UPCATET Complete Sample Paper

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Duration: 180 Minutes **Maximum Marks: 800**

Instructions

- This paper contains **200 Multiple Choice Questions** covering Part A: Physics (Q1–50), Part B: Chemistry (Q51–100), Part C: Biology (Q101–180), and Part D: General Studies (Q181–200), modelled on the **UPCATET** entrance examination (conducted by SVPUAT, Meerut).
- Each correct answer carries **+4 marks**. Each wrong answer carries **−1 mark**. Unattempted questions carry **0 marks**.
- Only **one** option is correct per question. Choose carefully.
- Syllabus level: Class 11–12 (UP Board / NCERT) — Physics, Chemistry, Biology, and General Studies as per the official UPCATET syllabus.
- This is an **OMR-based** pen-and-paper examination. Use only **HB pencil** to darken the appropriate bubble.
- Use of mobile phones, calculators, or any electronic gadgets is **strictly prohibited**.

Part A: Physics (Q1–Q50)

Q1. A train moves north at 60 km/h and another train moves south at 40 km/h on parallel tracks. The magnitude of their relative velocity is:

$$v_{rel} = v_A - (-v_B) \quad \begin{cases} v_A = 60 \text{ km/h (N)} \\ v_B = 40 \text{ km/h (S)} \end{cases}$$

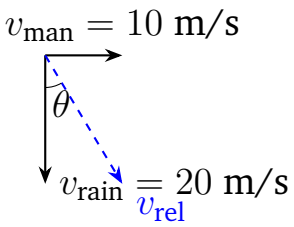
(A) 100 km/h

(B) 20 km/h

(C) 60 km/h

(D) 40 km/h

Q2. Rain falls vertically at 20 m/s. A man walks east at 10 m/s. The angle θ from vertical at which he should hold his umbrella satisfies $\tan\theta =$:



(A) 2

(B) $\frac{1}{2}$

(C) $\sqrt{3}$

(D) $\frac{1}{\sqrt{3}}$

Q3. A boat can row at 5 m/s in still water. The river flows at 3 m/s. To cross a river of width d by the shortest path (minimum distance), the boat must head upstream such that the resultant velocity is perpendicular to the bank. The sine of the angle θ (measured from the bank's perpendicular) that the boat makes with the perpendicular is:

(A) $\frac{3}{4}$

(B) $\frac{5}{3}$

(C) $\frac{4}{5}$

(D) $\frac{3}{5}$

Q4. Two objects move at right angles to each other with speeds 3 m/s and 4 m/s respectively. The magnitude of their relative speed is:

(A) 7 m/s

(B) 1 m/s

(C) 5 m/s

(D) 3.5 m/s

Q5. A particle moves in a circle of radius R at constant speed v. The magnitude of the relative velocity between the particle at two diametrically opposite positions is:

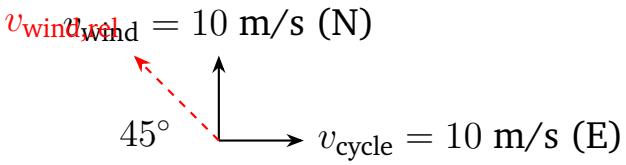
(A) $2v$

(B) v

(C) 0

(D) $v\sqrt{2}$

Q6. A cyclist moves east at 10 m/s. Wind blows north at 10 m/s. From which direction does the wind appear to blow to the cyclist?



(A) North

(B) North-west

(C) South-west

(D) South-east

Q7. Two equal masses m collide elastically head-on. Mass A moves at v_0; mass B is at rest. After collision, the velocity of A is:

(A) v_0

(B) $v_0/2$

(C) $-v_0/2$

(D) 0

Q8. A gun of mass M fires a bullet of mass m at muzzle speed v. The recoil speed of the gun is:

(A) $\frac{mv}{M}$

(B) $\frac{Mv}{m}$

(C) $\frac{(M+m)v}{M}$

(D) $\frac{mv}{M-m}$

Q9. A coefficient of restitution $e = 1$ corresponds to a:

(A) Perfectly inelastic collision

(B) Inelastic collision

(C) Perfectly elastic collision

(D) No collision

Q10. A ball of mass 0.5 kg moving at 4 m/s strikes a wall and rebounds at 2 m/s in the opposite direction. The magnitude of impulse imparted by the wall is:

(A) 1 N·s

(B) 3 N·s

(C) 2 N·s

(D) 5 N·s

Q11. In a perfectly inelastic collision between a mass m_1 moving at v_1 and a stationary mass m_2, the final common velocity is:

(A) $\frac{2m_1v_1}{m_1+m_2}$

(B) $\frac{m_1v_1}{m_2}$

(C) $\frac{(m_1+m_2)v_1}{m_1}$

(D) $\frac{m_1v_1}{m_1+m_2}$

Q12. A 60 kg person jumps from rest and just before landing has a speed of 3 m/s. The impulse delivered to the person during the jump phase is:

(A) 180 N·s

(B) 60 N·s

(C) 3 N·s

(D) 20 N·s

Q13. A satellite orbits at radius r. Its orbital radius is doubled to $2r$. By Kepler's third law ($T^2 \propto r^3$), the new time period is:

(A) $2T$

(B) $2\sqrt{2}\,T$

(C) $4T$

(D) $\sqrt{2}\,T$

Q14. The orbital velocity of a satellite moving at radius r from the centre of Earth (mass M) is:

(A) $\sqrt{GMr}$

(B) $\sqrt{2GM/r}$

(C) $\sqrt{GM/r}$

(D) GM/r

Q15. The escape velocity from the surface of Earth (radius R, mass M) is:

(A) $\sqrt{2GM/R}$

(B) $\sqrt{GM/R}$

(C) $\sqrt{2gR^2}$

(D) $2\sqrt{GM/R}$

Q16. A geostationary satellite appears stationary to an observer on Earth because its orbital period is:

(A) 12 hours

(B) 90 minutes

(C) 6 hours

(D) 24 hours

Q17. The gravitational potential energy of mass m at height h above the Earth's surface (Earth radius R, mass M) is:

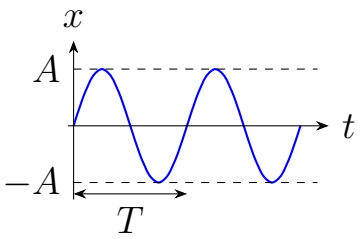
(A) $-GMm/h$

(B) $-GMm/(R+h)$

(C) GMm/R

(D) $-GMm/R^2$

Q18. A mass m is attached to a spring of spring constant k. The time period of its oscillation is:



(A) $2\pi\sqrt{k/m}$

(B) $\pi\sqrt{m/k}$

(C) $2\pi\sqrt{m/k}$

(D) $\sqrt{m/k}$

Q19. A simple pendulum of length L has time period T on Earth (gravitational acceleration g). On the Moon where gravitational acceleration is $g/6$, the time period becomes:

(A) $T\sqrt{6}$

(B) $T/6$

(C) $T/\sqrt{6}$

(D) $6T$

Q20. The total mechanical energy of a simple harmonic oscillator of amplitude A and spring constant k is:

(A) kA

(B) kA^2

(C) $\frac{1}{4}kA^2$

(D) $\frac{1}{2}kA^2$

Q21. In SHM, when the displacement equals $A/2$ (where A is amplitude), the ratio of kinetic energy to potential energy is:

(A) $1:3$

(B) $3:1$

(C) $1:1$

(D) $2:1$

Q22. In simple harmonic motion, the velocity of the particle is maximum at the:

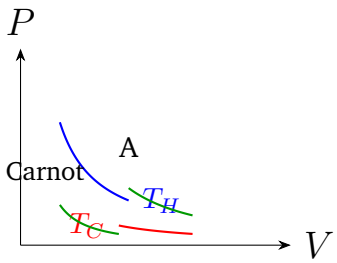
(A) Extreme position (amplitude)

(B) Position between mean and extreme

(C) Mean (equilibrium) position

(D) Any position

Q23. A Carnot engine operates between a hot reservoir at 600 K and a cold reservoir at 300 K. Its thermodynamic efficiency is:



(A) 50%

(B) 33%

(C) 67%

(D) 25%

Q24. The coefficient of performance (COP) of a refrigerator working between hot reservoir temperature T_1 and cold reservoir temperature T_2 ($T_1 > T_2$) is:

(A) $\dfrac{T_1}{T_1 - T_2}$

(B) $\dfrac{T_1 - T_2}{T_2}$

(C) $\dfrac{T_1}{T_2}$

(D) $\dfrac{T_2}{T_1 - T_2}$

Q25. The change in entropy of the universe in a perfectly reversible process is:

(A) Positive

(B) Zero

(C) Negative

(D) Infinite

Q26. The internal energy of an ideal gas depends only on its:

(A) Pressure

(B) Volume

(C) Temperature

(D) Both pressure and volume

Q27. In an adiabatic process, the heat exchange Q is:

(A) $Q = 0$

(B) $Q = W$

(C) $Q = \Delta U$

(D) $Q = -W$

Q28. The electric potential at distance r from a point charge Q (in vacuum) is:

(A) kQ/r^2

(B) kQr

(C) kQ

(D) kQ/r

Q29. The work done in moving a charge q between two points on the same equipotential surface (potential V) is:

(A) qV

(B) 0

(C) qV^2

(D) q/V

Q30. The electric field due to an infinite plane sheet with surface charge density σ at any point near the sheet is:

(A) $\dfrac{\sigma}{2\varepsilon_0}$

(B) $\dfrac{\sigma}{\varepsilon_0}$

(C) $\dfrac{2\sigma}{\varepsilon_0}$

(D) $\dfrac{\sigma^2}{\varepsilon_0}$

Q31. According to Gauss's law, the total electric flux through any closed surface enclosing a net charge Q is:

(A) $Q\varepsilon_0$

(B) $\dfrac{Q}{4\pi\varepsilon_0}$

(C) $\frac{Q}{\varepsilon_0}$

(D) $\frac{4\pi Q}{\varepsilon_0}$

Q32. The electric field at any interior point of a uniformly charged hollow (conducting) sphere is:

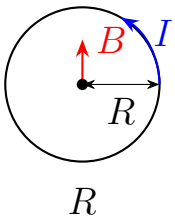
(A) kQ/r^2

(B) kQ/R^2

(C) σ/ε_0

(D) 0

Q33. The magnetic field at the centre of a circular loop of radius R carrying current I is:



R

(A) $\mu_0 I/R$

(B) $\mu_0 I/2R$

(C) $\mu_0 I/4R$

(D) $2\mu_0 I/R$

Q34. The force on a straight conductor of length L carrying current I placed perpendicular to a uniform magnetic field B is:

(A) BIL^2

(B) BI/L

(C) BIL

(D) B^2IL

Q35. Two long parallel wires carry currents I_1 and I_2 and are separated by distance d. The force per unit length between them is:

(A) $\frac{\mu_0 I_1 I_2}{2\pi d}$

(B) $\frac{\mu_0 I_1 I_2}{4\pi d}$

(C) $\frac{\mu_0 I_1 I_2}{\pi d}$

(D) $\frac{2\mu_0 I_1 I_2}{\pi d}$

Q36. Two long parallel wires carrying currents in the *same* direction will:

(A) Repel each other

(B) Experience no force

(C) First attract, then repel

(D) Attract each other

Q37. A charged particle of mass m and charge q moves with velocity v perpendicular to a uniform magnetic field B. The radius of its circular path is:

(A) qvB/m

(B) mv/qB

(C) qB/mv

(D) m/qvB

Q38. An object is placed at a distance $2f$ from a concave mirror of focal length f. The image is formed at:

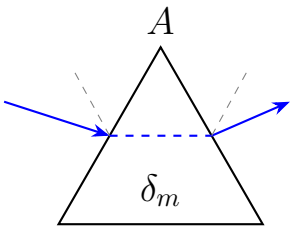
(A) f (behind mirror)

(B) Infinity

(C) $f/2$

(D) $2f$ (real, inverted, same size)

Q39. For a prism of apex angle A, at minimum deviation δ_m, the refractive index μ is:



(A) $\dfrac{\sin\left(\dfrac{A+\delta_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

(B) $\dfrac{\sin A}{\sin \delta_m}$

(C) $\dfrac{\sin \delta_m}{\sin A}$

(D) $\dfrac{\cos(A/2)}{\sin(\delta_m/2)}$

Q40. The critical angle θ_c for total internal reflection in a medium of refractive index $n > 1$ (with respect to air) satisfies:

(A) $\sin \theta_c = n$

(B) $\cos \theta_c = 1/n$

(C) $\sin \theta_c = 1/n$

(D) $\tan \theta_c = n$

Q41. A convex mirror always forms an image that is:

(A) Real, inverted, and magnified

(B) Virtual, erect, and diminished

(C) Real, erect, and same size

(D) Virtual, inverted, and magnified

Q42. Light travels from glass ($n = 1.5$) to air ($n = 1$). The critical angle for total internal reflection is approximately:

(A) 30°

(B) 45°

(C) 60°

(D) 42°

Q43. A source of sound of frequency f_0 moves toward a stationary observer at speed v_s. The speed of sound is v. The frequency observed is:

(A) $\dfrac{f_0\, v}{v - v_s}$

(B) $\dfrac{f_0\, v}{v + v_s}$

(C) $\dfrac{f_0(v - v_s)}{v}$

(D) $\dfrac{f_0(v + v_s)}{v}$

Q44. Two tuning forks of frequencies 480 Hz and 484 Hz are sounded simultaneously. The beat frequency heard is:

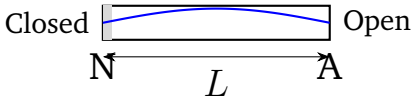
(A) 480 Hz

(B) 484 Hz

(C) 4 Hz

(D) 964 Hz

Q45. A closed organ pipe of length L has a displacement node at its closed end and an antinode at its open end. Its fundamental frequency (speed of sound $= v$) is:



(A) $v/2L$

(B) $v/4L$

(C) v/L

(D) $2v/L$

Q46. An open organ pipe of length L (open at both ends) has its fundamental frequency (speed of sound $= v$) as:

(A) $v/4L$

(B) v/L

(C) $3v/4L$

(D) $v/2L$

Q47. An observer moves toward a stationary source at speed v_0. Source frequency is f_0 and speed of sound is v. The observed frequency is:

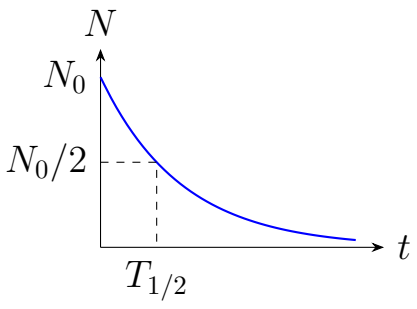
(A) $\dfrac{f_0(v+v_0)}{v}$

(B) $\dfrac{f_0\, v}{v+v_0}$

(C) $\dfrac{f_0(v-v_0)}{v}$

(D) $\dfrac{f_0\, v}{v-v_0}$

Q48. If N_0 is the initial number of radioactive nuclei and λ is the decay constant, the number of undecayed nuclei remaining after time t is:



(A) $N_0 e^{\lambda t}$

(B) $N_0(1-e^{-\lambda t})$

(C) $N_0 e^{-\lambda t}$

(D) $N_0/\lambda t$

Q49. The half-life $T_{1/2}$ is related to the decay constant λ by:

(A) $T_{1/2} = \lambda$

(B) $T_{1/2} = 0.693/\lambda$

(C) $T_{1/2} = 1/\lambda$

(D) $T_{1/2} = 2\lambda$

Q50. When a nucleus of mass number A and atomic number Z emits an alpha particle, the daughter nucleus has:

(A) $Z + 2$, $A + 4$

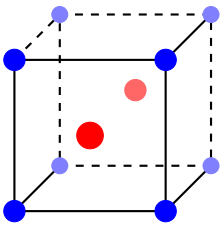
(B) $Z - 1$, $A - 1$

(C) $Z + 1$, A

(D) $Z - 2$, $A - 4$

Part B: Chemistry (Q51–Q100)

Q51. In a Face-Centred Cubic (FCC) unit cell, the total number of atoms is:



Corner: $\frac{1}{8} \times 8 = 1$; Face: $\frac{1}{2} \times 6 = 3$; Total $= 4$

(A) 1

(B) 2

(C) 4

(D) 6

Q52. The coordination number of an atom in a Body-Centred Cubic (BCC) crystal structure is:

(A) 8

(B) 6

(C) 12

(D) 4

Q53. The packing efficiency of a Face-Centred Cubic (FCC) structure is approximately:

(A) 52%

(B) 68%

(C) 80%

(D) 74%

Q54. In a Frenkel defect in an ionic crystal, a cation:

(A) Is missing entirely from the lattice

(B) Moves to an interstitial position within the same crystal

(C) Is replaced by a foreign ion impurity

(D) Creates an electron hole in the lattice

Q55. The presence of Schottky defects in a crystal causes its density to:

(A) Increase

(B) Remain the same

(C) Decrease

(D) Become zero

Q56. According to Raoult's law, the relative lowering of vapour pressure for a dilute solution equals:

(A) p^*/p

(B) $(p^* + p)/p^*$

(C) $p/(p^* - p)$

(D) $(p^* - p)/p^* = x_{\text{solute}}$

Q57. Molality (m) of a solution is defined as the number of moles of solute dissolved per:

(A) Kilogram of solvent

(B) Litre of solution

(C) Mole of solvent

(D) Litre of solvent

Q58. For a solute that associates or dissociates (van't Hoff factor i), the depression in freezing point ΔT_f is:

(A) $K_f \cdot m$

(B) $i\,K_f\,m$

(C) K_f/m

(D) $K_b m/i$

Q59. The osmotic pressure π of a solution of molarity M at temperature T with van't Hoff factor i is given by:

(A) MRT/i

(B) MR/T

(C) $iMRT$

(D) iM/RT

Q60. Which colligative property is most commonly used for determining the molecular mass of high-molecular-weight polymers?

(A) Boiling point elevation

(B) Freezing point depression

(C) Lowering of vapour pressure

(D) Osmotic pressure

Q61. For the galvanic cell $\mathrm{Zn|Zn^{2+}||Cu^{2+}|Cu}$, given $E^\circ(\mathrm{Zn^{2+}/Zn}) = -0.76$ V and $E^\circ(\mathrm{Cu^{2+}/Cu}) = +0.34$ V, the standard EMF of the cell is:

(A) 1.10 V

(B) 0.42 V

(C) -1.10 V

(D) 0.34 V

Q62. According to Faraday's first law of electrolysis, the mass of substance deposited at an electrode is proportional to:

(A) Current I only

(B) Time t only

(C) The quantity of charge passed (both I and t)

(D) Neither current nor time

Q63. One Faraday (≈ 96500 C) deposits one gram-equivalent of a substance at an electrode because:

(A) $96500 =$ Avogadro's number

(B) 96500 C mol^{-1} is the charge carried by one mole of electrons

(C) 1 F $=$ 1 coulomb exactly

(D) It always deposits exactly 1 gram of any element

Q64. During the corrosion (rusting) of iron, the iron surface acts as the:

(A) Cathode

(B) Electrolyte

(C) Neither electrode

(D) Anode

Q65. The electrode potential of the Standard Hydrogen Electrode (SHE) is:

(A) 0 V by definition

(B) $+1.0$ V

(C) -1.0 V

(D) $+0.5$ V

Q66. For the reaction with rate law: Rate $= k[\mathrm{A}][\mathrm{B}]^2$, if $[\mathrm{A}]$ is doubled and $[\mathrm{B}]$ is halved, the new rate compared to the original rate is:

(A) Doubles

(B) Quadruples

(C) Halves

(D) Remains unchanged

Q67. The half-life of a first-order reaction with rate constant k is:

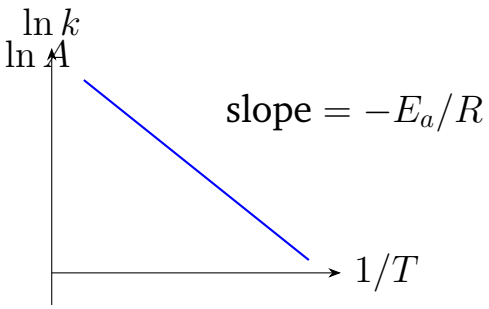
(A) $k/0.693$

(B) $1/k$

(C) $2/k$

(D) $0.693/k$

Q68. The Arrhenius equation relating the rate constant k to absolute temperature T and activation energy E_a is:



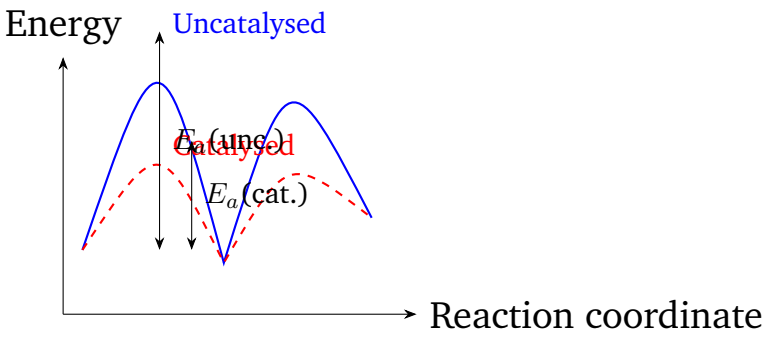
(A) $k = A\, e^{-E_a/RT}$

(B) $k = A\, e^{E_a/RT}$

(C) $k = E_a/RT$

(D) $\ln k = E_a/RT$

Q69. A catalyst increases the rate of a chemical reaction by:



(A) Increasing the activation energy

(B) Providing an alternate pathway of lower activation energy

(C) Shifting the equilibrium position towards products

(D) Being consumed during the reaction

Q70. The order of a chemical reaction is determined:

(A) From the stoichiometric coefficients in the balanced equation alone

(B) From the reaction mechanism only, without experiments

(C) Experimentally from the rate law derived by rate measurements

(D) From the molecular formula of the reactants

Q71. Molecular nitrogen (N_2) is extremely inert under normal conditions primarily because of its:

(A) High atomic mass

(B) Large size of the nitrogen atom

(C) Ionic character of bonding

(D) Very strong N≡N triple bond (bond enthalpy $\approx$ 941 kJ mol^{-1})

Q72. The geometry of the NH_3 molecule (considering the lone pair on nitrogen) is:

(A) Trigonal pyramidal

(B) Planar triangular

(C) Linear

(D) Tetrahedral

Q73. White phosphorus (P_4) is more chemically reactive than red phosphorus mainly because:

(A) White P_4 contains fewer phosphorus atoms per unit

(B) White P_4 contains P=P double bonds

(C) The P_4 tetrahedral units in white phosphorus have high angular ring strain (60° bond angles)

(D) White phosphorus is denser than red phosphorus

Q74. Which oxyacid of phosphorus is diprotic (dibasic), i.e., provides two ionisable protons?

(A) H_3PO_4 (orthophosphoric acid)

(B) H_3PO_3 (phosphorous acid)

(C) H_3PO_2 (hypophosphorous acid)

(D) HPO_3 (metaphosphoric acid)

Q75. Nitric acid (HNO_3) is manufactured industrially by the:

(A) Haber process

(B) Contact process

(C) Solvay process

(D) Ostwald process

Q76. According to Werner's theory of coordination compounds, the primary valence of the central metal is satisfied by:

(A) Counter-ions (anions in the ionisation sphere)

(B) Neutral ligands only

(C) Cations only

(D) Both anions and cations

Q77. The coordination number of the central cobalt ion in the complex $[Co(NH_3)_6]^{3+}$ is:

(A) 3

(B) 9

(C) 6

(D) 12

Q78. Strong-field ligands (such as CN^-, CO) in Crystal Field Theory cause:

(A) A small crystal field splitting (Δ)

(B) A large crystal field splitting (Δ)

(C) No splitting of d-orbitals

(D) Only spin-orbit coupling effects

Q79. The IUPAC name of the complex ion $[Cu(NH_3)_4]^{2+}$ is:

(A) Copper(II) tetraamine

(B) Tetraaminocopper(II)

(C) Copper tetraammine

(D) Tetraamminecopper(II)

Q80. Chelate complexes (formed by polydentate ligands) are thermodynamically more stable than analogous complexes of monodentate ligands primarily due to the:

(A) Chelate effect (large positive entropy change on chelation)

(B) Greater ionic character of chelates

(C) Lower coordination number of chelate complexes

(D) Covalent character being the only stabilising factor

Q81. An S_N2 reaction at a chiral centre proceeds with:

(A) Retention of configuration

(B) Complete racemisation

(C) Inversion of configuration (Walden inversion)

(D) No stereochemical change

Q82. The correct order of stability of carbocations is:

(A) $1^\circ > 2^\circ > 3^\circ$

(B) methyl $> 1^\circ > 2^\circ$

(C) $2^\circ > 3^\circ > 1^\circ$

(D) $3^\circ > 2^\circ > 1^\circ >$ methyl

Q83. An S_N1 reaction is most favoured by:

(A) A tertiary alkyl halide in a polar protic solvent

(B) A primary alkyl halide in a polar aprotic solvent

(C) A methyl halide in any solvent

(D) A secondary alkyl halide in a polar aprotic solvent

Q84. In the Lucas test (anhydrous $ZnCl_2$ + conc. HCl), a tertiary alcohol gives turbidity (cloudiness):

(A) Only on heating

(B) Immediately (at room temperature)

(C) After about 5 minutes

(D) No turbidity at all

Q85. When a Grignard reagent R$-$MgX reacts with water (H_2O), the organic product formed is:

(A) An alcohol (R$-$OH)

(B) An aldehyde

(C) An alkane (R$-$H)

(D) A ketone

Q86. Phenol is more acidic than ethanol because:

(A) Both contain the same $-OH$ group and should be equally acidic

(B) Ethanol has a longer carbon chain

(C) Phenol has a lower molecular weight than ethanol

(D) The phenoxide ion ($C_6H_5O^-$) is stabilised by resonance with the aromatic ring

Q87. Acid-catalysed dehydration of a secondary alcohol primarily gives (following Saytzeff's rule):

(A) An alkene (more substituted, according to Saytzeff's rule)

(B) An ether

(C) An alkane

(D) An aldehyde

Q88. The correct order of acidic strength among phenol, water, and ethanol is:

(A) Ethanol $>$ Water $>$ Phenol

(B) Phenol $>$ Water $>$ Ethanol

(C) Water $>$ Phenol $>$ Ethanol

(D) Ethanol $>$ Phenol $>$ Water

Q89. The reagent used in the Lucas test for distinguishing primary, secondary, and tertiary alcohols is:

(A) NaOH and HCl

(B) HCl alone

(C) Anhydrous $ZnCl_2$ and concentrated HCl

(D) Concentrated H_2SO_4

Q90. Oxidation of a primary alcohol with CrO_3/H_2SO_4 (Jones' reagent) initially gives:

(A) An alkane

(B) An ester

(C) A ketone

(D) An aldehyde (which is further oxidised to a carboxylic acid under excess oxidant)

Q91. Tollens' reagent (ammoniacal silver nitrate) gives a positive silver mirror test with:

(A) Aldehydes

(B) Ketones

(C) Alcohols

(D) Alkenes

Q92. The Cannizzaro reaction (disproportionation) is shown only by aldehydes that have:

(A) An α-hydrogen

(B) A β-hydrogen

(C) No α-hydrogen

(D) Only one hydrogen atom in total

Q93. The aldol condensation product formed when two molecules of acetaldehyde (CH_3CHO) react under dilute base is:

(A) 2-Hydroxypropanal

(B) 3-Hydroxybutanal

(C) Propanoic acid

(D) Ethanol

Q94. Fehling's solution (alkaline Cu^{2+} reagent) gives a positive test (brick-red precipitate) with:

(A) Benzaldehyde (aromatic aldehyde)

(B) Acetone (a ketone)

(C) Acetaldehyde alone

(D) Aliphatic aldehydes

Q95. Nucleophilic addition of HCN to acetone (CH_3COCH_3) gives:

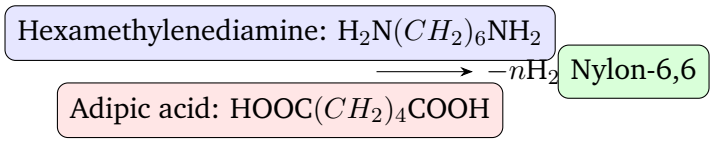
(A) Acetone cyanohydrin: $(CH_3)_2C(OH)CN$

(B) Propanenitrile

(C) Methanol

(D) Acetaldehyde

Q96. Nylon-6,6 is formed by condensation polymerisation of:



(A) Caprolactam alone (ring-opening polymerisation)

(B) Ethylene glycol and terephthalic acid (PET monomers)

(C) Hexamethylenediamine and adipic acid

(D) Styrene and butadiene

Q97. Polythene (polyethylene) is an example of a:

(A) Condensation polymer

(B) Addition polymer

(C) Copolymer

(D) Natural polymer

Q98. An amino acid exists predominantly as a zwitterion (dipolar ion) when:

(A) The solution pH is below the isoelectric point

(B) The solution pH is above the isoelectric point

(C) In strongly basic solution only

(D) The solution pH equals the isoelectric point (pI)

Q99. The covalent bond that links two amino acid residues in a polypeptide chain is called a:

(A) Peptide bond ($-CO-NH-$)

(B) Glycosidic bond

(C) Hydrogen bond

(D) Disulfide bond

Q100. The *primary structure* of a protein refers to:

(A) The formation of α-helix or β-pleated sheet (secondary structure)

(B) The overall three-dimensional folding of the polypeptide chain

(C) The specific sequence of amino acids linked by peptide bonds along the chain

(D) The quaternary arrangement of multiple polypeptide subunits

Part C: Biology (Q101–Q180)

Q101. The molecular formula of glucose is:

(A) $C_5H_{10}O_5$

(B) $C_{12}H_{22}O_{11}$

(C) $C_6H_{12}O_6$

(D) $C_6H_{10}O_5$

Q102. Sucrose is a disaccharide composed of:

(A) Glucose + Fructose

(B) Glucose + Galactose

(C) Glucose + Glucose

(D) Fructose + Galactose

Q103. Starch consists of:

(A) Only amylopectin

(B) Only amylose

(C) Cellulose + amylose

(D) Amylose + Amylopectin

Q104. The secondary structure of protein refers to:

(A) Sequence of amino acids

(B) α-helix and β-pleated sheet arrangements

(C) 3D folding of the polypeptide chain

(D) Quaternary subunit arrangement

Q105. A peptide bond is formed between:

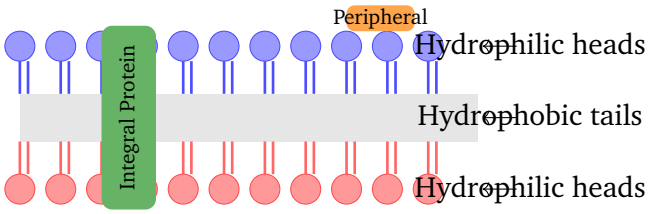
(A) Two carboxyl groups

(B) Two amino groups

(C) The amino group of one amino acid and the carboxyl group of another amino acid

(D) Two hydroxyl groups

Q106. The fluid mosaic model of the cell membrane was proposed by:



(A) Singer and Nicolson

(B) Watson and Crick

(C) Davson and Danielli

(D) Schleiden and Schwann

Q107. In active transport, energy is required because:

(A) Molecules move along the concentration gradient

(B) No membrane is crossed

(C) Water molecules are moving

(D) Molecules move against the concentration gradient

Q108. The Na^+/K^+ pump moves:

(A) 3 K^+ out and 2 Na^+ in per cycle

(B) 3 Na^+ out and 2 K^+ in per cycle

(C) 2 Na^+ out and 3 K^+ in per cycle

(D) Equal numbers of Na^+ and K^+ in both directions

Q109. Endocytosis where the cell engulfs solid particles is called:

(A) Pinocytosis

(B) Exocytosis

(C) Phagocytosis

(D) Osmosis

Q110. Osmosis is the movement of water from a region of:

(A) Higher water potential to lower water potential

(B) Lower to higher solute concentration

(C) Higher solute concentration to lower solute concentration

(D) Equal water potential (no net movement)

Q111. Haemophilia is an X-linked recessive disorder. A carrier mother (X^HX^h) and a normal father (X^HY) have a probability of having an affected son equal to:

(A) 1/4

(B) 1

(C) 0

(D) 1/2

Q112. Criss-cross inheritance means that X-linked traits are transmitted from:

(A) Father to son
(B) Father to daughter to grandson
(C) Mother to son only
(D) Mother to daughter

Q113. In humans, sex is determined by the:

(A) Sperm (X-bearing or Y-bearing)
(B) Egg (X-bearing or Y-bearing)
(C) Somatic cells of the embryo
(D) Environment during development

Q114. In birds, the sex-determination system is:

(A) XX female, XY male
(B) XO male, XX female
(C) ZZ male, ZW female
(D) ZW male, ZZ female

Q115. Colour blindness is more common in males because:

(A) Males lack a Y-chromosome gene to suppress it
(B) Females have stronger immune systems
(C) The gene for colour vision is on the Y chromosome
(D) Males have only one X chromosome, so a single defective allele is sufficient to express the disorder

Q116. Transcription begins at the:

(A) Promoter
(B) Terminator
(C) Exon
(D) Intron

Q117. During mRNA processing in eukaryotes, introns are:

(A) Retained in mature mRNA

(B) Added as a 5′ cap

(C) Removed by splicing

(D) Translated first before exons

Q118. The start codon on mRNA that initiates translation is:

(A) UAA

(B) AUG

(C) UAG

(D) UGA

Q119. The ribosome E-site (exit site) contains:

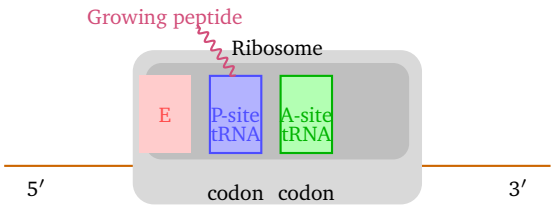
(A) The incoming aminoacyl-tRNA

(B) The peptidyl-tRNA

(C) The mRNA codon being decoded

(D) The discharged (empty) tRNA leaving the ribosome

Q120. Stop codons are:



(A) UAA, UAG, UGA

(B) AUG, GUG, UUG

(C) UUU, UUC, UUA

(D) GGG, CCC, AAA

Q121. Sharks belong to the class:

(A) Osteichthyes

(B) Amphibia

(C) Chondrichthyes

(D) Reptilia

Q122. *Labeo rohita* (Rohu fish) belongs to the class:

(A) Chondrichthyes

(B) Osteichthyes

(C) Reptilia

(D) Amphibia

Q123. The frog's heart has:

(A) 2 chambers

(B) 4 chambers

(C) 1 chamber

(D) 3 chambers

Q124. The crocodile has a:

(A) 4-chambered heart

(B) 3-chambered heart

(C) 2-chambered heart

(D) Single-chambered heart

Q125. Birds are warm-blooded (endothermic) and:

(A) Lay eggs and have a 3-chambered heart

(B) Have scales and are ectothermic

(C) Have a 4-chambered heart and feathers

(D) Are viviparous

Q126. Prokaryotic cells differ from eukaryotic cells in lacking a:

(A) Cell wall

(B) Ribosome

(C) DNA

(D) Membrane-bound nucleus

Q127. In the bacteriophage lytic cycle, the final stage is:

(A) Lysis of the host cell and release of new phages

(B) Integration into the host chromosome

(C) Lysogeny and dormancy

(D) Cell division of host without lysis

Q128. *Saccharomyces cerevisiae* is used in fermentation to produce:

(A) Citric acid

(B) Ethanol

(C) Lactic acid

(D) Penicillin

Q129. Penicillin was discovered from the fungus:

(A) *Aspergillus*

(B) *Rhizopus*

(C) *Penicillium*

(D) *Mucor*

Q130. Lichens are an example of symbiosis between:

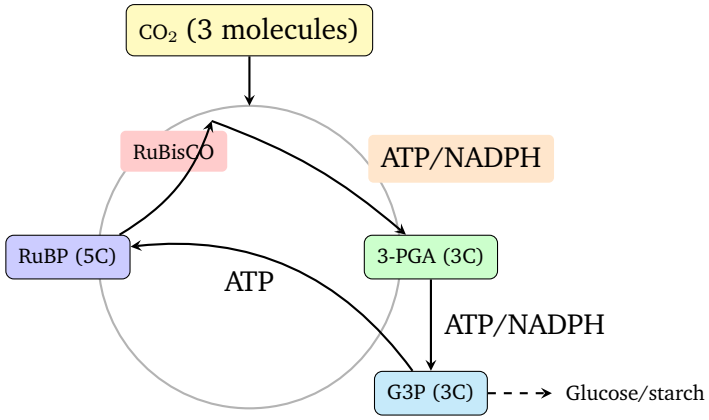
(A) Two bacteria

(B) Fungi and bacteria

(C) Algae and bacteria

(D) Algae (or cyanobacteria) and fungi

Q131. The enzyme that fixes CO_2 in the Calvin cycle is:



(A) RuBisCO

(B) PEP carboxylase

(C) ATP synthase

(D) Rubidoxin

Q132. The primary product of CO_2 fixation in the Calvin cycle is:

(A) Pyruvate

(B) Oxaloacetate

(C) 3-Phosphoglycerate (3-PGA)

(D) Glucose (produced directly)

Q133. C_4 plants use PEP carboxylase in mesophyll cells to first fix CO_2 into:

(A) 3-PGA

(B) Oxaloacetate (a 4-carbon compound)

(C) Glucose

(D) G3P

Q134. Kranz anatomy is characteristic of:

(A) C_3 plants (like wheat)

(B) CAM plants (like cactus)

(C) Bryophytes

(D) C_4 plants (like maize)

Q135. In the Calvin cycle, ATP and NADPH are used to convert:

(A) 3-PGA to G3P

(B) CO_2 to RuBP

(C) G3P to CO_2

(D) RuBP to glucose directly

Q136. In anaerobic respiration in yeast, the end products are:

(A) Lactic acid and CO_2

(B) Ethanol and H_2O

(C) Ethanol and CO_2

(D) Pyruvate and NADH

Q137. The Respiratory Quotient (RQ) for complete oxidation of glucose is:

(A) 0.7

(B) Greater than 1

(C) 0.5

(D) 1.0

Q138. The Respiratory Quotient (RQ) for fat oxidation is approximately:

(A) 1.0

(B) 0.7

(C) Greater than 1

(D) 0.5

Q139. Substrate-level phosphorylation occurs in:

(A) Glycolysis and the Krebs cycle

(B) The electron transport chain only

(C) Oxidative phosphorylation only

(D) Photosynthesis only

Q140. In muscle cells, anaerobic respiration produces:

(A) Ethanol

(B) Pyruvate only

(C) Lactic acid

(D) CO_2 and H_2O

Q141. Growth hormone (GH) is secreted by the:

(A) Thyroid gland

(B) Posterior pituitary

(C) Adrenal cortex

(D) Anterior pituitary

Q142. ADH (antidiuretic hormone) is synthesized in the hypothalamus and released from the:

(A) Anterior pituitary

(B) Posterior pituitary

(C) Adrenal medulla

(D) Thyroid gland

Q143. Insulin is produced by the:

(A) β-cells of the Islets of Langerhans

(B) α-cells of the Islets of Langerhans

(C) Adrenal cortex

(D) Thyroid gland

Q144. Glucagon has the opposite effect to insulin; it:

(A) Decreases blood glucose levels

(B) Promotes glycogenesis (glycogen synthesis)

(C) Raises blood glucose by promoting glycogenolysis

(D) Inhibits glucose absorption in the intestine

Q145. Thyroid hormones T_3 and T_4 require which mineral for their synthesis?

