonist.
- (D) Central α_2 agonism describes dexmedetomidine.

Final Answer: Non-competitive NMDA-receptor blockade $\Rightarrow$ C

Answer: (C) Go Back to Q53

Q54.

Solution

Concept — Non-dihydropyridine CCBs: Verapamil (a phenylalkylamine) blocks L-type calcium channels in both vessels and cardiac conducting tissue. **Reasoning:** Unlike dihydropyridines such as amlodipine, verapamil has prominent cardiac ac-

tion: it depresses SA-node automaticity and slows AV-nodal conduction, reducing heart rate and being useful in supraventricular tachycardia as well as hypertension and angina. **Why the other options are wrong:**

- (A) It does not block β_1 receptors.
- (B) Selective I_f inhibition describes ivabradine.
- (C) It does not open ATP-sensitive K^+ channels.

Final Answer: Phenylalkylamine L-type CCB with nodal action $\Rightarrow$ D

Answer: (D) Go Back to Q54

Q55.

Solution

Concept — Direct arteriolar vasodilators: Hydralazine relaxes arteriolar smooth muscle directly, lowering peripheral resistance. **Reasoning:** The abrupt fall in resistance unloads the baroreceptors, triggering reflex sympathetic activation (tachycardia, increased contractility) and renal sodium/water retention. This is why hydralazine is usually combined with a β-blocker and a diuretic. **Why the other options are wrong:**

- (B) It does not block β_1 receptors.
- (C) It is not an ACE inhibitor.
- (D) It is not a diuretic.

Final Answer: Direct arteriolar dilator with reflex tachycardia $\Rightarrow$ A

Answer: (A) Go Back to Q55

Q56.

Solution

Concept — Aldosterone antagonists: Spironolactone competitively blocks the mineralocorticoid (aldosterone) receptor in the late distal tubule and collecting duct. **Reasoning:** Blocking aldosterone reduces expression of luminal Na^+ channels and the Na^+/K^+-ATPase, so sodium is excreted while potassium is retained, giving a mild potassium-sparing diuresis useful in heart failure and resistant hypertension. **Why the other options are wrong:**

- (A) $Na^+/K^+/2Cl^-$ block describes loop diuretics.

- (C) Carbonic-anhydrase inhibition describes acetazolamide.
- (D) Direct ENaC blockade describes amiloride/triamterene, not spironolactone.

Final Answer: Mineralocorticoid-receptor antagonist $\Rightarrow$ B

Answer: (B) Go Back to Q56

Q57.

Solution

Concept — Cholesterol-absorption inhibition: Ezetimibe targets intestinal sterol uptake rather than synthesis. **Reasoning:** It inhibits the Niemann-Pick C1-like 1 (NPC1L1) transporter on enterocytes, cutting absorption of dietary and biliary cholesterol. The liver compensates by upregulating LDL receptors, lowering plasma LDL; it is often combined with a statin. **Why the other options are wrong:**

- (A) HMG-CoA reductase inhibition is the statin mechanism.
- (B) Bile-acid sequestration describes cholestyramine.
- (D) PPAR-α activation describes fibrates.

Final Answer: NPC1L1 inhibition reducing cholesterol absorption $\Rightarrow$ C

Answer: (C) Go Back to Q57

Q58.

Solution

Concept — Direct thrombin inhibitor: Dabigatran is an oral direct-acting anticoagulant (DOAC) that binds thrombin itself. **Reasoning:** It reversibly and directly inhibits thrombin (factor IIa), preventing fibrinogen-to-fibrin conversion. Its predictable pharmacokinetics avoid routine INR monitoring, and idarucizumab is its specific monoclonal-fragment reversal agent. **Why the other options are wrong:**

- (A) Vitamin-K epoxide reductase inhibition describes warfarin.
- (B) Antithrombin potentiation describes heparin.
- (C) $P2Y_{12}$ blockade describes antiplatelet thienopyridines.

Final Answer: Direct reversible thrombin (IIa) inhibitor $\Rightarrow$ D

Answer: (D) Go Back to Q58

Q59.

Solution

Concept — Triptans: Sumatriptan is a selective serotonin 5-$HT_{1B/1D}$ receptor agonist. **Reasoning:** 5-HT_{1B} activation constricts dilated cranial blood vessels, while 5-HT_{1D} activation on trigeminal sensory nerves inhibits release of vasoactive/pro-inflammatory neuropeptides (e.g. CGRP). Together these abort the acute migraine. **Why the other options are wrong:**

- (B) 5-HT_3 antagonism describes antiemetics like ondansetron.
- (C) Irreversible COX inhibition describes aspirin.
- (D) D_2 antagonism is unrelated to triptan action.

Final Answer: 5-$HT_{1B/1D}$ agonism $\Rightarrow$ A

Answer: (A) Go Back to Q59

Q60.

Solution

Concept — Reversible vs irreversible COX inhibition: Most NSAIDs are reversible competitive COX inhibitors; aspirin is the exception (irreversible acetylation). **Reasoning:** Diclofenac reversibly and competitively inhibits COX-1 and COX-2. Because the inhibition is reversible, its antiplatelet effect lasts only while drug is present and recovers as the drug is cleared, unlike aspirin's permanent platelet inhibition. **Why the other options are wrong:**

- (A) Irreversible acetylation is aspirin's mechanism, not diclofenac's.
- (B) It inhibits cyclooxygenase, not lipoxygenase.
- (D) It is not a selective COX-2 sparing agent.

Final Answer: Reversible competitive COX inhibition $\Rightarrow$ C

Answer: (C) Go Back to Q60

Q61.

Solution

Concept — Second-generation H_1 antihistamines: These antagonise peripheral H_1 receptors with little CNS entry. **Reasoning:** Fexofenadine is poorly lipophilic and is a P-glycoprotein substrate actively pumped out of the brain, so it crosses

the blood-brain barrier poorly and causes minimal sedation while still relieving allergic rhinitis. **Why the other options are wrong:**

- (A) It blocks H_1, not H_2, receptors.
- (C) It is a receptor antagonist, not merely a mast-cell stabiliser.
- (D) It is not a leukotriene receptor antagonist.

Final Answer: Non-sedating H_1 blocker with poor CNS penetration $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q61

Q62.

Solution

Concept — Peripheral D_2 antiemetic/prokinetic: Domperidone blocks dopamine D_2 receptors but is largely excluded from the brain. **Reasoning:** It poorly crosses the blood-brain barrier, so it acts at the chemoreceptor trigger zone (which lies outside the barrier) and on gut D_2 receptors, giving antiemetic and prokinetic effects with little risk of central extrapyramidal reactions (unlike metoclopramide). **Why the other options are wrong:**

- (A) It is a D_2 antagonist, not a 5-HT_3 antagonist.
- (B) It is not a muscarinic agonist.
- (C) It does not act primarily by H_1 blockade.

Final Answer: Peripheral D_2 antagonist sparing the CNS $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q62

Q63.

Solution

Concept — Glycopeptide cell-wall inhibition: Vancomycin blocks peptidoglycan synthesis at a step different from the β-lactams. **Reasoning:** It binds the terminal D-alanyl-D-alanine of the pentapeptide on peptidoglycan precursors, sterically preventing both transglycosylation and transpeptidation, so the growing cell wall cannot be assembled in Gram-positive bacteria. **Why the other options are wrong:**

- (B) Binding penicillin-binding proteins is the β-lactam mechanism, which the question contrasts against.

- (C) 30S inhibition describes aminoglycosides/tetracyclines.
- (D) DNA-gyrase inhibition describes fluoroquinolones.

Final Answer: Binds D-Ala-D-Ala, blocking peptidoglycan assembly $\Rightarrow$ A

Answer: (A) Go Back to Q63

Q64.

Solution

Concept — Tetracyclines: These bacteriostatic agents act on the 30S ribosomal subunit. **Reasoning:** Doxycycline reversibly binds the 30S subunit and blocks attachment of aminoacyl-tRNA to the ribosomal A site, halting addition of new amino acids and so inhibiting bacterial protein synthesis. **Why the other options are wrong:**

- (A) 50S/translocation block describes macrolides.
- (B) DHFR inhibition describes trimethoprim.
- (D) Covalent DNA adducts describe alkylating agents, not antibacterial tetracyclines.

Final Answer: 30S binding blocking aminoacyl-tRNA at the A site $\Rightarrow$ C

Answer: (C) Go Back to Q64

Q65.

Solution

Concept — Echinocandin antifungals: Echinocandins target the fungal cell wall, a structure azoles do not affect. **Reasoning:** Caspofungin non-competitively inhibits β-(1,3)-D-glucan synthase, blocking synthesis of the glucan polymer essential to the fungal cell wall, causing osmotic lysis of susceptible Candida and Aspergillus. **Why the other options are wrong:**

- (A) 14-α-demethylase inhibition (ergosterol synthesis) is the azole mechanism.
- (C) It does not inhibit fungal DNA polymerase.
- (D) Fungi do not have a bacterial-type 50S ribosome target here.

Final Answer: β-(1,3)-D-glucan synthase inhibition $\Rightarrow$ B

Answer: (B) Go Back to Q65

Q66.

Solution

Concept — Neuraminidase inhibitors: Influenza virus uses neuraminidase to release progeny virions from infected cells. **Reasoning:** Oseltamivir (its active carboxylate) inhibits viral neuraminidase, so newly formed virions stay bound to sialic acid on the host cell and cannot spread, limiting viral propagation and shortening illness when started early. **Why the other options are wrong:**

- (A) Reverse-transcriptase chain termination describes anti-HIV nucleosides.
- (B) M2 ion-channel blockade describes amantadine.
- (C) Viral DNA-polymerase inhibition describes acyclovir-type agents.

Final Answer: Viral neuraminidase inhibition blocking virion release $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q66

Q67.

Solution

Concept — SGLT2 inhibitors: These "gliflozins" lower glucose by promoting its urinary loss, independent of insulin. **Reasoning:** Empagliflozin inhibits the sodium-glucose co-transporter-2 in the proximal convoluted tubule, where most filtered glucose is reabsorbed. Blocking it produces glycosuria, lowering plasma glucose, with added weight loss and cardiovascular/renal benefits. **Why the other options are wrong:**

- (B) Closing β-cell K_{ATP} channels describes sulfonylureas.
- (C) α-glucosidase inhibition describes acarbose.
- (D) AMP-kinase activation/reduced gluconeogenesis describes metformin.

Final Answer: Proximal-tubule SGLT2 inhibition causing glycosuria $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q67

Q68.

Solution

Concept — Methaemoglobinaemia antidote: Methaemoglobin (ferric, Fe^{3+}) cannot carry oxygen; the antidote restores ferrous (Fe^{2+}) haemoglobin. **Reasoning:** Methylene blue is reduced by NADPH-methaemoglobin reductase to leu-

comethylene blue, which then reduces the ferric iron of methaemoglobin back to the ferrous form, restoring oxygen-carrying capacity. So option (C) is the correct pairing. **Why the other options are wrong:**

- (A) Warfarin is reversed by vitamin K (and plasma/PCC); protamine reverses heparin.
- (B) Digoxin toxicity is treated with digoxin-specific antibody (Fab) fragments, not flumazenil.
- (D) Cyanide poisoning is treated with hydroxocobalamin or sodium thiosulphate/nitrite, not N-acetylcysteine.

Final Answer: Methaemoglobinaemia $\rightarrow$ methylene blue $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q68

Q69.

Solution

Concept — Sandmeyer reaction: Aryl diazonium salts react with cuprous halides (CuCl, CuBr) so that the $-N_2^+$ group is replaced by a halide. **Reasoning:** Benzenediazonium chloride with CuCl gives chlorobenzene plus N_2. The copper(I) salt mediates the radical-type substitution; this is the classic Sandmeyer reaction for introducing Cl, Br or CN onto an aromatic ring. **Why the other options are wrong:**

- (A) Gattermann–Koch formylates arenes with CO/HCl, not a diazonium reaction.
- (B) Rosenmund reduces acyl chlorides to aldehydes.
- (D) Kolbe–Schmitt carboxylates phenoxide to salicylic acid.

Final Answer: It is the Sandmeyer reaction $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q69

Q70.

Solution

Concept — Chair conformation: The chair is the lowest-energy form of cyclohexane; each carbon has one axial and one equatorial position. **Reasoning:** A bulky group placed axial suffers 1,3-diaxial repulsions with the two axial hydrogens on the same face. Placing it equatorial points it outward, away from the ring,

minimising steric strain, so the equatorial position is strongly preferred. **Why the other options are wrong:**

- (A) Axial is the high-strain position for a bulky group.
- (B) Energetics clearly favour equatorial; the difference can be several kJ/mol.
- (C) The molecule stays a chair; it does not need a boat.

Final Answer: A bulky group prefers the equatorial position $\Rightarrow$ D

Answer: (D) Go Back to Q70

Q71.

Solution

Concept — Reimer–Tiemann reaction: Phenols react with $CHCl_3$ and aqueous base to introduce a –CHO group ortho to the hydroxyl. **Reasoning:** The base generates dichlorocarbene ($:CCl_2$), an electrophile that attacks the electron-rich phenoxide ortho position; hydrolysis then gives salicylaldehyde. The carbene intermediate is the diagnostic feature. **Why the other options are wrong:**

- (B) Wurtz couples alkyl halides with sodium.
- (C) Stephen reduction converts nitriles to aldehydes.
- (D) Gabriel synthesis makes primary amines from phthalimide.

Final Answer: It is the Reimer–Tiemann reaction $\Rightarrow$ A

Answer: (A) Go Back to Q71

Q72.

Solution

Concept — Substituent effects on acidity: Electron-withdrawing para groups stabilise the carboxylate and raise acidity (lower pK_a); electron-donating groups do the opposite. **Reasoning:** The para-nitro group withdraws electrons strongly by resonance and induction, best stabilising the conjugate base, so *p*-nitrobenzoic acid ($pK_a \approx 3.4$) is the strongest acid of the set. **Why the other options are wrong:**

- (A) $–OCH_3$ is electron-donating, weakening the acid.
- (C) $–CH_3$ is weakly electron-donating, also weakening it.

- (D) $-NH_2$ is strongly electron-donating, giving the weakest acid.

Final Answer: *p*-nitrobenzoic acid has the lowest $pK_a \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q72

Q73.

Solution

Concept — Tautomerism: Tautomers are constitutional isomers in rapid equilibrium that differ in the position of a proton and a double bond. **Reasoning:** The keto form (C=O with an α-H) and the enol form (C=C–OH) interconvert by migration of the α-hydrogen to oxygen. This proton-transfer equilibrium is keto–enol tautomerism. **Why the other options are wrong:**

- (A) Conformers differ only by bond rotation, not atom connectivity.
- (B) Optical isomers differ in 3-D arrangement at a stereocentre.
- (D) Geometric (cis/trans) isomers do not interconvert by proton transfer.

Final Answer: It is keto–enol tautomerism $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q73

Q74.

Solution

Concept — Hell–Volhard–Zelinsky (HVZ) reaction: Carboxylic acids with an α-hydrogen are α-halogenated using X_2 and a trace of red phosphorus. **Reasoning:** Phosphorus forms PBr_3, converting the acid to an acid bromide, whose enol is brominated at the α-carbon; exchange then regenerates the α-bromo acid. This is the HVZ reaction. **Why the other options are wrong:**

- (A) Finkelstein swaps one halide for another in alkyl halides.
- (B) Clemmensen reduces C=O to CH_2 with Zn(Hg)/HCl.
- (C) Wolff–Kishner reduces C=O to CH_2 via the hydrazone.

Final Answer: It is the Hell–Volhard–Zelinsky reaction $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q74

Q75.

Solution

Concept — Nucleophilic aromatic substitution (S_NAr): Aryl halides activated by ortho/para electron-withdrawing groups react with nucleophiles by addition–elimination. **Reasoning:** Ammonia adds to the ring to form a stabilised anionic Meisenheimer complex, where the two nitro groups delocalise the negative charge; chloride is then expelled. Hence the addition–elimination S_NAr mechanism. **Why the other options are wrong:**

- (B) Electrophilic substitution involves attack *by* an electrophile, not a nucleophile.
- (C) No radical chain is involved here.
- (D) E1cb is an elimination, not a substitution.

Final Answer: It is S_NAr (addition–elimination) $\Rightarrow$ A

Answer: (A) Go Back to Q75

Q76.

Solution

Concept — Selective oxidation: A mild, anhydrous Cr(VI) reagent stops at the aldehyde; strong aqueous oxidants over-oxidise to the acid. **Reasoning:** PCC in dichloromethane oxidises a primary alcohol cleanly to the aldehyde because the anhydrous, non-aqueous conditions prevent formation of the hydrate that would be further oxidised to the carboxylic acid. **Why the other options are wrong:**

- (A) Hot acidic $KMnO_4$ drives oxidation to the carboxylic acid.
- (C) Jones reagent (aqueous CrO_3/H_2SO_4) over-oxidises to the acid.
- (D) Alkaline $KMnO_4$ with heat also gives the acid.

Final Answer: PCC in dichloromethane gives the aldehyde $\Rightarrow$ B

Answer: (B) Go Back to Q76

Q77.

Solution

Concept — Alkene stability and substitution: More highly substituted alkenes are more stable owing to hyperconjugation and the electron-releasing alkyl groups. **Reasoning:** But-2-ene is disubstituted (two alkyl groups on the double bond), whereas but-1-ene is monosubstituted (terminal). The greater number of hyperconjugative C–H interactions makes but-2-ene the more stable isomer, as confirmed by its lower heat of hydrogenation. **Why the other options are wrong:**

- (A) Terminal (less substituted) alkenes are less stable.
- (B) Their stabilities differ measurably.
- (D) Both are perfectly stable at room temperature.

Final Answer: The disubstituted but-2-ene is more stable $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q77

Q78.

Solution

Concept — Williamson ether synthesis: An alkoxide displaces a halide from an alkyl halide by S_N2 to form an ether. **Reasoning:** Sodium ethoxide attacks ethyl bromide at carbon, displacing bromide and forming diethyl ether. Using a primary halide and avoiding hindered substrates (which favour elimination) gives the best yields. **Why the other options are wrong:**

- (A) Kolbe electrolysis couples carboxylate salts to alkanes.
- (B) Fischer esterification makes esters from acid + alcohol.
- (C) Hofmann bromamide degrades an amide to an amine with one fewer carbon.

Final Answer: It is the Williamson ether synthesis $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q78

Q79.

Solution

Concept — Indole: A benzene ring fused to a pyrrole ring gives the indole bicyclic aromatic system. **Reasoning:** The drawn structure is a six-membered benzene fused to a five-membered nitrogen ring (with N–H). This is indole, the core of tryptophan, serotonin and many alkaloids. **Why the other options are wrong:**

- (B) Quinoline is benzene fused to pyridine (two six-membered rings).
- (C) Purine is a fused imidazole + pyrimidine system (four nitrogens).
- (D) Imidazole is a single five-membered ring with two nitrogens.

Final Answer: The ring system is indole $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q79

Q80.

Solution

Concept — Hydroboration–oxidation: Borane adds to alkenes with anti-Markovnikov, syn regiochemistry; oxidation replaces boron with –OH at the same carbon. **Reasoning:** Boron (the larger, electron-deficient atom) adds to the *less* hindered, less substituted carbon, so after oxidation the –OH ends up on the less substituted carbon. The net result is anti-Markovnikov hydration with no carbocation and no rearrangement. **Why the other options are wrong:**

- (A) Markovnikov addition would place OH on the more substituted carbon.
- (C) It is an electrophilic syn addition, not a radical substitution.
- (D) No carbocation forms, so no rearrangement occurs.

Final Answer: Anti-Markovnikov addition (OH on the less substituted carbon) $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q80

Q81.

Solution

Concept — Torsional strain in ethane: Eclipsed conformations are energy maxima; staggered conformations are minima. **Reasoning:** The curve peaks at the eclipsed conformations (dihedral 0°, 120°, 240°), where C–H bonds overlap and

torsional (Pitzer) strain is largest. The barrier to rotation in ethane is about 12 kJ/mol (roughly 4 kJ/mol per eclipsing H–H interaction). **Why the other options are wrong:**

- (A) The staggered form is the minimum, not the maximum, and 50 kJ/mol is far too high.
- (B) Staggered is a minimum; 1 kJ/mol grossly underestimates the barrier.
- (D) There is a real, measurable rotational barrier.

Final Answer: Maxima are eclipsed; barrier ≈ 12 kJ/mol $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q81

Q82.

Solution

Concept — Gabriel synthesis: Phthalimide provides a protected, monosubstitutable nitrogen for making clean primary amines. **Reasoning:** The phthalimide nitrogen is alkylated only once (no over-alkylation), and subsequent hydrolysis or hydrazinolysis releases a pure primary amine, avoiding the secondary/tertiary mixtures that direct ammonia alkylation gives. **Why the other options are wrong:**

- (A) The Mannich reaction makes β-amino ketones, not free primary amines.
- (B) The Curtius rearrangement makes amines from acyl azides, a different route.
- (C) The Strecker synthesis makes α-amino acids.

Final Answer: It is the Gabriel synthesis $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q82

Q83.

Solution

Concept — Resonance and acidity: Delocalising the negative charge of a conjugate base over more atoms stabilises it and increases acidity. **Reasoning:** The phenoxide ion delocalises its negative charge from oxygen into the ortho and para ring carbons (as the contributing structure shows). Cyclohexanol's alkoxide has no such resonance, so phenol is far more acidic. The stabilising influence is resonance (mesomeric) stabilisation of the conjugate base. **Why the other options**

are wrong:

- (A) Steric inhibition of resonance would *reduce* acidity, the opposite effect.
- (C) Hyperconjugation is minor compared with the full π delocalisation here.
- (D) Hydrogen has a negligible inductive effect.

Final Answer: Resonance stabilisation of phenoxide $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q83

Q84.

Solution

Concept — Mannich reaction: An active-hydrogen compound, formaldehyde and a secondary amine combine to give a β-amino carbonyl (Mannich base). **Reasoning:** Formaldehyde and the amine form an iminium ion that is attacked by the enol of the carbonyl compound, installing a $-CH_2NR_2$ group β to the carbonyl. This aminomethylation is widely used in alkaloid and drug synthesis. **Why the other options are wrong:**

- (B) Knoevenagel condenses an active-methylene compound with an aldehyde (no amine incorporated).
- (C) Michael addition adds a nucleophile to an α,β-unsaturated carbonyl.
- (D) Benzoin condensation dimerises aldehydes under cyanide/NHC catalysis.

Final Answer: It is the Mannich reaction $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q84

Q85.

Solution

Concept — Antifolate targets: Methotrexate (human) and trimethoprim (bacterial) both block tetrahydrofolate regeneration. **Reasoning:** Both drugs competitively inhibit dihydrofolate reductase (DHFR), which reduces dihydrofolate to tetrahydrofolate. Loss of THF halts thymidylate and purine synthesis, blocking DNA replication. **Why the other options are wrong:**

- (A) Dihydropteroate synthase is the target of *sulfonamides*, not these drugs.
- (B) Thymidylate synthase is inhibited by 5-fluorouracil's metabolite, not by these.

- (D) DNA gyrase is the quinolone target.

Final Answer: They inhibit dihydrofolate reductase $\Rightarrow$ C

Answer: (C) Go Back to Q85

Q86.

Solution

Concept — Statin mechanism: Statins are competitive inhibitors of the rate-limiting enzyme of cholesterol biosynthesis. **Reasoning:** The dihydroxy-acid side chain of statins mimics the mevaldyl/HMG portion of the natural substrate and competitively inhibits HMG-CoA reductase, lowering hepatic cholesterol synthesis and up-regulating LDL receptors. **Why the other options are wrong:**

- (A) ACE is the target of captopril/enalapril.
- (B) Cyclooxygenase is inhibited by NSAIDs.
- (C) Acetylcholinesterase is inhibited by anticholinesterases (e.g. neostigmine).

Final Answer: Statins inhibit HMG-CoA reductase $\Rightarrow$ D

Answer: (D) Go Back to Q86

Q87.

Solution

Concept — Acid-activated covalent inhibitor: Omeprazole is a prodrug that becomes reactive only in the strongly acidic parietal-cell canaliculus. **Reasoning:** In acid the benzimidazole rearranges to a cyclic sulfenamide that forms a covalent disulfide bond with cysteine residues of the H^+/K^+-ATPase, irreversibly inhibiting the proton pump. Thus it is an acid-activated prodrug giving an irreversible covalent inhibitor. **Why the other options are wrong:**

- (B) The action is covalent and irreversible, not a simple reversible block.
- (C) It does not act by chelating a metal.
- (D) It is not an osmotic agent.

Final Answer: An acid-activated prodrug forming a covalent inhibitor $\Rightarrow$ A

Answer: (A) Go Back to Q87

Q88.

Solution

Concept — Fluoroquinolone target: Quinolones interfere with bacterial DNA supercoiling and decatenation. **Reasoning:** Ciprofloxacin and levofloxacin inhibit DNA gyrase (topoisomerase II) in Gram-negative bacteria and topoisomerase IV in Gram-positive bacteria, trapping the enzyme–DNA complex and causing lethal DNA breaks. **Why the other options are wrong:**

- (A) The 30S ribosome is the target of aminoglycosides/tetracyclines.
- (C) The transpeptidase (PBP) is the β-lactam target.
- (D) DHFR is the trimethoprim target.

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

Answer: (B) Go Back to Q88

Q89.

Solution

Concept — Nucleoside analogue antiviral: Acyclovir is selectively activated and then terminates viral DNA chains. **Reasoning:** Viral thymidine kinase monophosphorylates acyclovir selectively in infected cells; host kinases complete the triphosphate. Acyclovir triphosphate is incorporated by viral DNA polymerase and, lacking a 3′-OH, acts as a chain terminator while also inhibiting the polymerase. **Why the other options are wrong:**

- (A) Neuraminidase is the target of oseltamivir, not acyclovir.
- (B) It inhibits, it does not activate, a polymerase.
- (D) It has nothing to do with proton pumps.

Final Answer: A chain-terminating inhibitor of viral DNA polymerase $\Rightarrow$ C

Answer: (C) Go Back to Q89

Q90.

Solution

Concept — H_2-antagonist design: Cimetidine was developed from histamine by retaining the imidazole and modifying the side chain. **Reasoning:** A strongly basic terminal amine, protonated at physiological pH, conferred residual H_2 agonist

(stimulatory) activity. Replacing it with a neutral, polar cyanoguanidine removed this agonism while preserving receptor affinity, giving a pure H_2 antagonist. **Why the other options are wrong:**

- (A) Increasing molecular weight was not the design aim.
- (B) Oxidising ability is irrelevant to receptor antagonism.
- (C) The change did not introduce a chiral centre.

Final Answer: To obtain pure antagonism without agonist activity $\Rightarrow$ D

Answer: (D) Go Back to Q90

Q91.

Solution

Concept — ACE inhibitor design: ACE is a zinc metalloprotease; effective inhibitors carry a group that coordinates the active-site zinc. **Reasoning:** Captopril's sulfhydryl (–SH) group is the zinc-binding moiety; it ligates the catalytic Zn^{2+} far more strongly than a carboxylate, accounting for its high potency. (Later agents like enalaprilat use a carboxylate instead.) **Why the other options are wrong:**

- (B) The aromatic ring contributes hydrophobic binding, not zinc coordination.
- (C) Captopril has no quaternary ammonium centre.
- (D) It has no nitro group.

Final Answer: The sulfhydryl (–SH) group binds the zinc $\Rightarrow$ A

Answer: (A) Go Back to Q91

Q92.

Solution

Concept — Parabolic log$P$–activity relationship: Activity rises then falls with lipophilicity, peaking at an optimum logP_0. **Reasoning:** Moderate lipophilicity helps a drug cross membranes, but excessively lipophilic compounds partition into and remain trapped in lipid membranes (and have poor aqueous solubility), so they are poorly delivered to the aqueous biophase at the target. Hence activity falls beyond logP_0. **Why the other options are wrong:**

- (A) Beyond logP_0 the molecules are too lipophilic, not too water-soluble.

- (C) Ionisation is governed by pK_a, not $\log P$.
- (D) Molecular size is not the variable being changed here.

Final Answer: They are trapped in lipid membranes / poorly distributed $\Rightarrow$ B

Answer: (B) Go Back to Q92

Q93.

Solution

Concept — COX-2 selectivity: The COX-2 active site is larger than COX-1, with an additional side pocket. **Reasoning:** Coxibs such as celecoxib carry a bulky sulfonamide (or sulfone) group that fits the extra side pocket unique to COX-2, giving selective inhibition while sparing gastroprotective COX-1. **Why the other options are wrong:**

- (A) Classic acidic NSAIDs (with –COOH) are non-selective.
- (B) A simple methyl group is too small to confer selectivity.
- (D) A lone halogen does not provide the required bulk in the side pocket.

Final Answer: A bulky sulfonamide/sulfone substituent $\Rightarrow$ C

Answer: (C) Go Back to Q93

Q94.

Solution

Concept — Drug–receptor binding forces: Reversible binding sums several weak interactions; their strengths differ markedly. **Reasoning:** When an ionised drug group pairs with an oppositely charged receptor residue, the ionic (electrostatic) interaction contributes the largest single binding energy (roughly 20–40 kJ/mol), far more than a hydrogen bond or van der Waals contact, though such ionic pairs are less common. **Why the other options are wrong:**

- (A) London dispersion forces are individually very weak.
- (B) A single hydrogen bond is weaker than an ionic bond.
- (C) Dipole–dipole interactions are weaker than full ionic interactions.

Final Answer: The ionic (electrostatic) interaction is strongest $\Rightarrow$ D

Answer: (D) Go Back to Q94

Q95.

Solution

Concept — Lipinski's Rule of Five: A set of physicochemical limits predicting acceptable oral absorption. **Reasoning:** Poor absorption is likely if more than one of these is violated: molecular weight ≤ 500, log$P \leq 5$, hydrogen-bond donors ≤ 5, and hydrogen-bond acceptors ≤ 10. The limits are all multiples of five, giving the rule its name. **Why the other options are wrong:**

- (B) These limits are far too high.
- (C) These limits are too restrictive and not the published rule.
- (D) The rule does include molecular-weight and log$P$ limits.

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

Answer: (A) Go Back to Q95

Q96.

Solution

Concept — Inorganic oxidising antiseptics: Some inorganic salts disinfect by releasing nascent oxygen. **Reasoning:** Potassium permanganate ($KMnO_4$) is a powerful oxidiser; in dilute solution it liberates nascent oxygen that destroys microorganisms and acts as an astringent, hence its topical antiseptic use (e.g. in wet dressings). **Why the other options are wrong:**

- (A) Sodium bicarbonate is a systemic/urinary alkaliser and antacid.
- (C) Magnesium sulfate is a saline cathartic.
- (D) Calcium gluconate is a calcium supplement/antidote.

Final Answer: Potassium permanganate is the oxidising antiseptic $\Rightarrow$ B

Answer: (B) Go Back to Q96

Q97.

Solution

Concept — Diagnostic radiopharmaceuticals: An ideal imaging radionuclide emits pure gamma radiation with a short, convenient half-life. **Reasoning:** Technetium-99m, eluted from a ^{99}Mo/^{99m}Tc generator, has a 6-hour half-life and emits a pure 140 keV gamma photon ideal for gamma-camera detection, with no

particulate radiation; it is the workhorse of diagnostic nuclear medicine. **Why the other options are wrong:**

- (A) Iodine-131 emits beta particles and is used therapeutically (longer half-life).
- (B) Cobalt-60 is a high-energy source for radiotherapy, not diagnostic imaging.
- (D) Radium-226 is an alpha emitter, unsuitable for imaging.

Final Answer: Technetium-99m is the imaging radionuclide $\Rightarrow$ C

Answer: (C) Go Back to Q97

Q98.

Solution

Concept — Cyclodextrin inclusion complexes: The lipophilic cavity hosts a guest molecule while the hydrophilic exterior keeps the complex water-soluble. **Reasoning:** A poorly soluble drug sits inside the β-cyclodextrin cavity, forming a host–guest inclusion complex. This raises the drug's apparent aqueous solubility and dissolution rate and can improve chemical stability and mask taste/odour. **Why the other options are wrong:**

- (A) Cyclodextrins are not oxidising preservatives.
- (B) They do not function as pH-lowering acids.
- (C) They are not radio-opaque contrast agents.

Final Answer: They form inclusion complexes that enhance solubility/stability $\Rightarrow$ D

Answer: (D) Go Back to Q98

Q99.

Solution

Concept — Beer–Lambert calibration: for a line through the origin, $A = (\text{slope}) \times c$, so $c = A/\text{slope}$. **Reasoning:** The slope is 0.040 L mg^{-1} and the sample absorbance is 0.36. Therefore $c = 0.36/0.040 = 9.0$ mg L^{-1}. **Why the other options are wrong:**

- (B) 0.0144 multiplies 0.36×0.040 instead of dividing.

- (C) 14.4 divides by 0.025, a wrong slope.
- (D) 0.11 has no consistent derivation.

Final Answer: $c = 0.36/0.040 = 9.0$ mg $L^{-1} \Rightarrow$ A

Answer: (A) Go Back to Q99

Q100.

Solution

Concept — Absorbance and transmittance: $A = -\log_{10} T$, where T is the fractional transmittance. **Reasoning:** 10% transmittance means $T = 0.10$. Hence $A = -\log_{10}(0.10) = -(-1) = 1.0$. **Why the other options are wrong:**

- (A) 0.10 confuses T itself with absorbance.
- (C) 0.90 is $(1 - T)$, the fraction absorbed, not the absorbance.
- (D) 2.0 corresponds to $T = 0.01$ (1% transmittance).

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

Answer: (B) Go Back to Q100

Q101.

Solution

Concept — Equivalent weight: equivalent weight = molar mass ÷ number of reactive (replaceable) protons. **Reasoning:** KHP donates one acidic proton per molecule, so its equivalence factor is 1. Equivalent weight = $204.2/1 = 204.2$ g eq^{-1}, equal to its molar mass. **Why the other options are wrong:**

- (A) 102.1 treats KHP as diprotic $(204.2/2)$.
- (B) 408.4 doubles the molar mass.
- (D) 68.1 uses a factor of 3, which is incorrect.

Final Answer: Monoprotic, so equivalent weight $= 204.2$ g $eq^{-1} \Rightarrow$ C

Answer: (C) Go Back to Q101

Q102.

Solution

Concept — Paper chromatography: the water held on cellulose is the true stationary phase; separation is by partition. **Reasoning:** Solutes distribute themselves between the stationary bound-water layer and the moving organic solvent according to their partition coefficients, so the mechanism is liquid–liquid partition, not adsorption. **Why the other options are wrong:**

- (A) Bare-cellulose adsorption is not the dominant mechanism when water is bound.
- (B) Ion exchange needs fixed charged groups, not present here.
- (C) Size exclusion separates by molecular size in porous gels, not on paper.

Final Answer: Partition between bound water and the organic mobile phase $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q102

Q103.

Solution

Concept — IR of carboxylic acids: a hydrogen-bonded O–H gives a very broad band over 3300–$2500\ \text{cm}^{-1}$, alongside a strong C=O. **Reasoning:** The combination of a very broad O–H envelope (from dimeric hydrogen bonding) overlapping the C–H region plus a carbonyl stretch is the signature of a carboxylic acid. No other simple group shows this broad low-frequency O–H together with C=O. **Why the other options are wrong:**

- (A) A simple ketone has C=O but no broad O–H.
- (B) An ether has neither a broad O–H nor a carbonyl band.
- (C) A tertiary amine has no O–H or C=O of this kind.

Final Answer: Broad O–H plus C=O $\Rightarrow$ carboxylic acid $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q103

Q104.

Solution

Concept — Karl Fischer titration: a selective reaction of water with iodine and sulphur dioxide in a methanolic base. **Reasoning:** Iodine is consumed only in the presence of water; the volume (volumetric KF) or charge (coulometric KF) needed is proportional to the water present. It is the standard pharmacopoeial assay for moisture in drug substances. **Why the other options are wrong:**

- (A) Total ash is measured by ignition (gravimetry), not KF.
- (C) Heavy metals use limit tests/AAS, not KF.
- (D) Optical rotation uses a polarimeter.

Final Answer: Water (moisture) content $\Rightarrow$ B

Answer: (B) Go Back to Q104

Q105.

Solution

Concept — R_f in TLC: $R_f = \dfrac{\text{distance moved by solute}}{\text{distance moved by solvent front}}$. **Reasoning:** The solute moved 6.3 cm while the front moved 9.0 cm, so $R_f = 6.3/9.0 = 0.70$. R_f is dimensionless and lies between 0 and 1. **Why the other options are wrong:**

- (B) 1.43 is the inverse ratio $(9.0/6.3)$; R_f cannot exceed 1.
- (C) 0.30 is $(1 - R_f)$, the unmoved fraction.
- (D) 0.63 misplaces the decimal of the solute distance.

Final Answer: $R_f = 6.3/9.0 = 0.70 \Rightarrow$ A

Answer: (A) Go Back to Q105

Q106.

Solution

Concept — Stokes shift: fluorescence emission occurs at lower energy (longer wavelength) than excitation. **Reasoning:** After excitation, some energy is lost by vibrational relaxation before emission, so the emitted photon is of lower energy. The gap between excitation and emission maxima is the Stokes shift, exploited in fluorimetry for selectivity and sensitivity. **Why the other options are wrong:**

- (A) Bathochromic shift describes an absorption maximum moving to longer wavelength, not the excitation–emission gap.
- (B) Doppler shift is a motion-related frequency change in spectroscopy of moving atoms.
- (D) Chemical shift is an NMR term, unrelated to fluorescence.

Final Answer: Stokes shift $\Rightarrow$ C

Answer: (C) Go Back to Q106

Q107.

Solution

Concept — Primary-standard oxidant: a primary standard must be pure, stable, and weighable directly. **Reasoning:** Potassium dichromate is obtainable in high purity, is non-hygroscopic, and is stable to air and light, so it can be dried and weighed accurately to make a standard solution without re-standardisation. It is a strong oxidant ($Cr^{6+} \rightarrow Cr^{3+}$). **Why the other options are wrong:**

- (A) It is an oxidising agent, not a reducing agent, and does not liberate oxygen.
- (B) It does not require daily standardisation; that describes permanganate.
- (C) It does not decompose or absorb water readily; that is the opposite of the truth.

Final Answer: Stable, pure, non-hygroscopic primary standard $\Rightarrow$ D

Answer: (D) Go Back to Q107

Q108.

Solution

Concept — Resolution: $R_s = \dfrac{2(t_{R2} - t_{R1})}{w_1 + w_2}$. **Reasoning:** Substituting, $R_s = \dfrac{2(6.0 - 5.0)}{0.50 + 0.50} = \dfrac{2(1.0)}{1.0} = 2.0$. A value of 2.0 indicates more than baseline separation ($R_s \geq 1.5$). **Why the other options are wrong:**

- (A) 1.0 omits the factor of 2.
- (C) 0.5 is the reciprocal-type error.
- (D) 4.0 doubles the numerator incorrectly.

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

Answer: (B) Go Back to Q108

Q109.

Solution

Concept — TMS reference: TMS protons are highly shielded by silicon, resonating upfield of almost all organic protons. **Reasoning:** Silicon is electropositive, so the twelve equivalent methyl protons of TMS are strongly shielded and give one sharp signal taken as $\delta = 0$. TMS is volatile, inert, and soluble in organic solvents, making it an ideal internal reference. **Why the other options are wrong:**

- (A) TMS protons are shielded (upfield), not deshielded.
- (B) TMS is diamagnetic and gives a sharp, not broadened, line.
- (D) Its twelve equivalent protons give a single singlet, not a multiplet.

Final Answer: Highly shielded, inert, single sharp signal $\Rightarrow$ C

Answer: (C) Go Back to Q109

Q110.

Solution

Concept — Capacity (retention) factor: $k' = (t_R - t_0)/t_0$. **Reasoning:** With $t_R = 8.0$ min and $t_0 = 2.0$ min, $k' = (8.0 - 2.0)/2.0 = 6.0/2.0 = 3.0$. This means the solute spends three times as long in the stationary phase as in the mobile phase. **Why the other options are wrong:**

- (B) 0.25 inverts the ratio.
- (C) 4.0 uses t_R/t_0 without subtracting t_0.
- (D) 6.0 is the adjusted retention time, not k'.

Final Answer: $k' = (8.0 - 2.0)/2.0 = 3.0 \Rightarrow$ A

Answer: (A) Go Back to Q110

Q111.

Solution

Concept — λ_{max} read-off: the assay wavelength is the one at the peak of the absorbance curve. **Reasoning:** The dashed line drops from the curve peak to the axis at the 280 nm tick mark, so $\lambda_{max} \approx 280$ nm. Quantitation at this maximum gives best sensitivity and least error from small wavelength drift. **Why the other options are wrong:**

- (A) 240 nm lies on the rising side, not the peak.
- (C) 320 nm lies on the falling side, past the maximum.
- (D) 200 nm is off-scale to the left of the plotted region.

Final Answer: Peak occurs at about 280 nm $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q111

Q112.

Solution

Concept — Half-equivalence point: for a weak acid, $\text{pH} = \text{p}K_a + \log\frac{[\text{A}^-]}{[\text{HA}]}$ (Henderson–Hasselbalch). **Reasoning:** At half-neutralisation, $[\text{HA}] = [\text{A}^-]$, so the log term is zero and $\text{pH} = \text{p}K_a$. The point H therefore reads the $\text{p}K_a$ of the weak acid directly, and buffering is maximal here. **Why the other options are wrong:**

- (A) pH equals 7 only at the equivalence point of a strong acid–strong base titration, not here.
- (B) Complete conversion to salt occurs at the equivalence point, not at half-equivalence.
- (C) $\text{p}K_a$ of the weak acid (not its conjugate base) is read at H.

Final Answer: $\text{pH} = \text{p}K_a$ since $[\text{HA}] = [\text{A}^-] \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q112

Q113.

Solution

Concept — Nernstian response: potential changes by $2.303RT/F$ per decade of activity, which is ≈ 59 mV at $25\,^{\circ}$C for a singly charged ion. **Reasoning:** For the H^+-selective glass electrode, each unit of pH (a tenfold change in H^+ activity) shifts the cell potential by about 59 mV. This Nernstian slope is the basis of pH measurement. **Why the other options are wrong:**

- (A) 9 mV is far too small for a Nernstian one-electron response.
- (B) 100 mV overstates the slope.
- (D) 1000 mV is physically unrealistic per pH unit.

Final Answer: About 59 mV per pH unit $\Rightarrow$ C

Answer: (C) Go Back to Q113

Q114.

Solution

Concept — Nitrogen rule: a neutral organic molecule of *odd* nominal mass contains an odd number of nitrogen atoms. **Reasoning:** Nitrogen is trivalent but has an even mass (14), so its presence in odd number makes the molecular mass odd. An odd $M^{+\bullet}$ (e.g. 121) therefore signals an odd number of N atoms (1, 3, ...). **Why the other options are wrong:**

- (B) A molecule with no nitrogen has an even nominal mass.
- (C) Cl/Br affect isotope patterns, not the odd/even mass rule for nitrogen.
- (D) An even number of N atoms gives an even molecular mass.

Final Answer: Odd mass $\Rightarrow$ odd number of nitrogen atoms $\Rightarrow$ A

Answer: (A) Go Back to Q114

Q115.

Solution

Concept — GLC carrier gas: an inert gas serves as the mobile phase moving sample vapour through the column. **Reasoning:** In GLC the stationary phase is a liquid coated on a solid support; the carrier gas (N_2, He) is the inert mobile phase that sweeps the volatilised analytes past the stationary liquid to the detector. It

does not react with the sample. **Why the other options are wrong:**

- (A) The stationary phase is the coated liquid, not the gas.
- (B) The carrier gas is not a detector reagent.
- (C) It does not derivatise the sample.

Final Answer: Mobile phase transporting the sample $\Rightarrow$ D

Answer: (D) Go Back to Q115

Q116.

Solution

Concept — AAS source: a line source emitting the analyte's own narrow lines is needed so the atoms absorb efficiently. **Reasoning:** The hollow-cathode lamp has a cathode made of (or coated with) the element being determined; when excited it emits that element's characteristic sharp emission lines, which the ground-state atoms in the flame absorb. This gives the selectivity AAS requires. **Why the other options are wrong:**

- (A) The deuterium lamp is a continuum source used for background correction, not as the line source.
- (C) The tungsten–halogen lamp is a visible continuum source used in UV-Vis.
- (D) The Nernst glower is an IR source.

Final Answer: Hollow-cathode lamp $\Rightarrow$ B

Answer: (B) Go Back to Q116

Q117.

Solution

Concept — EDTA chelation: EDTA is a hexadentate ligand that wraps a single metal ion. **Reasoning:** Regardless of the metal's charge (Ca^{2+}, Al^{3+}, Fe^{3+}, etc.), one EDTA molecule binds one metal ion through its six donor sites, giving a fixed $1:1$ stoichiometry. This simplifies complexometric calculations. **Why the other options are wrong:**

- (B) $2:1$ would need two ligands per metal, which EDTA does not.
- (C) $1:2$ implies one EDTA binding two metals, which it cannot.
- (D) $3:1$ has no basis for a hexadentate ligand.

Final Answer: EDTA : metal $= 1:1 \Rightarrow$ A

Answer: (A) Go Back to Q117

Q118.

Solution

Concept — HPLC flow path: solvent $\rightarrow$ pump $\rightarrow$ injector $\rightarrow$ column $\rightarrow$ detector. **Reasoning:** The component immediately after the column that converts the separated bands into an electrical signal (the chromatogram) is the detector (e.g. UV, RI, fluorescence). Y is therefore the detector. **Why the other options are wrong:**

- (A) The reservoir is at the start of the path.
- (C) The pump precedes the injector, not the column outlet.
- (D) The injector is before the column, not after it.

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

Answer: (B) Go Back to Q118

Q119.

Solution

Concept — Coupling constant J: J is a through-bond interaction whose magnitude in Hz does not depend on the spectrometer field. **Reasoning:** Chemical shifts in Hz scale with the applied field (so δ in ppm stays constant), but J in Hz is an intrinsic molecular property and is unchanged from 300 to 600 MHz. Only the apparent separation of peaks relative to the shift changes. **Why the other options are wrong:**

- (A) J does not double with field; that is true of shift differences in Hz.
- (B) J is not inversely proportional to field.
- (C) J does not vanish at high field.

Final Answer: J (Hz) is field-independent, so it stays the same $\Rightarrow$ D

Answer: (D) Go Back to Q119

Q120.

Solution

Concept — Back-titration: add a known excess of reagent, let it react, then titrate the leftover excess. **Reasoning:** When the analyte reacts slowly, is insoluble, or gives an indistinct direct end point, a measured excess of standard reagent is added to ensure complete reaction; the unreacted excess is then titrated with a second standard. The analyte equals the difference. **Why the other options are wrong:**

- (B) A fast, sharp strong acid–strong base reaction is ideal for direct titration.
- (C) A self-indicating titrant favours direct titration, not back-titration.
- (D) Back-titration in fact requires two standard solutions.

Final Answer: Used when direct reaction is slow or end point unclear $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q120

Q121.

Solution

Concept — Size-exclusion chromatography: large molecules cannot enter the gel pores and pass straight through, eluting first. **Reasoning:** Small molecules diffuse into the porous gel beads, take a longer path, and are delayed. Large molecules are excluded from the pores, travel only the interstitial volume, and elute earliest. So elution is in order of decreasing size. **Why the other options are wrong:**

- (A) Reverses the actual order; smallest are retained longest, not eluted first.
- (C) Separation is by size, not charge (that is ion exchange).
- (D) Molecules are separated by size, not co-eluted together.

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

Answer: (B) Go Back to Q121

Q122.

Solution

Concept — Robustness (ICH Q2): a measure of a method's capacity to remain unaffected by small, deliberate variations in its parameters. **Reasoning:** Robustness is evaluated by intentionally varying parameters such as mobile-phase pH, flow rate, and column temperature to confirm the result stays within acceptance limits, indicating the method is reliable in routine use. **Why the other options are wrong:**

- (A) Linearity is the proportionality of response to concentration.
- (B) Accuracy is closeness to the true value.
- (D) Specificity is the ability to assess the analyte amid interferents.

Final Answer: Effect of small deliberate parameter changes = robustness $\Rightarrow$ C

Answer: (C) Go Back to Q122

Q123.

Solution

Concept — Organized vs unorganized drugs: Organized drugs are entire plant organs (leaf, bark, wood, root, fruit, stigma) with a cellular structure; unorganized drugs are cell-free metabolic products such as resins, dried extracts and gels. **Reasoning:** Colophony is the solid resin remaining after distilling turpentine, catechu is a dried aqueous extract, and agar is a dried mucilaginous gel from seaweed. None possesses an organized cellular tissue, so the set in option (C) is entirely unorganized. **Why the other options are wrong:**

- (A) Leaf, wood and fruit are organized organs.
- (B) Root, bark and stigma are organized.
- (D) Coca leaf and senega root are organized; the set is mixed.

Final Answer: Colophony, catechu and agar are all cell-free products $\Rightarrow$ C

Answer: (C) Go Back to Q123

Q124.

Solution

Concept — Chemical classification: Crude drugs may be grouped by the chemical nature of their principal constituents, independent of botany or therapeutics. **Reasoning:** Headings such as carbohydrates, glycosides, alkaloids, volatile oils, tannins and resins refer purely to the chemical class of the chief constituent, which is the defining feature of chemical classification. **Why the other options are wrong:**

- (B) Morphological grouping is by the plant part used.
- (C) Pharmacological grouping is by therapeutic action.
- (D) Alphabetical grouping is merely by name order.

Final Answer: Grouping by constituent chemistry is chemical classification $\Rightarrow$ A

Answer: (A) Go Back to Q124

Q125.

Solution

Concept — Taxonomical classification: Crude drugs are arranged according to their botanical position (family, genus, species). **Reasoning:** *Cymbopogon*, *Saccharum* and *Triticum* are grouped together solely because they share the grass family Poaceae, irrespective of their constituents or the part used. This is taxonomical (botanical) classification. **Why the other options are wrong:**

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

Final Answer: Grouping by botanical family is taxonomical classification $\Rightarrow$ B

Answer: (B) Go Back to Q125

Q126.

Solution

Concept — Datura alkaloids: *Datura* (Solanaceae) leaves and tops contain tropane alkaloids, chiefly hyoscine (scopolamine) along with hyoscyamine. **Reasoning:** Scopolamine is the 6,7-epoxide tropane ester used for motion sickness,

and its principal source is *Datura metel / Datura stramonium*. **Why the other options are wrong:**

- (A) *Rauwolfia* yields reserpine.
- (B) *Catharanthus* yields vincristine/vinblastine.
- (C) *Withania* yields withanolide steroidal lactones, not tropanes.

Final Answer: Scopolamine is obtained from *Datura* $\Rightarrow$ D

Answer: (D) Go Back to Q126

Q127.

Solution

Concept — Cocoa purine bases: The seeds of *Theobroma cacao* contain the purine (xanthine) bases, chiefly theobromine with a little caffeine. **Reasoning:** Theobromine is the dimethylxanthine that dominates cocoa; its ring nitrogens come from the purine ring rather than an amino acid, so it is a purine pseudo-alkaloid, acting as a mild diuretic and cardiac stimulant. **Why the other options are wrong:**

- (B) Reserpine is from *Rauwolfia*.
- (C) Vinblastine is from *Catharanthus*.
- (D) Quinidine is from *Cinchona*.

Final Answer: The cocoa purine base is theobromine $\Rightarrow$ A

Answer: (A) Go Back to Q127

Q128.

Solution

Concept — Lobelia alkaloids: *Lobelia inflata* (Campanulaceae) yields piperidine alkaloids, the chief being lobeline. **Reasoning:** Lobeline has a nicotine-like action on respiratory chemoreceptors and was used as a respiratory stimulant and smoking deterrent. It is the principal alkaloid of lobelia. **Why the other options are wrong:**

- (A) Sparteine is from broom (*Cytisus*).
- (C) Coniine is from hemlock (*Conium*).
- (D) Arecoline is from areca nut (*Areca catechu*).

Final Answer: The chief alkaloid of lobelia is lobeline $\Rightarrow$ B

Answer: (B) Go Back to Q128

Q129.

Solution

Concept — Alkaloid precipitating reagents: Wagner's reagent is iodine in potassium iodide; Mayer's is potassium mercuric iodide; Dragendorff's is potassium bismuth iodide. **Reasoning:** A reddish-brown precipitate produced by iodine–potassium iodide solution is the classic positive Wagner's test for alkaloids such as sanguinarine. **Why the other options are wrong:**

- (A) Mayer's gives a cream/white precipitate.
- (B) Dragendorff's gives an orange precipitate.
- (D) Bornträger's detects anthraquinones, not alkaloids.

Final Answer: Reddish-brown precipitate with iodine–KI is Wagner's test $\Rightarrow$ C

Answer: (C) Go Back to Q129

Q130.

Solution

Concept — Glycoside structure: A glycoside joins a sugar (glycone) to a non-sugar aglycone (genin); the bond is most commonly an O-glycosidic (acetal) linkage formed at the anomeric carbon of the sugar. **Reasoning:** In salicin the aglycone is saligenin and the sugar is D-glucose. The benzylic hydroxyl of saligenin is bonded through oxygen to C-1 of glucose, an O-glycosidic acetal bond; the sugar D-glucose is the glycone. **Why the other options are wrong:**

- (A) The bond is not an ester, and the sugar is the glycone, not the aglycone.
- (B) It is not a peptide bond.
- (C) Salicin is an O-glycoside, not a C-glycoside, and the sugar is the glycone.

Final Answer: An O-glycosidic acetal bond joins the glycone (glucose) $\Rightarrow$ D

Answer: (D) Go Back to Q130

Q131.

Solution

Concept — Cardiac glycoside lactone rings: Cardenolides carry a five-membered α,β-unsaturated butenolide ring, whereas bufadienolides carry a six-membered doubly-unsaturated α-pyrone (2-pyrone) lactone ring. **Reasoning:** Squill glycosides such as scillaren A and scilliroside have the six-membered doubly-unsaturated lactone, so they are bufadienolides, in contrast to the cardenolides of *Digitalis*. **Why the other options are wrong:**

- (B) Cardenolides have the five-membered ring, as in *Digitalis*.
- (C) Saponins are non-cardioactive frothing glycosides.
- (D) Anthraquinones are purgative phenolic glycosides.

Final Answer: Six-membered lactone marks them as bufadienolides $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q131

Q132.

Solution

Concept — Cascara cascarosides: Cascara bark contains anthraquinone glycosides in which the sugar is linked through a carbon atom (C-glycoside) as well as an oxygen (O-glycoside), the cascarosides. **Reasoning:** The cascarosides are C-glycosides: the sugar is joined directly to a ring carbon of the aglycone, a bond that resists ordinary acid hydrolysis, unlike the O-glycosidic sennosides of senna. **Why the other options are wrong:**

- (A) They are anthraquinone glycosides, not alkaloids.
- (C) Cardenolides are steroidal cardiac glycosides, not cascara constituents.
- (D) Cascara releases no hydrocyanic acid; it is not cyanogenetic.

Final Answer: Cascarosides are acid-resistant C-glycosides $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q132

Q133.

Solution

Concept — Ginseng saponins: The root of *Panax ginseng* contains a series of dammarane-type triterpenoid saponin glycosides responsible for its adaptogenic activity. **Reasoning:** These characteristic saponins are named ginsenosides (also called panaxosides), the active markers used to standardise ginseng. **Why the other options are wrong:**

- (A) Sennosides are anthraquinone glycosides of senna.
- (B) Cascarosides are anthraquinone C-glycosides of cascara.
- (D) Cardenolides are cardiac glycosides.

Final Answer: Ginseng saponins are the ginsenosides $\Rightarrow$ C

Answer: (C) Go Back to Q133

Q134.

Solution

Concept — Cyanogenetic glycosides: These release hydrocyanic acid on hydrolysis; in *Sorghum* the relevant glycoside is dhurrin, whose aglycone (p-hydroxymandelonitrile) is derived from tyrosine. **Reasoning:** Enzymatic hydrolysis of dhurrin liberates glucose, p-hydroxybenzaldehyde and HCN, accounting for the cyanide hazard of young sorghum shoots. **Why the other options are wrong:**

- (A) Sinigrin is a glucosinolate of mustard, not cyanogenetic.
- (B) Glycyrrhizin is a triterpenoid saponin of liquorice.
- (C) Barbaloin is an anthraquinone C-glycoside of aloe.

Final Answer: The sorghum cyanogenetic glycoside is dhurrin $\Rightarrow$ D

Answer: (D) Go Back to Q134

Q135.

Solution

Concept — Nutmeg oil: The volatile oil of nutmeg (*Myristica fragrans*) contains terpenes together with the aromatic ether myristicin. **Reasoning:** Myristicin is the phenylpropanoid (aromatic ether) constituent responsible for the weak hallucinogenic and toxic effects of large doses of nutmeg, and is its characteristic marker.

Why the other options are wrong:

- (B) Menthol is from peppermint.
- (C) Carvone is from caraway/spearmint.
- (D) Citral is from lemongrass.

Final Answer: The characteristic constituent of nutmeg is myristicin $\Rightarrow$ A

Answer: (A) Go Back to Q135

Q136.

Solution

Concept — Anise oil: The volatile oil of anise fruit (*Pimpinella anisum*) is dominated by the phenylpropene ether anethole. **Reasoning:** Anethole makes up roughly 80–90% of anise oil and gives the sweet liquorice-like odour; the same constituent dominates fennel and star anise oils. **Why the other options are wrong:**

- (A) Eugenol is from clove.
- (C) Thymol is from thyme/ajowan.
- (D) Cinnamaldehyde is from cinnamon.

Final Answer: The chief constituent of anise oil is anethole $\Rightarrow$ B

Answer: (B) Go Back to Q136

Q137.

Solution

Concept — Valerian constituents: *Valeriana officinalis* owes its sedative action to a volatile oil and to a group of unstable iridoid esters, the valepotriates. **Reasoning:** The valepotriates (valtrate and related esters) are the iridoid sedative principles; their decomposition products contribute to the characteristic odour of stored valerian. **Why the other options are wrong:**

- (A) Sennosides are purgative anthraquinone glycosides.
- (B) Ginsenosides are ginseng saponins.
- (D) Cardenolides are cardiac glycosides.

Final Answer: The valerian sedative iridoids are the valepotriates $\Rightarrow$ C

Answer: (C) Go Back to Q137

Q138.

Solution

Concept — Resin vs gum: Colophony (rosin) is the solid residual resin left after distilling volatile turpentine oil from pine oleoresin; sodium alginate is the sodium salt of alginic acid, a polysaccharide from brown seaweed. **Reasoning:** They differ in both origin and chemistry: colophony is a coniferous resin (mainly abietic-type diterpene acids), while sodium alginate is a marine polysaccharide gum used as a suspending/film-forming agent. Option (D) states this correctly. **Why the other options are wrong:**

- (A) Colophony is not a seaweed polysaccharide.
- (B) Sodium alginate is not a coniferous resin.
- (C) The descriptions are interchanged.

Final Answer: Colophony is a pine resin; sodium alginate is a seaweed polysaccharide salt $\Rightarrow$ D

Answer: (D) Go Back to Q138

Q139.

Solution

Concept — Acetate–mevalonate pathway: Three acetyl-CoA units form HMG-CoA, which is reduced by NADPH to mevalonic acid and then converted to the C5 isoprene units IPP and DMAPP. **Reasoning:** IPP/DMAPP are the universal building blocks of all terpenoids (mono-, sesqui-, di-, tri-) and steroids. The scheme therefore depicts the acetate–mevalonate pathway generating terpenoids and steroids. **Why the other options are wrong:**

- (B) Shikimate gives aromatic amino acids.
- (C) Acetate–malonate gives fatty acids and polyketide phenols.
- (D) The pentose phosphate pathway supplies sugars/NADPH, not isoprene units.

Final Answer: It is the acetate–mevalonate pathway giving terpenoids $\Rightarrow$ A

Answer: (A) Go Back to Q139

Q140.

Solution

Concept — Shikimic acid pathway: Erythrose-4-phosphate and PEP condense and proceed via shikimic acid, chorismate and prephenate to the aromatic amino acids phenylalanine and tyrosine. **Reasoning:** Phenylalanine is deaminated to cinnamic acid, which on ortho-hydroxylation and lactonisation gives simple coumarins like umbelliferone. The aromatic precursor therefore comes from the shikimic acid pathway. **Why the other options are wrong:**

- (A) Acetate–mevalonate gives terpenoids, not aromatic amino acids.
- (C) Acetate–malonate gives fatty acids and some phenols, but not Phe.
- (D) The glyoxylate cycle is concerned with acetate/C4 metabolism, not aromatics.

Final Answer: Phenylalanine for coumarins arises from the shikimic acid pathway $\Rightarrow$ B

Answer: (B) Go Back to Q140

Q141.

Solution

Concept — Trichomes: Trichomes are epidermal appendages, classified as covering (clothing) or glandular; covering trichomes may be unicellular or multicellular and lack a secretory head. **Reasoning:** The sketch shows an elongated, pointed, unicellular outgrowth with a warty cuticle and no glandular head, which is a unicellular covering (clothing) trichome, a common diagnostic powder character. **Why the other options are wrong:**

- (A) A glandular trichome bears a secretory head, absent here.
- (B) An anomocytic stoma is a pore with guard/subsidiary cells, not a hair.
- (D) Raphides are needle-shaped calcium oxalate crystals, not epidermal hairs.

Final Answer: The structure is a unicellular covering trichome $\Rightarrow$ C

Answer: (C) Go Back to Q141

Q142.

Solution

Concept — Retardation factor (R_f): R_f is the ratio of the distance travelled by the solute to the distance travelled by the solvent front, both measured from the baseline. **Reasoning:** Here $R_f = d/D = 2.6/4.0 = 0.65$. The value is dimensionless and lies between 0 and 1, as expected for a valid spot. **Why the other options are wrong:**

- (B) 1.54 is D/d (the inverse) and exceeds 1, which is impossible.
- (C) 0.26 misplaces the decimal.
- (D) 0.40 ignores the actual distances.

Final Answer: $R_f = 2.6/4.0 = 0.65 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q142

Q143.

Solution

Concept — Type of overhang from a restriction cut: Where an enzyme cuts within its palindrome decides the product: a cut towards the 5′ side of each strand leaves a 5′ overhang, a cut towards the 3′ side leaves a 3′ overhang, and a central cut leaves blunt ends. **Reasoning:** *Kpn*I recognises GGTACC and cleaves GGTAC↓C, that is between the C and the final C close to the 3′ end of each strand. This leaves a four-base 3′-overhang (3′-CATG). It is the only listed enzyme giving a 3′ protruding end. **Why the other options are wrong:**

- (A) *Bam*HI (G↓GATCC) leaves a 5′ overhang, not 3′.
- (B) *Eco*RV (GAT↓ATC) cuts centrally, giving blunt ends.
- (D) *Hpa*I (GTT↓AAC) cuts centrally, giving blunt ends.

Final Answer: *Kpn*I leaves a 3′ overhang $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q143

Q144.

Solution

Concept — Shuttle vector: A shuttle vector carries two origins of replication and (usually) selectable markers that work in two different host species, so the same recombinant DNA can be moved ("shuttled") between, for example, *E. coli* and yeast. **Reasoning:** The map shows one bacterial origin (*ori*E) and one yeast origin (*ori*Y) on the same circle, plus a marker and an MCS. Because it can replicate and be selected in both hosts, it is by definition a shuttle vector, convenient for doing the cloning steps in *E. coli* and then expressing the gene in yeast. **Why the other options are wrong:**

- (B) An M13 vector is a single-stranded phage vector for one host, with one origin.
- (C) A cosmid carries a *cos* site for λ packaging of large inserts, not two species-specific origins.
- (D) A BAC is a single-host F-plasmid-based vector for very large inserts.

Final Answer: Two species-specific origins define a shuttle vector $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q144

Q145.

Solution

Concept — Energy requirement of DNA ligase: Forming a phosphodiester bond at a nick is endergonic and must be driven by hydrolysis of a high-energy cofactor. T4 (phage) and eukaryotic ligases use ATP; the *E. coli* ligase uses NAD^+. **Reasoning:** The cofactor adenylylates the ligase, which then transfers the AMP to the 5′-phosphate; attack by the adjacent 3′-OH seals the backbone and releases AMP. Without ATP (or NAD^+) no covalent join occurs, distinguishing ligase from a simple nuclease. **Why the other options are wrong:**

- (A) Mg^{2+} is needed but is not the energy source; a nucleotide cofactor is essential.
- (B) A primer is needed by polymerases, not by ligase.
- (C) Inorganic phosphate cannot supply the bond energy.

Final Answer: Ligation needs ATP (or NAD^+ for the bacterial enzyme) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q145

Q146.

Solution

Concept — Recombinant dornase alfa (DNase I): In cystic fibrosis, dying neutrophils release large amounts of DNA into the airway secretions, making the mucus thick and tenacious. **Reasoning:** Inhaled recombinant human DNase I (dornase alfa) enzymatically cleaves this extracellular DNA into smaller fragments, sharply reducing sputum viscosity and improving clearance and lung function. Its action is therefore mucolytic, by digesting DNA. **Why the other options are wrong:**

- (A) Stimulating red-cell formation is the role of erythropoietin.
- (C) Replacing a clotting factor is the role of recombinant Factor VIII/IX.
- (D) Dissolving fibrin clots is the role of thrombolytics such as streptokinase.

Final Answer: Dornase alfa digests airway DNA to thin the mucus $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q146

Q147.

Solution

Concept — G-CSF (filgrastim): Granulocyte colony-stimulating factor drives the proliferation and maturation of neutrophil precursors in the bone marrow and their release into the blood. **Reasoning:** Recombinant filgrastim is given to cancer patients whose chemotherapy has depleted their neutrophils (febrile neutropenia), and to mobilise stem cells for transplant. By raising the neutrophil count it lowers the risk of serious infection. **Why the other options are wrong:**

- (B) Lowering blood glucose is the action of insulin.
- (C) Activating plasminogen is the action of thrombolytics.
- (D) Promoting bone growth is the action of growth hormone (somatropin).

Final Answer: Filgrastim raises neutrophils in chemotherapy-induced neutropenia $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q147

Q148.

Solution

Concept — Solid-state fermentation (SSF): The microbe grows on a moist solid matrix with little or no free water; the substrate itself (e.g. wheat bran, rice husk) supports growth and supplies nutrients. **Reasoning:** SSF is the classical way to produce many fungal enzymes (amylases, proteases), organic acids and *koji*-type products. It mimics the natural habitat of moulds and avoids the large water volumes of submerged culture. **Why the other options are wrong:**

- (A) A chemostat is a continuous liquid culture, the opposite of SSF.
- (B) Submerged batch culture grows cells freely suspended in liquid broth.
- (D) Dialysis culture separates cells from medium by a membrane, still in liquid.

Final Answer: Growth on a moist solid substrate is solid-state fermentation $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q148

Q149.

Solution

Concept — Inoculum development: A production fermenter must be seeded with a large, vigorous, contamination-free, log-phase culture so that the lag phase in the main vessel is short. **Reasoning:** The organism is therefore grown through progressively larger vessels (slant $\rightarrow$ shake flask $\rightarrow$ seed tank $\rightarrow$ pre-fermenter), each step expanding the active biomass. This staged scale-up of the seed is called inoculum development. **Why the other options are wrong:**

- (A) Downstream processing is product recovery after fermentation, not before.
- (C) Strain improvement alters the genetics of the organism, a separate activity.
- (D) Sterility testing checks for contamination; it does not build up biomass.

Final Answer: Staged build-up of the seed culture is inoculum development $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q149

Q150.

Solution

Concept — Foam control: Protein and aeration generate stable foam that can carry cells into exhaust lines and breach sterility. Foam is suppressed chemically with antifoam (silicone oils, vegetable oils, polypropylene glycol) that lower surface tension and collapse bubbles. **Reasoning:** A small dose of a silicone or vegetable-oil antifoam, added through a foam-sensing probe, destabilises the foam lamellae and quickly knocks the foam down without harming the culture, so it is the direct chemical measure. **Why the other options are wrong:**

- (A) Faster stirring usually generates more foam, not less.
- (B) Raising temperature would stress or kill the organism.
- (C) Closing the sparger stops oxygen supply and stalls aerobic growth.

Final Answer: Adding an antifoam agent controls the foam $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q150

Q151.

Solution

Concept — Uncompetitive inhibition: The inhibitor binds only to the ES complex. This lowers both the apparent V_{max} and the apparent K_m by the same factor $(1 + [I]/K_i)$, so the ratio V_{max}/K_m (the slope of the Lineweaver–Burk line) is unchanged. **Reasoning:** Because the slope K_m/V_{max} stays the same while both intercepts shift, the double-reciprocal lines are **parallel**, exactly as drawn. The inhibited line has a larger $1/V_{max}$ intercept (lower V_{max}). **Why the other options are wrong:**

- (B) Raising K_m with V_{max} unchanged is competitive inhibition (intersecting lines on the $1/v$ axis).
- (C) Lowering V_{max} with K_m unchanged is non-competitive inhibition (intersecting lines on the $1/[S]$ axis).
- (D) An inhibitor with no effect would not shift the line at all.

Final Answer: Uncompetitive inhibition lowers V_{max} and K_m together, giving parallel lines $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q151

Q152.

Solution

Concept — Meaning of K_m: K_m is the substrate concentration giving half-maximal velocity and is inversely related to substrate affinity: a **low** K_m means the enzyme reaches half its speed at low [S], i.e. it binds substrate tightly. **Reasoning:** Isoenzyme P (K_m = 0.1 mM) has a far lower K_m than Q (K_m = 2.0 mM), so P has the higher affinity and is more efficient at the low substrate levels typical of cells. With equal V_{max}, the catalytic efficiency V_{max}/K_m is greater for P. **Why the other options are wrong:**

- (A) A larger K_m means weaker, not tighter, binding.
- (B) K_m strongly affects efficiency at low [S].
- (D) Affinity is reflected by K_m, not by V_{max} alone.

Final Answer: The lower-K_m isoenzyme P has higher affinity and works better at low [S] $\Rightarrow$ C

Answer: (C) Go Back to Q152

Q153.

Solution

Concept — Antibody hinge region: Between the Fab arms and the Fc stem of IgG lies a proline-rich, flexible hinge. It lets the two Fab arms splay and rotate so the antibody can engage antigens at varying distances and orientations. **Reasoning:** The point Z where the two arms meet the stem is the hinge. Its flexibility permits the "Y" to open and close, aiding bivalent binding and cross-linking; it is also the region cleaved by papain/pepsin into Fab and Fc fragments. **Why the other options are wrong:**

- (A) The paratope (antigen-binding site) is at the tips of the Fab arms, not the junction.
- (C) The light-chain variable region is in the Fab arm, not the central hinge.
- (D) The Fc effector region is the stem below the hinge.

Final Answer: The flexible junction Z is the hinge region $\Rightarrow$ B

Answer: (B) Go Back to Q153

Q154.

Solution

Concept — Recombinant subunit vaccine: A subunit vaccine contains only a defined antigenic component of a pathogen. When that component is produced by cloning and expressing its gene, the vaccine is a recombinant subunit vaccine. **Reasoning:** The hepatitis B vaccine is made by expressing the HBsAg gene in *Saccharomyces cerevisiae*; the purified surface-antigen protein self-assembles into immunogenic particles. It contains no whole virus and no viral DNA, so it cannot cause infection. **Why the other options are wrong:**

- (A) It is not a live attenuated virus; no replicating virus is present.
- (B) It is not a killed whole virus; only one protein is used.
- (C) A toxoid is an inactivated exotoxin (diphtheria/tetanus), not a viral surface protein.

Final Answer: Cloned, yeast-expressed HBsAg is a recombinant subunit vaccine $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q154

Q155.

Solution

Concept — Type II (cytotoxic) hypersensitivity: IgG or IgM antibodies bind antigens fixed on a cell surface and destroy that cell through complement-mediated lysis, opsonisation/phagocytosis, or antibody-dependent cellular cytotoxicity. **Reasoning:** In a mismatched blood transfusion, recipient antibodies bind donor red-cell surface antigens (e.g. ABO), triggering complement and phagocytic destruction of those cells, i.e. classic Type II cytotoxic hypersensitivity. Haemolytic disease of the newborn is another example. **Why the other options are wrong:**

- (B) Type I is IgE-mediated immediate allergy (e.g. anaphylaxis).
- (C) Type III involves soluble antigen–antibody immune complexes deposited in tissues.
- (D) Type IV is delayed and T-cell-mediated, with no antibody.

Final Answer: Antibody-mediated destruction of mismatched red cells is Type II $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q155

Q156.

Solution

Concept — Type IV (delayed) hypersensitivity: This reaction is mediated by sensitised T lymphocytes and macrophages, not antibody, and develops slowly (24–72 h) after antigen exposure. **Reasoning:** The tuberculin (Mantoux) test produces an indurated lesion 48–72 h after intradermal tuberculin because memory T cells recruit and activate macrophages at the site. The delayed timing and cellular (not humoral) basis make it Type IV. Contact dermatitis is another example. **Why the other options are wrong:**

- (A) Type II is antibody-mediated cell destruction, and immediate to hours.
- (C) Type I is IgE-mediated and occurs within minutes.
- (D) Type III involves immune complexes, with a faster (hours) onset.

Final Answer: The delayed, T-cell-mediated tuberculin reaction is Type IV $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q156

Q157.

Solution

Concept — Competitive (radio)immunoassay: In RIA a fixed, limited amount of antibody is offered both labelled and unlabelled antigen, which compete for the same binding sites. **Reasoning:** The more unlabelled (sample) antigen present, the more it outcompetes the radiolabelled antigen for the antibody, so **less** radioactivity is bound to the antibody. The antibody-bound radioactivity is therefore inversely related to the analyte concentration, and a standard curve converts the measured counts into a result. **Why the other options are wrong:**

- (A) Bound label falls (not rises) as unlabelled antigen increases.
- (B) It clearly depends on the unlabelled antigen, that is the basis of the assay.
- (D) Only a fraction binds the limited antibody, not the total added label.

Final Answer: Antibody-bound radioactivity is inversely related to sample antigen $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q157

Q158.

Solution

Concept — Acid-fast (Ziehl–Neelsen) staining: Mycobacteria have a cell wall rich in long-chain mycolic acids forming a thick, waxy, hydrophobic coat. Once heated carbol-fuchsin penetrates, this wax resists removal by acid-alcohol, so the cells stay red (acid-fast). **Reasoning:** The mycolic-acid layer is the chemical reason for acid-fastness, allowing detection of *M. tuberculosis* that Gram staining misses. Decolourised background cells are counterstained with methylene blue. **Why the other options are wrong:**

- (B) Thick peptidoglycan alone explains Gram-positivity, not acid-fastness.
- (C) An LPS outer membrane is the Gram-negative feature.
- (D) Mycobacteria do have a (waxy) cell wall.

Final Answer: Waxy mycolic acids make the cells acid-fast $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q158

Q159.

Solution

Concept — Generation time: The generation (doubling) time g is the time for one doubling. If the population goes from 2^a to 2^b, the number of doublings $n = b - a$, and $g = t/n$. **Reasoning:** Here the count rises from 2^3 to 2^7, so $n = 7 - 3 = 4$ doublings in $t = 120$ min. Therefore $g = 120/4 = 30$ minutes per generation. (Equivalently $N = N_0\, 2^{t/g}$ gives $2^7 = 2^3 \cdot 2^{120/g}$, so $120/g = 4$.) **Why the other options are wrong:**

- (A) 60 min would give only $120/60 = 2$ doublings, reaching 2^5.
- (B) 24 min gives 5 doublings, reaching 2^8.
- (C) 40 min gives 3 doublings, reaching 2^6.

Final Answer: Four doublings in 120 min give $g = 30$ min $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q159

Q160.

Solution

Concept — Biological indicators: A biological indicator carries a standardised population of spores of an organism known to be unusually resistant to the particular sterilising agent; their death proves the cycle was lethal. **Reasoning:** For moist-heat (steam/autoclave) cycles the indicator organism is *Geobacillus stearothermophilus* (formerly *Bacillus stearothermophilus*), whose spores are highly heat-resistant. (For dry heat and ethylene oxide, *Bacillus atrophaeus* spores are used instead.) Absence of growth after incubation confirms sterility assurance. **Why the other options are wrong:**

- (A) *E. coli* is a non-spore-forming, heat-sensitive vegetative organism.
- (C) *S. aureus* likewise forms no heat-resistant spores.
- (D) *S. cerevisiae* is a yeast, not a resistant-spore indicator.

Final Answer: The steam-cycle biological indicator is *Geobacillus stearothermophilus* $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q160

Answer Key

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