(A) Iron

(B) Iodine

(C) Calcium

(D) Zinc

Q146. Voluntary (skeletal) muscle fibres are:

(A) Striated and multinucleated

(B) Non-striated and uninucleated

(C) Striated and uninucleated

(D) Non-striated and multinucleated

Q147. According to the sliding filament theory, during muscle contraction:

(A) Myosin filaments shorten

(B) Actin filaments shorten

(C) Both actin and myosin filaments shorten

(D) Actin slides over myosin (the filaments themselves do not shorten)

Q148. Calcium ions in muscle contraction bind to:

(A) Myosin directly

(B) ATP

(C) Troponin, displacing tropomyosin from actin binding sites

(D) ADP

Q149. The A-band in a sarcomere:

(A) Contains only actin filaments

(B) Contains myosin (and overlapping actin) filaments

(C) Shortens during contraction

(D) Disappears completely during maximal contraction

Q150. ATP is directly used in muscle contraction for:

(A) Detachment of the myosin head from actin and re-cocking (re-energising) the head

(B) Initial binding of actin and myosin

(C) Calcium release from the sarcoplasmic reticulum

(D) Moving tropomyosin off actin binding sites

Q151. B-lymphocytes differentiate into _____ that produce antibodies:

(A) T-helper cells
(B) Memory T cells
(C) Plasma cells
(D) Natural killer cells

Q152. Memory cells are produced during an immune response so that:

(A) The antigen is neutralised more quickly on first exposure
(B) No immune response occurs on re-exposure
(C) T cells are activated more slowly
(D) A faster and stronger response occurs on second exposure to the same antigen

Q153. Innate immunity includes:

(A) Skin, mucus, phagocytes — non-specific first-line barriers
(B) Antibody production by plasma cells
(C) Activation of B and T lymphocytes
(D) Formation of memory cells after infection

Q154. Vaccination works by:

(A) Directly killing pathogens inside the body
(B) Inducing memory cells without causing disease
(C) Producing antibodies externally and injecting them
(D) Permanently preventing any infection

Q155. Cytotoxic T-cells ($CD8^+$) function to:

(A) Help B-cells produce antibodies
(B) Produce antibodies themselves
(C) Kill infected or cancerous cells directly
(D) Present antigens to helper T cells

Q156. Rod cells in the retina are responsible for:

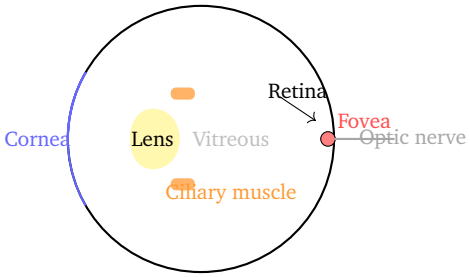
(A) Colour vision

(B) High-acuity daylight vision

(C) Day vision and colour discrimination

(D) Scotopic (dim-light) vision

Q157. Accommodation in the eye (focusing on near objects) involves:



(A) Contraction of ciliary muscles, increasing lens curvature (lens becomes more convex)

(B) Relaxation of ciliary muscles, increasing lens curvature

(C) Pupil constriction only, without lens shape change

(D) Movement of the retina towards the lens

Q158. The cochlea in the ear is responsible for:

(A) Balance and equilibrium

(B) Sound frequency (pitch) detection

(C) Amplifying sound mechanically

(D) Transmitting impulses directly to the cerebellum

Q159. Semicircular canals in the ear detect:

(A) Sound waves

(B) Static pressure changes

(C) Rotational movement (angular acceleration)

(D) Temperature changes

Q160. The fovea centralis in the retina is:

(A) A region with only rod cells

(B) The blind spot (optic disc)

(C) A region with only rod cells for dim vision

(D) The point of highest visual acuity (populated mostly by cone cells)

Q161. Natality refers to:

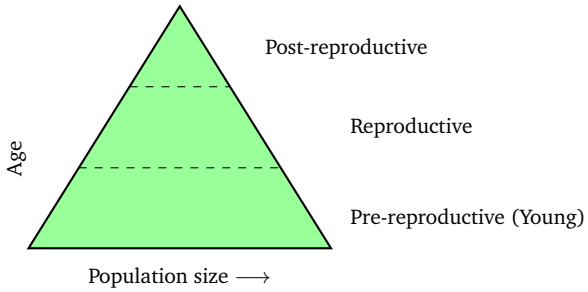
(A) Birth rate in a population

(B) Death rate in a population

(C) Migration rate of a population

(D) Total population size

Q162. A growing (expanding) age pyramid is:



(A) Narrow at the base (few young individuals)

(B) Rectangular (uniform age distribution)

(C) Broad at the base (many young individuals)

(D) Broad at the top (many old individuals)

Q163. The logistic growth equation is:

(A) $dN/dt = rN$

(B) $dN/dt = rN\left(\dfrac{K-N}{K}\right)$

(C) $dN/dt = K - N$

(D) $dN/dt = rK$

Q164. Carrying capacity (K) is the:

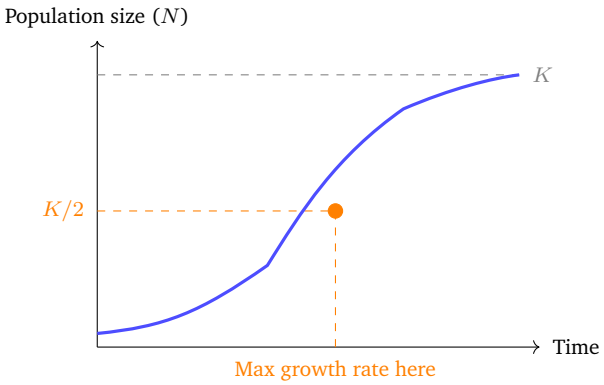
(A) Intrinsic growth rate constant of the population

(B) Maximum birth rate achievable by the population

(C) Maximum possible population size (theoretical)

(D) Maximum population that an environment can sustainably support

Q165. In logistic growth, the population growth rate is maximum when N equals:



(A) 0

(B) K

(C) $K/2$

(D) $2K$

Q166. Eutrophication refers to:

(A) Ozone layer depletion

(B) Nutrient enrichment of water bodies causing excessive algal bloom

(C) Acid rain damage to aquatic ecosystems

(D) Deforestation leading to habitat loss

Q167. Biomagnification means:

(A) The concentration of toxic substances increases at each successive trophic level

(B) Biodiversity increases up the food chain

(C) Producers have the greatest concentration of toxins

(D) Decomposers accumulate the least toxins

Q168. The main cause of ozone layer depletion is:

(A) CO_2 emissions from burning fossil fuels

(B) Methane released from wetlands and livestock

(C) Nitrogen oxides emitted from vehicles

(D) Chlorofluorocarbons (CFCs) from refrigerants and aerosols

Q169. E-waste hazards include release of toxic metals such as:

(A) Carbon and nitrogen

(B) Calcium and magnesium

(C) Lead, mercury, and cadmium

(D) Oxygen and sulphur

Q170. DDT is an example of a persistent organic pollutant because:

(A) It is biodegradable in water within weeks

(B) It is non-biodegradable and accumulates in fat tissue

(C) It only affects plants and not animals

(D) It decomposes quickly under sunlight

Q171. Spermatogenesis occurs in the:

(A) Seminiferous tubules of the testes

(B) Epididymis

(C) Vas deferens

(D) Prostate gland

Q172. Fertilization in humans normally occurs in the:

(A) Uterus

(B) Cervix

(C) Fallopian tube (oviduct)

(D) Ovary

Q173. Implantation of the blastocyst occurs in the:

(A) Fallopian tube
(B) Ovary
(C) Cervix
(D) Uterus (endometrium)

Q174. During oogenesis, meiosis I is completed to form:

(A) A mature (secondary) oocyte ready for fertilization
(B) Secondary oocyte and the first polar body
(C) Primary oocyte only
(D) Oogonium

Q175. The hormone that triggers ovulation is:

(A) LH (luteinizing hormone) surge
(B) FSH alone
(C) Oestrogen alone
(D) Progesterone alone

Q176. Lamarck's theory of evolution is based on:

(A) Natural selection of pre-existing variations
(B) Mutation as the sole driver of evolution
(C) Use and disuse of organs and the inheritance of acquired characters
(D) Genetic drift in small populations

Q177. Darwin's theory of natural selection states that:

(A) Individuals acquire new traits during their lifetime and pass them on to offspring
(B) Mutations alone drive all evolutionary change
(C) All species remain fixed and unchanging
(D) Individuals with favourable variations survive and reproduce more (survival of the fittest)

Q178. Hardy-Weinberg equilibrium states that allele frequencies in a population remain constant if:

(A) No evolution is occurring (no mutation, migration, selection, random mating with large population)

(B) Natural selection is actively operating on the population

(C) Migration occurs freely between populations

(D) Genetic drift is occurring in a small population

Q179. Fossils provide evidence of evolution because:

(A) They are living organisms preserved perfectly

(B) They show remains or impressions of past organisms, indicating changes over geological time

(C) They prove Lamarckian evolution directly

(D) They show that species do not change over time

Q180. Analogous structures (like wings of insects and birds) indicate:

(A) Common ancestry (homology)

(B) Divergent evolution from a common ancestor

(C) Identical genetic makeup

(D) Convergent evolution (similar function evolved independently, different origin)

Part D: General Studies (Q181–Q200)

Q181. Dudhwa National Park is located in:

(A) Uttarakhand

(B) Madhya Pradesh

(C) Uttar Pradesh

(D) Rajasthan

Q182. Project Tiger was launched in India in:

(A) 1973

(B) 1980

(C) 1992

(D) 2000

Q183. Project Elephant was launched in:

(A) 1973

(B) 1985

(C) 2000

(D) 1992

Q184. Kaziranga National Park is famous for:

(A) Bengal tiger

(B) One-horned rhinoceros

(C) Snow leopard

(D) Asiatic lion

Q185. The Snow Leopard conservation programme in India focuses on which region?

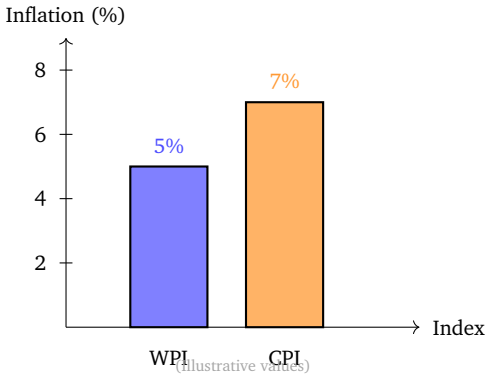
(A) Himalayan region

(B) Western Ghats

(C) Andaman Islands

(D) Sundarbans

Q186. Which method calculates GDP by summing value added at each stage of production?



(A) Income method
(B) Expenditure method
(C) Production (value-added) method
(D) Subsidy method

Q187. The repo rate is the rate at which:

(A) Commercial banks lend to each other overnight
(B) RBI borrows money from commercial banks
(C) SLR (Statutory Liquidity Ratio) is maintained
(D) RBI lends money to commercial banks

Q188. NABARD was established to provide financial support for:

(A) Urban infrastructure development
(B) Agriculture and rural development
(C) Defence procurement and manufacturing
(D) Space research and technology

Q189. Under the PM-KISAN scheme, eligible farmers receive how much financial assistance per year?

(A) Rs. 6,000
(B) Rs. 12,000
(C) Rs. 3,000
(D) Rs. 9,000

Q190. e-NAM is an electronic platform for:

(A) Soil health testing and card distribution
(B) Crop insurance claim processing
(C) Agricultural produce trading (mandi connectivity across states)
(D) Farmer credit and loan disbursement

Q191. PMFBY (Pradhan Mantri Fasal Bima Yojana) is related to:

(A) Fertiliser subsidy distribution
(B) Irrigation scheme implementation
(C) Farm mechanisation support
(D) Crop insurance for farmers

Q192. The largest area in Uttar Pradesh is under which crop?

(A) Rice
(B) Wheat
(C) Sugarcane
(D) Mustard

Q193. Uttar Pradesh is the largest producer in India of:

(A) Sugarcane
(B) Wheat
(C) Cotton
(D) Pulses

Q194. MSP (Minimum Support Price) for crops is announced by:

(A) State governments independently
(B) NABARD
(C) Central Government (based on CACP recommendations)
(D) Mandi samitis at the district level

Q195. Meerut is known as an important centre for which agricultural product?

(A) Tea
(B) Spices
(C) Cotton
(D) Sugarcane and sugar mills

Q196. The Wildlife Protection Act was enacted in:

(A) 1972

(B) 1980

(C) 1986

(D) 1974

Q197. The Forest Conservation Act was passed in:

(A) 1972

(B) 1986

(C) 1980

(D) 1988

Q198. The Environment (Protection) Act was enacted in:

(A) 1972

(B) 1986

(C) 1980

(D) 1990

Q199. CPCB stands for:

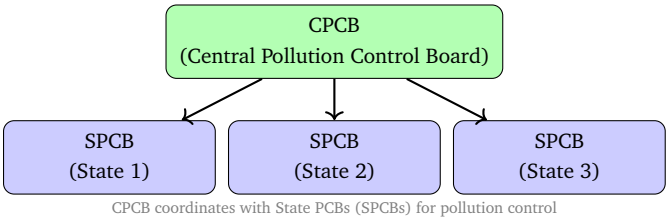
(A) Central Pollution Control Bureau

(B) Central Production Control Board

(C) Central Pesticide Control Board

(D) Central Pollution Control Board

Q200. The National Green Tribunal (NGT) was established under:



CPCB coordinates with State PCBs (SPCBs) for pollution control

(A) National Green Tribunal Act, 2010

(B) Environment (Protection) Act, 1986

(C) Wildlife (Protection) Act, 1972

(D) Forest (Conservation) Act, 1980

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans