UPCATET Complete Sample Paper

– 4

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. The dimensional formula of pressure is:

(A) $[\mathrm{ML^{-1}T^{-2}}]$

(B) $[\mathrm{ML^{2}T^{-2}}]$

(C) $[\mathrm{MLT^{-2}}]$

(D) $[\mathrm{M^{0}L^{-1}T^{-2}}]$

Q2. Which of the following equations is dimensionally homogeneous, where v is velocity, u is initial velocity, a is acceleration, and t is time?

(A) $v = u + at^2$

(B) $v^2 = u^2 + 2at$

(C) $s = ut + \frac{1}{2}at^2$

(D) $v = u + \frac{1}{2}at^2$

Q3. The dimensional formula of surface tension is:

(A) $[\mathrm{MLT}^{-1}]$

(B) $[\mathrm{ML}^{-1}\mathrm{T}^{-2}]$

(C) $[\mathrm{MT}^{-2}]$

(D) $[\mathrm{M}^{0}\mathrm{LT}^{-2}]$

Q4. The dimensional formula of viscosity η in Stokes' law $F = 6\pi\eta r v$ is:

(A) $[\mathrm{M}^{0}\mathrm{L}^{-1}\mathrm{T}^{-1}]$

(B) $[\mathrm{ML}^{-1}\mathrm{T}^{0}]$

(C) $[\mathrm{M}^{2}\mathrm{L}^{-1}\mathrm{T}^{-2}]$

(D) $[\mathrm{ML}^{-1}\mathrm{T}^{-1}]$

Q5. The result of $6.324 + 0.05 + 4.3$ rounded to appropriate significant figures is:

(A) 10.7

(B) 10.67

(C) 10.674

(D) 11

Q6. If $Z = A \times B$ and the percentage errors in A and B are 2% and 3% respectively, the percentage error in Z is:

(A) 1%

(B) 5%

(C) 6%

(D) 2.5%

Q7. A person of mass 60 kg stands in a lift accelerating upward at 2 m/s^2. Taking $g = 10$ m/s^2, the apparent weight (normal reaction) is:

(A) 480 N

(B) 600 N

(C) 720 N

(D) 540 N

Q8. A man of mass 70 kg is in a lift decelerating downward at 3 m/s^2 (i.e. decelerating while going down). Taking $g = 10$ m/s^2, his apparent weight is:

(A) 490 N

(B) 490 N

(C) 630 N

(D) 910 N

Q9. A ball is placed on the floor of a car accelerating forward at 5 m/s^2. In the reference frame of the car, the ball appears to experience a pseudo-force of (mass of ball $= 2$ kg):

(A) 10 N backward

(B) 10 N forward

(C) 5 N backward

(D) 5 N forward

Q10. A car moves on a banked road of radius $r = 100$ m banked at angle $\theta = 30$. Taking $g = 10$ m/s^2 and $\tan 30 \approx 0.577$, the optimal speed (no friction) is approximately:

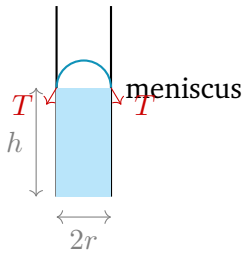
(A) 20 m/s

(B) 24 m/s

(C) 28 m/s

(D) 30 m/s

Q11. A capillary tube of radius r is dipped in a liquid of surface tension T, density ρ, and contact angle θ. The diagram shows the capillary rise:



The capillary rise h is given by:

(A) $\dfrac{2T\cos\theta}{\rho g r}$

(B) $\dfrac{T\cos\theta}{\rho g r}$

(C) $\dfrac{2T}{\rho g r\cos\theta}$

(D) $\dfrac{T}{\rho g r}$

Q12. A soap bubble of radius r has surface tension T. The excess pressure inside the bubble compared to outside is:

(A) $\dfrac{T}{r}$

(B) $\dfrac{2T}{r}$

(C) $\dfrac{4T}{r}$

(D) $\dfrac{8T}{r}$

Q13. The excess pressure inside a liquid drop of radius r and surface tension T is:

(A) $\dfrac{4T}{r}$

(B) $\frac{T}{r}$

(C) $\frac{8T}{r}$

(D) $\frac{2T}{r}$

Q14. Mercury shows capillary depression in a glass tube because:

(A) The angle of contact of mercury with glass is obtuse (> 90)

(B) Mercury has low surface tension

(C) The angle of contact of mercury with glass is acute

(D) Mercury has high density

Q15. For a liquid that wets the surface of a solid (like water on glass), the angle of contact θ satisfies:

(A) $\theta = 90$

(B) $\theta < 90$

(C) $\theta > 90$

(D) $\theta = 180$

Q16. A particle in SHM has displacement $x = 4\sin\left(2\pi t + \frac{\pi}{6}\right)$ cm. The initial phase (epoch) is:

(A) 0

(B) 2π

(C) $\frac{\pi}{6}$

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

Q17. A particle of mass m executes SHM with amplitude A and angular frequency ω. Its total mechanical energy is:

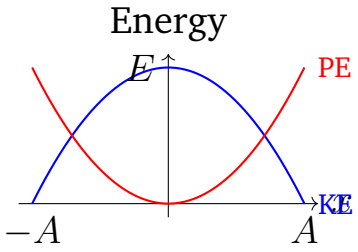
(A) $\frac{1}{2}m\omega A$

(B) $m\omega^2 A$

(C) $\frac{1}{4}m\omega^2A^2$

(D) $\frac{1}{2}m\omega^2A^2$

Q18. In SHM, the graph of kinetic energy (KE) and potential energy (PE) vs displacement x is shown below:



At the equilibrium position ($x = 0$), which statement is correct?

(A) KE is maximum and PE is zero

(B) KE is zero and PE is maximum

(C) Both KE and PE are equal

(D) Both KE and PE are zero

Q19. In a damped oscillation, the amplitude:

(A) Increases exponentially with time

(B) Decreases exponentially with time

(C) Remains constant

(D) Oscillates about a mean value

Q20. In forced oscillations, resonance occurs when the frequency of the applied force equals the:

(A) Half the natural frequency of the system

(B) Twice the natural frequency of the system

(C) Natural frequency of the system

(D) Square root of the natural frequency of the system

Q21. A block of mass m attached to a spring of spring constant k has time period:

(A) $T = 2\pi\sqrt{\frac{k}{m}}$

(B) $T = \pi\sqrt{\frac{m}{k}}$

(C) $T = \frac{1}{2\pi}\sqrt{\frac{m}{k}}$

(D) $T = 2\pi\sqrt{\frac{m}{k}}$

Q22. The rms speed of gas molecules of molar mass M at temperature T (absolute) is given by:

(A) $v_{rms} = \sqrt{\frac{3RT}{M}}$

(B) $v_{rms} = \sqrt{\frac{2RT}{M}}$

(C) $v_{rms} = \sqrt{\frac{RT}{M}}$

(D) $v_{rms} = \sqrt{\frac{8RT}{\pi M}}$

Q23. The most probable speed v_p of gas molecules of molar mass M at temperature T is:

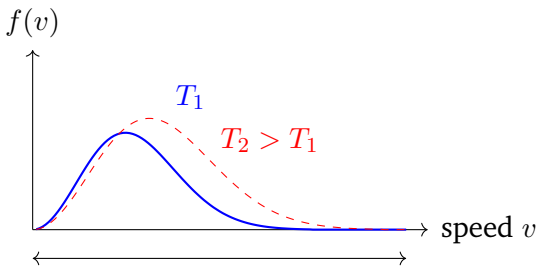
(A) $\sqrt{\frac{3RT}{M}}$

(B) $\sqrt{\frac{2RT}{M}}$

(C) $\sqrt{\frac{8RT}{\pi M}}$

(D) $\sqrt{\frac{RT}{M}}$

Q24. The Maxwell speed distribution curve for an ideal gas is shown below. If the temperature is increased, what happens to the curve?



Which statement about the dashed (T_2) curve is correct?

(A) Peak moves left and becomes taller

(B) Peak remains at same position, area increases

(C) Peak moves right, becomes lower, and area remains same

(D) Peak moves right and area decreases

Q25. The number of degrees of freedom for a diatomic gas molecule at moderate temperatures is:

(A) 3

(B) 4

(C) 6

(D) 5

Q26. According to the law of equipartition of energy, the average energy per degree of freedom for a gas molecule at temperature T is:

(A) $\frac{1}{2}k_BT$

(B) k_BT

(C) $\frac{3}{2}k_BT$

(D) $\frac{1}{2}RT$

Q27. The mean (average) speed of gas molecules of molar mass M at temperature T is:

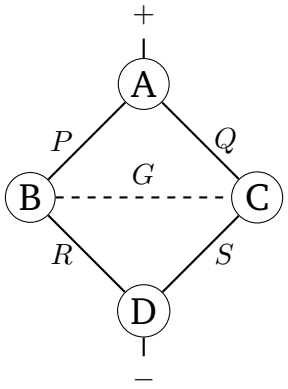
(A) $\sqrt{\frac{3RT}{M}}$

(B) $\sqrt{\frac{8RT}{\pi M}}$

(C) $\sqrt{\frac{2RT}{M}}$

(D) $\frac{RT}{M}$

Q28. The Wheatstone bridge circuit is shown below. The bridge is balanced when:



(A) $P \cdot S = Q \cdot R$

(B) $P + Q = R + S$

(C) $\frac{P}{Q} = \frac{R}{S}$

(D) $P \cdot Q = R \cdot S$

Q29. A cell of EMF E and internal resistance r delivers current I to an external circuit. The terminal voltage across the cell is:

(A) $E + Ir$

(B) $E \cdot r$

(C) $\frac{E}{r}$

(D) $E - Ir$

Q30. In a potentiometer experiment to compare EMFs E_1 and E_2 of two cells, the null-point lengths are l_1 and l_2 respectively. Then:

(A) $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

(B) $\frac{E_1}{E_2} = \frac{l_2}{l_1}$

(C) $E_1 \cdot E_2 = l_1 \cdot l_2$

(D) $E_1 + E_2 = l_1 + l_2$

Q31. In a potentiometer, the balancing length with a cell in open circuit is L_0 and with external resistance R connected is L. The internal resistance r of the cell is:

(A) $r = R \cdot \frac{L}{L_0}$

(B) $r = R\left(\frac{L_0 - L}{L}\right)$

(C) $r = R\left(\frac{L}{L_0 - L}\right)$

(D) $r = \frac{L_0}{R \cdot L}$

Q32. According to Kirchhoff's Voltage Law (KVL), the algebraic sum of all voltages in a closed loop is:

(A) Equal to the EMF of the source

(B) Maximum

(C) Zero

(D) Equal to the total resistance

Q33. A parallel plate capacitor has capacitance C_0 in vacuum. When a dielectric slab of dielectric constant K is inserted between the plates, the new capacitance becomes:

(A) C_0/K

(B) $C_0\sqrt{K}$

(C) $C_0 + K$

(D) KC_0

Q34. The energy density (energy stored per unit volume) in an electric field E in a medium of permittivity ε_0 is:

(A) $\frac{1}{2}\varepsilon_0 E^2$

(B) $\varepsilon_0 E^2$

(C) $\frac{1}{2\varepsilon_0} E^2$

(D) $\varepsilon_0 E$

Q35. The electric field inside a charged conductor in electrostatic equilibrium is:

(A) Maximum at the centre

(B) Zero everywhere inside

(C) Equal to the surface charge density

(D) Non-zero but uniform

Q36. In a Van de Graaff generator, charge is transferred to the metallic sphere using a moving belt. The charge accumulates on the:

(A) Inner surface of the sphere

(B) Belt surface

(C) Outer surface of the sphere

(D) Insulating column

Q37. The dielectric constant (relative permittivity) K of a material is defined as:

(A) $K = \frac{\varepsilon_0}{\varepsilon}$

(B) $K = \varepsilon_0 \varepsilon$

(C) $K = \varepsilon - \varepsilon_0$

(D) $K = \frac{\varepsilon}{\varepsilon_0}$

Q38. In single slit diffraction, the condition for the first minimum on either side of the central maximum (slit width a, wavelength λ) is:

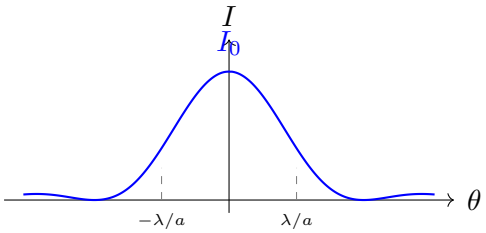
(A) $a \sin\theta = \lambda$

(B) $a \sin\theta = \lambda/2$

(C) $a \sin\theta = 3\lambda/2$

(D) $a \sin\theta = 2\lambda$

Q39. The single slit diffraction intensity pattern is shown below. Which feature correctly identifies the central maximum?



(A) The central maximum has the same width as secondary maxima

(B) The central maximum is the tallest and widest peak

(C) Secondary maxima are taller than the central maximum

(D) The central maximum has zero intensity

Q40. Plane-polarised light of intensity I_0 passes through a polaroid (analyser) whose transmission axis makes angle θ with the polarisation direction. The transmitted intensity is:

(A) $I_0 \sin^2\theta$

(B) $I_0 \sin\theta \cos\theta$

(C) $I_0 \cos^2\theta$

(D) $I_0/2$

Q41. Brewster's angle θ_B for a medium of refractive index μ satisfies:

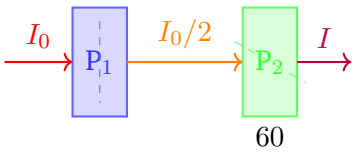
(A) $\sin\theta_B = \mu$

(B) $\cos\theta_B = \mu$

(C) $\cot\theta_B = \mu$

(D) $\tan\theta_B = \mu$

Q42. The diagram below shows two polaroids P_1 and P_2. If the angle between their transmission axes is 60 and incident intensity is I_0, the transmitted intensity through both is:



(A) $I_0/8$

(B) $I_0/4$

(C) $I_0/2$

(D) $3I_0/8$

Q43. Which of the following lists the electromagnetic spectrum in *increasing* order of frequency?

(A) Gamma $\rightarrow$ X-ray $\rightarrow$ UV $\rightarrow$ Visible $\rightarrow$ IR $\rightarrow$ Microwave $\rightarrow$ Radio

(B) Radio $\rightarrow$ Microwave $\rightarrow$ IR $\rightarrow$ Visible $\rightarrow$ UV $\rightarrow$ X-ray $\rightarrow$ Gamma

(C) IR $\rightarrow$ UV $\rightarrow$ X-ray $\rightarrow$ Visible $\rightarrow$ Microwave $\rightarrow$ Radio $\rightarrow$ Gamma

(D) Visible $\rightarrow$ IR $\rightarrow$ Radio $\rightarrow$ Microwave $\rightarrow$ UV $\rightarrow$ X-ray $\rightarrow$ Gamma

Q44. The speed of electromagnetic waves in vacuum is given by $c = 1/\sqrt{\mu_0\varepsilon_0}$. Taking $\mu_0 = 4\pi \times 10^{-7}$ T·m/A and $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N{\cdot}m^2$, the approximate value of c is:

(A) 3×10^5 m/s

(B) 3×10^4 m/s

(C) 3×10^8 m/s

(D) 3×10^6 m/s

Q45. If the speed of light in a medium is v, then the refractive index μ of the medium with respect to vacuum (speed c) is:

(A) $\mu = v/c$

(B) $\mu = c + v$

(C) $\mu = c - v$

(D) $\mu = c/v$

Q46. X-rays are used in medicine for imaging bones because they:

(A) Penetrate soft tissue but are absorbed by denser bone

(B) Have wavelengths in the visible range

(C) Are reflected by soft tissues

(D) Travel slower than visible light

Q47. Infrared radiation is used in:

(A) Sterilising medical instruments

(B) Remote controls and thermal imaging

(C) Cancer treatment

(D) Fluorescent lighting

Q48. In a nuclear reaction, the Q-value is calculated from the mass defect Δm (in atomic mass units) using:

(A) $Q = \Delta m \times 9 \times 10^{16}$ J

(B) $Q = \Delta m \times 931.5$ J

(C) $Q = \Delta m \times 931.5$ MeV

(D) $Q = \Delta m \times c^2$ in joules only

Q49. The approximate energy released in the fission of a single $^{235}_{92}$U nucleus is:

(A) 2 MeV

(B) 20 MeV

(C) 2000 MeV

(D) 200 MeV

Q50. Nuclear fusion is energetically favourable for light nuclei and requires extremely high temperatures of about:

(A) 10^7–10^8 K

(B) 10^3 K

(C) 10^5 K

(D) 300 K

Part B: Chemistry (Q51–Q100)

Q51. In alpha decay, the parent nucleus ${}^{A}_{Z}X$ emits an alpha particle ${}^{4}_{2}\text{He}$. The daughter nucleus has:

(A) $Z+2$ protons and $A+4$ nucleons

(B) $Z-2$ protons and $A-4$ nucleons

(C) $Z+1$ protons and A nucleons

(D) $Z-1$ protons and A nucleons

Q52. In beta-minus (β^-) decay, a neutron converts to a proton and emits an electron (and antineutrino). As a result, the atomic number Z:

(A) Decreases by 1, mass number decreases by 1

(B) Remains the same, mass number decreases by 1

(C) Increases by 1, mass number remains the same

(D) Decreases by 2, mass number decreases by 4

Q53. Gamma radiation is emitted when:

(A) A proton converts to a neutron

(B) A neutron converts to a proton

(C) An alpha particle is emitted

(D) An excited nucleus transitions to a lower energy state

Q54. The Uranium-238 radioactive decay series ultimately ends in the stable isotope:

(A) $^{206}_{82}$Pb

(B) $^{208}_{82}$Pb

(C) $^{207}_{82}$Pb

(D) $^{204}_{82}$Pb

Q55. A radioactive element has a half-life of 20 days. After 60 days, the fraction of the original sample remaining is:

(A) $1/4$

(B) $1/8$

(C) $1/16$

(D) $1/2$

Q56. The Nernst equation for an electrochemical cell at temperature T is:

(A) $E = E^\circ + \dfrac{RT}{nF} \ln Q$

(B) $E = E^\circ + \dfrac{nF}{RT} \ln Q$

(C) $E = E^\circ - \dfrac{RT}{nF} \ln Q$

(D) $E = E^\circ \times \dfrac{nF}{RT}$

Q57. During the electrolysis of dilute sulphuric acid (H_2SO_4) solution using inert electrodes:

(A) O_2 is produced at cathode, H_2 at anode

(B) H_2 is produced at both electrodes

(C) O_2 is produced at both electrodes

(D) H_2 is produced at cathode, O_2 at anode

Q58. A concentration cell consists of two electrodes of the same metal dipped in solutions of the same electrolyte at different concentrations C_1 and C_2 ($C_1 > C_2$). The EMF of the cell arises from:

(A) The difference in concentration of the electrolyte solutions

(B) The difference in electrode materials

(C) Different temperatures of the two half-cells

(D) Different volumes of the solutions

Q59. Faraday's second law of electrolysis states that the masses of different substances deposited by the same quantity of electricity are proportional to their:

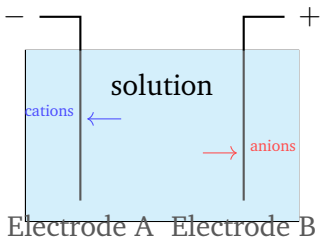
(A) Atomic masses

(B) Equivalent masses (atomic mass / valency)

(C) Molecular masses

(D) Densities

Q60. In the electrolysis diagram below, which electrode is the cathode and what reaction occurs there?



(A) Electrode B (positive terminal); oxidation occurs

(B) Electrode A (negative terminal); oxidation occurs

(C) Electrode A (negative terminal); reduction occurs

(D) Electrode B (positive terminal); reduction occurs

Q61. Which of the following correctly distinguishes physisorption from chemisorption?

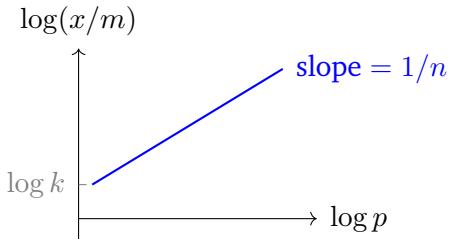
(A) Physisorption is irreversible; chemisorption is reversible

(B) Physisorption involves covalent bond formation

(C) Chemisorption decreases with temperature

(D) Physisorption is reversible and weak (van der Waals); chemisorption involves covalent bonds and is stronger

Q62. The Freundlich adsorption isotherm is expressed as $x/m = kp^{1/n}$. The linear form (graph of $\log(x/m)$ vs $\log p$) is:



(A) A straight line with slope $1/n$ and intercept $\log k$

(B) A straight line with slope n and intercept $\log k$

(C) A curve (not linear)

(D) A straight line passing through the origin

Q63. The Tyndall effect is observed in colloidal solutions because colloidal particles:

(A) Absorb all wavelengths of light

(B) Scatter light due to their intermediate particle size

(C) Transmit all light without scattering

(D) Reflect light like a mirror

Q64. According to the Hardy-Schulze rule, the coagulating power of ions for a negatively charged colloid follows the order:

(A) $Na^{+} > Ca^{2+} > Al^{3+}$

(B) $Al^{3+} < Ca^{2+} < Na^{+}$

(C) $Ca^{2+} > Al^{3+} > Na^{+}$

(D) $Al^{3+} > Ca^{2+} > Na^{+}$

Q65. Lyophilic colloids (e.g., starch, gelatin) differ from lyophobic colloids (e.g., gold sol, sulphur sol) in that lyophilic colloids:

(A) Are easily coagulated by small amounts of electrolytes

(B) Do not show the Tyndall effect

(C) Cannot be re-dispersed once coagulated

(D) Are more stable and require larger amounts of electrolytes to coagulate

Q66. Lanthanide contraction refers to the gradual decrease in atomic and ionic radii across the lanthanide series (Ce to Lu). The primary cause is:

(A) Poor shielding of nuclear charge by 4f electrons

(B) Increase in nuclear charge with complete shielding by 4f electrons

(C) Decrease in the number of protons

(D) Increase in the number of neutrons

Q67. The lanthanide series consists of 14 elements from Cerium (Ce) to Lutetium (Lu). During this series, the subshell being filled is:

(A) $5f$

(B) $4f$

(C) $3d$

(D) $4d$

Q68. The actinide series (Th to Lr) involves filling of the:

(A) $4f$ subshell

(B) $3d$ subshell

(C) $5f$ subshell

(D) $6d$ subshell

Q69. Rare earth metals (lanthanides) are used in all of the following EXCEPT:

(A) Strong permanent magnets (e.g., Nd in NdFeB magnets)

(B) Phosphors in TV screens and LED lights

(C) Catalysts in petroleum cracking (lanthanum)

(D) As major structural materials in construction (like steel or aluminium)

Q70. The most common oxidation state of lanthanides is $+3$. The stability of this state is due to:

(A) The formation of a stable $[Xe]4f^n$ configuration after losing 3 electrons

(B) The large ionic radius of lanthanides

(C) The high electronegativity of lanthanides

(D) The presence of unpaired electrons in the 5d subshell

Q71. In the free radical chlorination of methane (CH_4) with Cl_2 under UV light, the propagation step involves:

(A) $Cl_2 \rightarrow 2\ Cl^\bullet$ (homolysis by UV)

(B) $Cl^\bullet + CH_4 \rightarrow HCl + CH_3^\bullet$, then $CH_3^\bullet + Cl_2 \rightarrow CH_3Cl + Cl^\bullet$

(C) $CH_4 \rightarrow CH_3^+ + H^-$ (heterolysis)

(D) $Cl^\bullet + Cl^\bullet \rightarrow Cl_2$ (termination)

Q72. In the electrophilic addition of Br_2 to an alkene, the intermediate formed is a:

(A) Carbanion

(B) Carbocation (open chain)

(C) Cyclic bromonium ion

(D) Free radical

Q73. Which of the following substrates preferentially undergoes SN1 reaction over SN2?

(A) CH_3Br (methyl bromide)

(B) CH_3CH_2Br (primary)

(C) $(CH_3)_2CHBr$ (secondary)

(D) $(CH_3)_3CBr$ (tertiary)

Q74. When a tertiary alkyl halide is treated with a strong base at high temperature, the preferred reaction is:

(A) Elimination (E2) to give alkene

(B) SN2 substitution

(C) SN1 substitution at low temperature

(D) Radical substitution

Q75. A carbon atom is chiral (a stereocentre) when it is bonded to:

(A) Four identical groups

(B) Four different groups

(C) Two identical and two different groups

(D) Three identical groups and one different group

Q76. Enantiomers are stereoisomers that are:

(A) Identical in all physical and chemical properties

(B) Superimposable mirror images

(C) Non-superimposable mirror images with opposite optical rotation

(D) Non-mirror images with different physical properties

Q77. A meso compound is optically inactive because it contains:

(A) No stereocentres

(B) An odd number of stereocentres

(C) A chiral axis

(D) An internal plane of symmetry despite having stereocentres

Q78. In CIP (R/S) nomenclature, priorities are assigned based on:

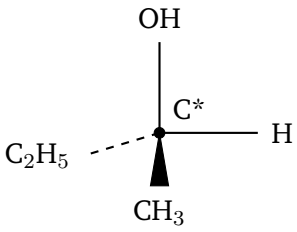
(A) Atomic number (higher atomic number = higher priority)

(B) Alphabetical order of element symbols

(C) Molecular mass of the groups

(D) Number of hydrogen atoms attached

Q79. The diagram below shows a tetrahedral carbon with four different groups. The wedge bond represents:



(A) A bond going into the plane of the paper (behind)

(B) A bond coming out of the plane of the paper (towards viewer)

(C) A bond in the plane of the paper

(D) A double bond

Q80. Diastereomers differ from enantiomers in that diastereomers:

(A) Are non-superimposable mirror images

(B) Have identical physical properties

(C) Are stereoisomers that are NOT mirror images of each other, with different physical properties

(D) Rotate plane-polarised light by equal and opposite angles

Q81. Which of the following is a *non-reducing* sugar?

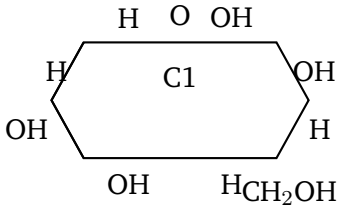
(A) Glucose

(B) Fructose

(C) Maltose

(D) Sucrose

Q82. In the Haworth projection of α-D-glucose, the OH group at C-1 (anomeric carbon) is:



(A) Below the ring plane (axial, α configuration)

(B) Above the ring plane

(C) In the ring plane

(D) Absent (no OH at C-1)

Q83. Mutarotation of glucose refers to the:

(A) Change in colour of glucose solution on standing

(B) Change in optical rotation of glucose solution due to interconversion of α and β anomers

(C) Formation of glucose from starch

(D) Decomposition of glucose at high temperature

Q84. Tollens' reagent (ammoniacal silver nitrate) gives a silver mirror with:

(A) Sucrose only

(B) Starch only

(C) Glucose (a reducing sugar)

(D) Cellulose

Q85. D-Glucose belongs to the D-series because the OH group on the:

(A) C-2 carbon is on the right in Fischer projection

(B) C-1 (anomeric) carbon is on the right

(C) Highest numbered asymmetric carbon (C-5) is on the left in Fischer projection

(D) Highest numbered asymmetric carbon (C-5) is on the right in Fischer projection

Q86. Aldol condensation occurs between two molecules of an aldehyde (or ketone) having α-hydrogen atoms in the presence of dilute NaOH. The product first formed is a:

(A) β-hydroxy aldehyde (aldol)

(B) α-hydroxy aldehyde

(C) Carboxylic acid

(D) Ketone

Q87. In the Wolff-Kishner reduction, a carbonyl compound (ketone or aldehyde) is converted to the corresponding alkane using:

(A) Zn-Hg amalgam / HCl

(B) N_2H_4 / KOH, heat (ethylene glycol)

(C) $LiAlH_4$

(D) H_2 / Pd-C

Q88. The Clemmensen reduction converts a ketone (C=O) to a $-CH_2-$ group using:

(A) N_2H_4 / KOH

(B) H_2 / Raney Ni

(C) Zn-Hg amalgam / concentrated HCl

(D) $LiAlH_4$ / ether

Q89. The Reimer-Tiemann reaction converts phenol to salicylaldehyde (2-hydroxybenza by treatment with $CHCl_3$ in alkaline conditions. The electrophile involved is:

(A) Cl_2

(B) $HCCl_3$

(C) CHO^-

(D) Dichlorocarbene ($:CCl_2$)

Q90. Claisen condensation occurs between two molecules of an ester (with α-H) in the presence of a strong base (e.g., NaOEt), giving a:

(A) β-keto ester

(B) α-hydroxy ester

(C) Dicarboxylic acid

(D) Alcohol

Q91. Froth flotation is used to concentrate ores of:

(A) Oxide ores (like haematite)

(B) Sulphide ores (like copper pyrite, zinc blende)

(C) Carbonate ores

(D) Halide ores

Q92. Roasting of a sulphide ore in air converts it into:

(A) A carbonate

(B) A halide

(C) An oxide and SO_2 gas

(D) A sulphate only

Q93. Zone refining is used to obtain ultra-pure metals. It works because:

(A) Impurities have higher melting points than the metal

(B) The metal is dissolved in acid and re-deposited

(C) Impurities are removed by oxidation

(D) Impurities concentrate in the molten zone which is moved along the metal rod

Q94. In electrolytic refining of copper, the impure copper is made the:

(A) Anode; pure copper deposits at cathode

(B) Cathode; impurities settle as anode mud

(C) Cathode; copper dissolves into solution

(D) Anode; copper settles as anode mud

Q95. Aluminium is extracted from its ore (bauxite, Al_2O_3) by:

(A) Carbon reduction (smelting with coke)

(B) Electrolytic reduction (Hall-Héroult process)

(C) Reduction with hydrogen

(D) Reduction with CO

Q96. Aspirin (acetylsalicylic acid) acts as an analgesic by:

(A) Blocking dopamine receptors in the brain

(B) Acting as an antibiotic

(C) Inhibiting the synthesis of prostaglandins (anti-inflammatory)

(D) Raising body temperature

Q97. Penicillin, a widely used antibiotic, belongs to the class of β-lactam antibiotics. It acts by:

(A) Inhibiting protein synthesis in bacteria

(B) Disrupting bacterial cell membrane

(C) Inhibiting DNA replication in bacteria

(D) Inhibiting bacterial cell wall synthesis

Q98. Milk of magnesia ($Mg(OH)_2$) is used as an antacid because it:

(A) Neutralises excess HCl in the stomach

(B) Increases acid secretion in the stomach

(C) Acts as an antibiotic

(D) Inhibits enzyme activity in the gut

Q99. Synthetic detergents (unlike soaps) work effectively in hard water because they:

(A) React with Ca^{2+}/Mg^{2+} to form soluble salts

(B) Do not form insoluble scum with Ca^{2+}/Mg^{2+} ions

(C) Contain fatty acid salts

(D) Have shorter hydrocarbon chains

Q100. Paracetamol (acetaminophen) is primarily classified as:

(A) An antibiotic

(B) An antacid

(C) An antipyretic and mild analgesic

(D) An antihistamine

Part C: Biology (Q101–Q180)

Q101. Which model of enzyme-substrate interaction proposes that the enzyme active site changes its shape to accommodate the substrate upon binding?

(A) Lock-and-key model (Fischer)

(B) Transition state model

(C) Allosteric model

(D) Induced fit model (Koshland)

Q102. The Michaelis-Menten equation describes the relationship between reaction velocity v and substrate concentration [S]. The velocity at half-maximal rate ($v = V_{max}/2$) occurs when [S] equals:

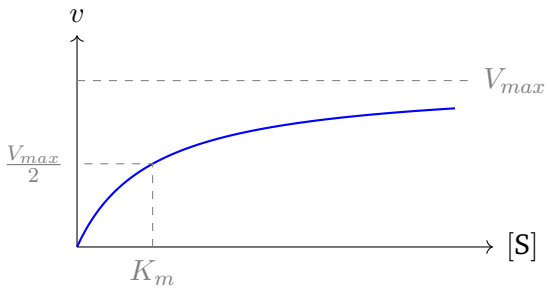
(A) K_m (Michaelis constant)

(B) $2K_m$

(C) V_{max}

(D) $K_m/2$

Q103. The Michaelis-Menten saturation curve (velocity v vs substrate concentration [S]) is shown below. What does the plateau region represent?



(A) The substrate concentration is zero

(B) All enzyme active sites are saturated with substrate (V_{max})

(C) The enzyme is inhibited

(D) The enzyme is denatured

Q104. In competitive inhibition, the inhibitor:

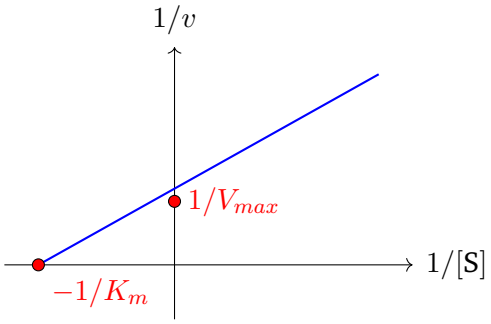
(A) Binds to an allosteric site and decreases V_{max}

(B) Binds covalently to the active site irreversibly

(C) Competes with the substrate for the active site; K_m increases but V_{max} is unchanged

(D) Increases K_m and decreases V_{max}

Q105. In the Lineweaver-Burk (double-reciprocal) plot ($1/v$ vs $1/[S]$), the y-intercept gives:



(A) $-K_m$

(B) K_m

(C) V_{max}

(D) $1/V_{max}$

Q106. When a G-protein coupled receptor (GPCR) is activated by a ligand, the α-subunit of the G-protein:

(A) Activates adenylyl cyclase, increasing cAMP levels

(B) Directly opens ion channels in the nucleus

(C) Inhibits RNA polymerase

(D) Activates the ribosome

Q107. Which of the following is NOT a second messenger in cell signalling?

(A) cAMP

(B) ATP (as energy currency in the cytoplasm)

(C) Ca^{2+} ions

(D) IP_3 (inositol trisphosphate)

Q108. Receptor tyrosine kinases (RTKs) transmit signals by:

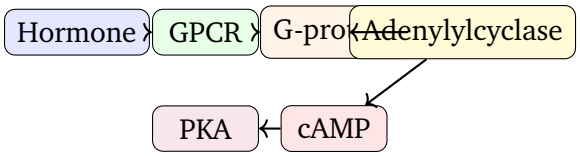
(A) Activating cAMP via adenylyl cyclase

(B) Directly opening Na^+ channels

(C) Autophosphorylation of tyrosine residues upon ligand binding

(D) Cleaving GTP to GDP

Q109. The signal transduction diagram shows: Hormone → GPCR → G-protein → Adenylyl cyclase → cAMP → PKA → Target protein. cAMP activates PKA by:



(A) Phosphorylating the regulatory subunit of PKA

(B) Dephosphorylating PKA

(C) Binding to the catalytic subunit directly

(D) Dissociating PKA catalytic subunits from inhibitory regulatory subunits

Q110. Diacylglycerol (DAG) generated during phospholipid signalling acts as a second messenger by:

(A) Activating Protein Kinase C (PKC) at the plasma membrane

(B) Stimulating adenylyl cyclase

(C) Opening Ca^{2+} channels in the ER

(D) Inhibiting phospholipase C

Q111. A transition mutation involves the substitution of:

(A) A purine for a pyrimidine (or vice versa)

(B) A purine for a purine, or a pyrimidine for a pyrimidine

(C) Insertion of one or more nucleotides

(D) Deletion of one or more nucleotides

Q112. Ultraviolet (UV) radiation primarily induces mutations by:

(A) Causing double-strand breaks in DNA

(B) Alkylating guanine residues

(C) Forming covalent thymine dimers between adjacent thymine bases

(D) Intercalating between base pairs

Q113. A frameshift mutation occurs when:

(A) A single base is substituted by another

(B) The entire chromosome is duplicated

(C) A segment of DNA is inverted

(D) One or more nucleotides are inserted or deleted (not in multiples of 3)

Q114. In nucleotide excision repair (NER), the damaged section of DNA is:

(A) Excised as an oligonucleotide, then repaired using the complementary strand as template

(B) Directly reversed (photoreactivation)

(C) Repaired by mismatch recognition proteins only

(D) Left unrepaired until the next replication cycle

Q115. Mismatch repair (MMR) corrects errors introduced by:

(A) UV radiation-induced thymine dimers

(B) DNA polymerase that escaped proofreading during replication

(C) Chemical mutagens that alkylate bases

(D) Spontaneous depurination

Q116. In the Polymerase Chain Reaction (PCR), the denaturation step (typically at 94C) is followed by:

(A) Extension by Taq polymerase at 72C

(B) Loading onto gel electrophoresis

(C) Primer annealing at a lower temperature (50–65C)

(D) Addition of restriction enzymes

Q117. Match the blotting technique with the molecule it detects:

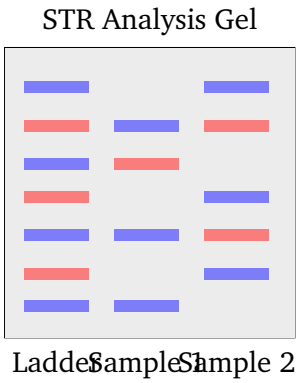
(A) Southern blot: RNA; Northern blot: DNA

(B) Western blot: DNA; Southern blot: Protein

(C) Northern blot: Protein; Western blot: RNA

(D) Southern blot: DNA; Northern blot: RNA; Western blot: Protein

Q118. DNA fingerprinting (used in forensics) is based on the analysis of:



(A) Short Tandem Repeats (STRs) — repetitive sequences that vary between individuals

(B) Single nucleotide polymorphisms in the coding region only

(C) The entire DNA sequence of an individual

(D) Restriction enzyme cut sites only

Q119. FISH (Fluorescence In Situ Hybridisation) is used to:

(A) Sequence an entire genome

(B) Visualise specific DNA sequences on chromosomes using fluorescent probes

(C) Amplify a specific DNA region

(D) Separate proteins by size

Q120. Taq polymerase is used in PCR because it:

(A) Has proofreading activity superior to all other polymerases

(B) Works at very low temperatures (4C)

(C) Is thermostable and remains active at the high temperatures used for denaturation

(D) Can amplify RNA directly

Q121. In the Gram staining procedure, Gram-positive bacteria retain the crystal violet stain because they have:

(A) A thin peptidoglycan layer and an outer membrane

(B) An outer membrane that traps the stain

(C) A lipopolysaccharide (LPS) layer

(D) A thick peptidoglycan cell wall without an outer membrane

Q122. Gram-negative bacteria (e.g. *E. coli*, *Salmonella*) appear pink/red after Gram staining because they:

(A) Lose crystal violet during decolourisation (thin PG + outer membrane) and take up safranin

(B) Have a very thick peptidoglycan layer

(C) Lack a cell wall entirely

(D) Have additional proteins that bind crystal violet permanently

Q123. Endospores are produced by certain bacteria (e.g. *Bacillus subtilis*) as a survival mechanism. Endospores are notable for their:

(A) Rapid growth rate at high temperatures

(B) Extreme resistance to heat, desiccation, and chemicals

(C) High metabolic activity

(D) Ability to perform photosynthesis

Q124. Under optimal conditions, *E. coli* divides by binary fission with a doubling time of about 20 minutes. Starting from 100 cells, how many cells are present after 1 hour?

(A) 200

(B) 400

(C) 800

(D) 1000

Q125. Which of the following is a mechanism by which bacteria become resistant to antibiotics?

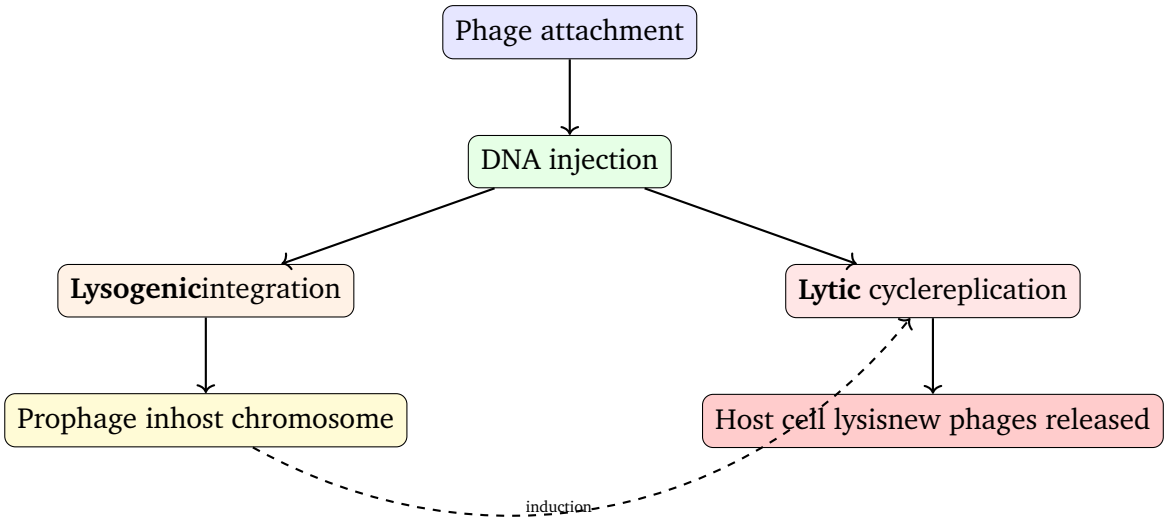
(A) Bacteria evolve to produce antigens against the antibiotic

(B) Bacteria spontaneously change into a eukaryotic cell type

(C) Bacteria increase their photosynthesis rate

(D) Bacteria produce enzymes (e.g. β-lactamase) that inactivate the antibiotic

Q126. In the lysogenic cycle of a bacteriophage, the phage DNA:



(A) Integrates into the host chromosome as a prophage and replicates with the host

(B) Immediately causes lysis of the host cell

(C) Is degraded by host restriction enzymes

(D) Remains as a separate circular plasmid in the cytoplasm permanently

Q127. HIV is classified as a retrovirus because it:

(A) Has double-stranded DNA as its genetic material

(B) Uses reverse transcriptase to convert its RNA genome into DNA inside the host cell

(C) Infects plant cells

(D) Replicates exclusively in the nucleus without reverse transcription

Q128. The protein coat surrounding a virus's genetic material is called the:

(A) Envelope

(B) Nucleoid

(C) Capsid

(D) Cell wall

Q129. Prions are infectious agents responsible for diseases such as BSE (mad cow disease) and CJD (Creutzfeldt-Jakob disease). They consist of:

(A) Double-stranded RNA

(B) DNA wrapped in a protein coat

(C) Naked RNA without capsid

(D) Misfolded proteins (PrP^{Sc}) with no nucleic acid

Q130. The correct sequence of events in the lytic cycle of a bacteriophage is:

(A) Attachment $\rightarrow$ Injection $\rightarrow$ Synthesis $\rightarrow$ Assembly $\rightarrow$ Lysis

(B) Injection $\rightarrow$ Attachment $\rightarrow$ Lysis $\rightarrow$ Assembly $\rightarrow$ Synthesis

(C) Attachment $\rightarrow$ Lysis $\rightarrow$ Injection $\rightarrow$ Assembly $\rightarrow$ Synthesis

(D) Synthesis $\rightarrow$ Attachment $\rightarrow$ Injection $\rightarrow$ Assembly $\rightarrow$ Lysis

Q131. Imbibition during seed germination refers to:

(A) The absorption of mineral salts by the seed

(B) The absorption of water by the dry seed, causing it to swell

(C) The breakdown of starch by amylases

(D) The emergence of the radicle from the seed coat

Q132. The essential conditions required for seed germination are:

(A) Light, high temperature, and CO_2

(B) Absence of water and presence of light

(C) Water, oxygen, and suitable temperature

(D) Darkness, low temperature, and high CO_2

Q133. Seed dormancy maintained by chemical inhibitors (e.g. abscisic acid) can be broken by treatment with:

(A) Application of more abscisic acid (ABA)

(B) Lowering the pH of the soil

(C) Removal of the seed coat (scarification)

(D) Gibberellins or stratification (cold treatment)

Q134. During seed germination, starch stored in the endosperm is broken down to sugars by the enzyme:

(A) Amylase

(B) Lipase

(C) Protease

(D) Nuclease

Q135. Stratification is a method used to break seed dormancy in certain seeds (especially temperate species). It involves:

(A) Soaking seeds in concentrated sulphuric acid

(B) Exposing moist seeds to cold temperatures (0–10C) for several weeks

(C) Treating seeds with ethylene gas

(D) Removing the seed coat mechanically

Q136. Rice is a short-day plant. It flowers when:

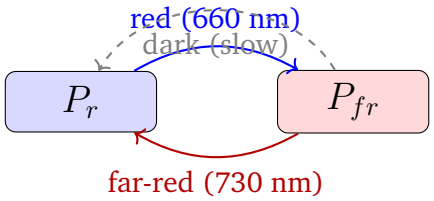
(A) The day length exceeds the critical night length

(B) Light period is longer than the dark period

(C) The night length exceeds the critical night length (or day length is shorter than critical)

(D) It receives continuous light

Q137. Phytochrome exists in two interconvertible forms. The diagram below shows the interconversion:



P_{fr} (the active form) is responsible for:

(A) Inhibiting flowering in short-day plants

(B) Causing seed dormancy

(C) Preventing seed germination

(D) Promoting flowering in long-day plants and other light-regulated responses

Q138. Wheat and spinach are examples of long-day plants (LDP). They flower when:

(A) The night length is shorter than the critical night length (or day length exceeds critical)

(B) The night length exceeds the critical night length

(C) They receive equal periods of light and dark

(D) They receive no light (continuous dark)

Q139. Day-neutral plants (e.g. tomato, sunflower) flower:

(A) Only in short days

(B) Regardless of photoperiod (day length), when they reach physiological maturity

(C) Only in long days

(D) Only in continuous light

Q140. The P_r form of phytochrome absorbs light at approximately:

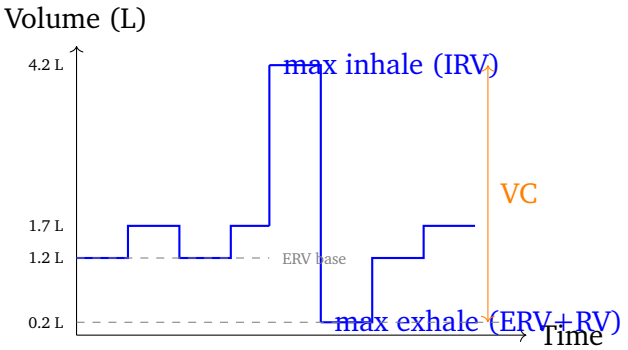
(A) 730 nm (far-red)

(B) 450 nm (blue)

(C) 660 nm (red)

(D) 380 nm (UV-A)

Q141. The spirogram below shows lung volumes. Vital capacity (VC) is the sum of:



(A) Tidal volume + Residual volume

(B) Inspiratory reserve volume + Residual volume

(C) Expiratory reserve volume + Residual volume

(D) Tidal volume + Inspiratory reserve volume + Expiratory reserve volume

Q142. According to Fick's law, the rate of gas diffusion across the alveolar membrane is proportional to:

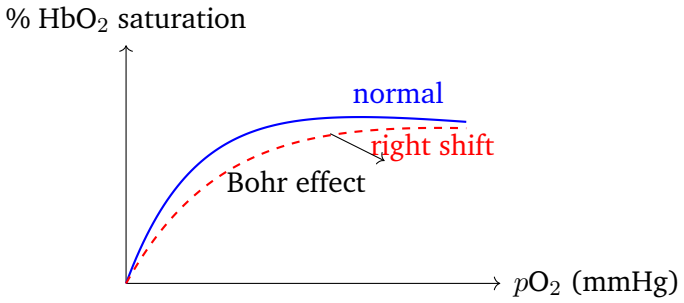
(A) Surface area $\times$ (partial pressure difference) / membrane thickness

(B) Temperature only

(C) Membrane thickness / surface area

(D) Square of the partial pressure difference

Q143. The oxyhaemoglobin dissociation curve shifts to the *right* (Bohr effect) when:



(A) Decreased CO_2, increased pH, decreased temperature

(B) Increased CO_2, decreased pH (increased acidity), increased temperature

(C) Increased O_2 concentration

(D) Decreased 2,3-BPG concentration

Q144. The volume of air inhaled or exhaled in a single normal breath (at rest) is called the:

(A) Inspiratory reserve volume (IRV)

(B) Expiratory reserve volume (ERV)

(C) Tidal volume (≈ 500 mL)

(D) Residual volume (RV)

Q145. The residual volume (RV) of the lungs (≈ 1200 mL) represents the air:

(A) Inspired above normal tidal volume

(B) Expelled forcibly beyond tidal expiration

(C) Exchanged during normal breathing

(D) That remains in the lungs even after maximum forcible expiration

Q146. Salivary amylase (ptyalin) acts on starch and converts it to maltose. The optimal pH for salivary amylase is approximately:

(A) 6.8 (slightly acidic/neutral)

(B) 2.0 (strongly acidic)

(C) 8.5 (alkaline)

(D) 5.0 (moderately acidic)

Q147. Pepsin is the major gastric protease. It is secreted as the inactive precursor pepsinogen and is activated by:

(A) Enteropeptidase in the duodenum

(B) HCl in the stomach (low pH ≈ 2)

(C) Bile salts in the duodenum

(D) Bicarbonate ions

Q148. Trypsinogen (secreted by the pancreas) is activated to trypsin by:

(A) HCl in the stomach

(B) Pepsin

(C) Enteropeptidase (enterokinase) in the duodenum

(D) Bile salts

Q149. Pancreatic lipase acts on fats (triglycerides) in the small intestine, producing:

(A) Glucose and galactose

(B) Amino acids

(C) Cholesterol and phospholipids

(D) Fatty acids and monoglycerides (glycerol)

Q150. Sucrase, present in the brush border of the small intestine, breaks sucrose into:

(A) Glucose + Fructose

(B) Glucose + Galactose

(C) Glucose + Glucose

(D) Fructose + Galactose

Q151. MALT (Mucosa-Associated Lymphoid Tissue) includes all of the following EXCEPT:

(A) Tonsils

(B) Thymus gland

(C) Peyer's patches in the small intestine

(D) Appendix-associated lymphoid tissue

Q152. The spleen is the largest lymphoid organ and functions primarily to:

(A) Produce T lymphocytes from stem cells

(B) Filter lymph fluid from tissues

(C) Filter blood and mount immune responses against blood-borne antigens

(D) Produce digestive enzymes

Q153. The thymus gland is the site of:

(A) B-cell maturation and antibody production

(B) Red blood cell production

(C) Platelet production

(D) T-lymphocyte maturation and education (self/non-self distinction)

Q154. The secondary (anamnestic) immune response to a re-exposure to an antigen is faster and stronger than the primary response because of:

(A) Memory B and T cells formed during the primary response

(B) Increased production of non-specific innate immune cells

(C) Higher antigen dose in the secondary exposure

(D) More efficient antigen-presenting cells in the secondary exposure

Q155. Lymph nodes function as filters for lymph fluid. During an infection, lymph nodes may swell because:

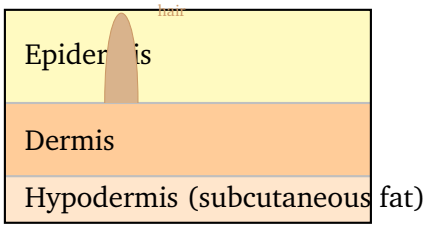
(A) Fat accumulates inside them

(B) Lymphocytes proliferate rapidly within them in response to antigens

(C) Blood vessels in them dilate permanently

(D) They produce excess lymph fluid

Q156. The correct order of skin layers from outermost to innermost is:



(A) Dermis → Epidermis → Hypodermis

(B) Hypodermis → Epidermis → Dermis

(C) Epidermis → Dermis → Hypodermis

(D) Dermis → Hypodermis → Epidermis

Q157. Meissner's corpuscles are sensory receptors found in the skin that detect:

(A) Deep pressure and vibration

(B) Pain and temperature

(C) Temperature change only

(D) Light touch and texture

Q158. When body temperature rises above normal, cutaneous blood vessels undergo vasodilation to:

(A) Increase heat loss by radiation and convection from the skin surface

(B) Conserve heat by reducing blood flow to the skin

(C) Increase metabolic rate

(D) Stimulate sweat gland activity directly

Q159. Eccrine sweat glands are distributed widely over the body surface and function primarily in:

(A) Producing scent secretions (apocrine function)

(B) Thermoregulation via evaporative cooling

(C) Secreting sebum to waterproof the skin

(D) Producing hair-shaft lubrication

Q160. Shivering during cold exposure generates heat because:

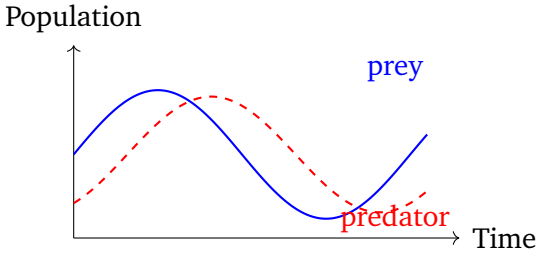
(A) Blood vessels dilate to bring warm blood to muscles

(B) Sweat glands increase secretion

(C) Rapid involuntary muscle contractions produce heat as a byproduct of ATP hydrolysis

(D) Brown adipose tissue becomes inactive

Q161. The Lotka-Volterra predator-prey model predicts that predator and prey populations oscillate. The diagram shows these oscillations:



Which statement correctly interprets the lag between predator and prey cycles?

(A) Predator population peaks before prey population

(B) Both populations peak simultaneously

(C) Prey population peak occurs after predator population peak

(D) Predator population peak lags behind prey population peak (prey peak first, then predators increase)

Q162. Gause's competitive exclusion principle states that:

(A) Two species competing for identical resources cannot coexist indefinitely; one will outcompete the other

(B) Two species can coexist if they occupy the same niche

(C) Mutualistic species always exclude competitors

(D) Predation always leads to prey extinction

Q163. Mycorrhizae represent an example of:

(A) Parasitism $(+/-)$ between fungus and plant

(B) Mutualism $(+/+)$: fungus receives carbohydrates from plant; plant receives minerals and water

(C) Commensalism $(+/0)$

(D) Amensalism $(0/-)$

Q164. Orchids growing on tree branches (using the tree for support without harming or benefiting it) is an example of:

(A) Mutualism

(B) Parasitism

(C) Commensalism $(+/0)$

(D) Amensalism

Q165. The relationship between *Penicillium* mould and bacteria (mould secretes penicillin, harming bacteria with no effect on the mould) is an example of:

(A) Mutualism

(B) Commensalism

(C) Parasitism

(D) Amensalism $(0/-)$

Q166. The Convention on Biological Diversity (CBD) was adopted at the Earth Summit in Rio de Janeiro in:

(A) 1992

(B) 1987

(C) 2000

(D) 2002

Q167. The Ramsar Convention (1971) specifically deals with the conservation of:

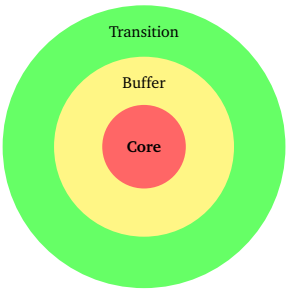
(A) Tropical rainforests

(B) Wetlands and their biodiversity

(C) Coral reefs

(D) Grassland ecosystems

Q168. A biosphere reserve is divided into three zones. The correct description of the core zone is:



(A) Area where human activities such as tourism and research are permitted

(B) Area where traditional land use is allowed under regulation

(C) Strictly protected area with no or minimal human interference

(D) Area where sustainable economic development is promoted

Q169. The Cartagena Protocol on Biosafety (2000) specifically addresses the safe handling, transport, and use of:

(A) Endangered migratory bird species

(B) Wetland ecosystems

(C) Marine biodiversity

(D) Living Modified Organisms (LMOs/GMOs) that may affect biodiversity

Q170. The Wildlife Crime Control Bureau (WCCB) in India is under the:

(A) Ministry of Environment, Forests and Climate Change

(B) Ministry of Agriculture and Farmers Welfare

(C) Ministry of Home Affairs

(D) Ministry of Science and Technology

Q171. Holoblastic cleavage (complete division of the egg) occurs in eggs with:

(A) Very large amounts of yolk (heavily telolecithal eggs like birds)

(B) Little or no yolk (isolecithal eggs like sea urchin, placental mammals)

(C) Moderate yolk concentrated at one pole only

(D) Yolk distributed in a ring around the egg periphery

Q172. During gastrulation, three primary germ layers are formed. The *mesoderm* gives rise to:

(A) Brain, spinal cord, and skin epidermis (from ectoderm)

(B) Gut lining, liver, and lungs (from endoderm)

(C) Muscles, bones, heart, and blood vessels

(D) Notochord only

Q173. Neurulation is the process by which the neural plate forms the neural tube. Incomplete closure of the neural tube leads to:

(A) Down syndrome (trisomy 21)

(B) Sickle cell anaemia

(C) Turner syndrome

(D) Neural tube defects such as spina bifida or anencephaly

Q174. The blastula stage of embryonic development is characterised by:

(A) A hollow sphere of cells (blastomeres) surrounding a fluid-filled cavity (blastocoel)

(B) The formation of three germ layers

(C) The beginning of organogenesis

(D) Implantation of the embryo in the uterine wall

Q175. The brain and spinal cord (central nervous system) are derived from which embryonic germ layer?

(A) Endoderm

(B) Ectoderm

(C) Mesoderm

(D) Trophoblast

Q176. The Five-Kingdom Classification (Whittaker, 1969) includes which kingdoms?

(A) Plantae, Animalia only (two kingdoms)

(B) Monera, Protista, Fungi, Plantae, Animalia, Archaea (six kingdoms)

(C) Monera, Protista, Fungi, Plantae, Animalia

(D) Bacteria, Archaea, Eukarya (three domains)

Q177. The Three-Domain Classification (Woese, 1990) is based primarily on:

(A) Morphological characteristics of organisms

(B) Mode of nutrition

(C) Cell wall composition

(D) 16S rRNA sequence analysis (molecular phylogeny)

Q178. 16S rRNA gene sequences are widely used in molecular phylogeny because:

(A) They are highly conserved and present in all prokaryotes, allowing universal comparison

(B) They evolve very rapidly, making them ideal for recent speciation events

(C) They are unique to eukaryotes

(D) They code for the most variable protein in all organisms

Q179. Carl Linnaeus proposed the Two-Kingdom classification (Plantae and Animalia). A major limitation of this system was that it:

(A) Failed to distinguish prokaryotes from eukaryotes adequately; microorganisms and fungi were placed incorrectly

(B) Distinguished bacteria from archaea correctly

(C) Placed viruses in a separate kingdom

(D) Used molecular data to classify organisms

Q180. In a phylogenetic tree, the branching points (nodes) represent:

(A) Present-day species only

(B) Extinct species that have no surviving descendants

(C) Common ancestors from which two or more lineages diverged

(D) The most recently evolved species

Part D: General Studies (Q181–Q200)

Q181. Plant tissue culture exploits the property of *totipotency*, which means:

(A) Only root cells can regenerate a whole plant

(B) Only seeds can develop into new plants

(C) Cells can only divide but not differentiate

(D) Any living plant cell has the potential to develop into a complete organism

Q182. Marker-Assisted Selection (MAS) in crop improvement involves using:

(A) DNA markers linked to desirable genes to select superior crop varieties efficiently

(B) Radioactive isotopes to label crop chromosomes

(C) Conventional cross-breeding without molecular tools

(D) Chemical mutagens to induce random mutations

Q183. Rhizobium is used as a biofertilizer because it:

(A) Produces phosphate-solubilising enzymes

(B) Fixes atmospheric nitrogen in root nodules of leguminous plants

(C) Produces growth-promoting hormones (auxins)

(D) Controls fungal pathogens in the soil

Q184. *Bacillus thuringiensis* (Bt) is used as a biopesticide. The Bt toxin (Cry protein) kills insect pests by:

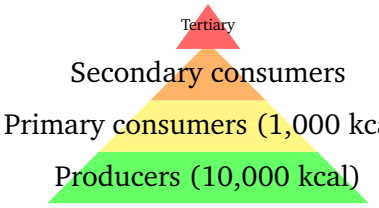
(A) Inhibiting the nervous system of the insect

(B) Producing a fungal infection in the insect's body

(C) Binding to receptors in the insect's gut epithelium and causing cell lysis

(D) Interfering with insect reproduction

Q185. The diagram below shows a pyramid of energy. Which statement about energy transfer between trophic levels is correct?



(A) 100% of energy is transferred to the next trophic level

(B) 50% of energy is transferred to each successive level

(C) All energy is stored as biomass in each level

(D) Approximately 10% of energy is transferred to each successive trophic level (ten-percent law)

Q186. The Taj Mahal, a UNESCO World Heritage Site located in Agra, was commissioned by Mughal Emperor:

(A) Shah Jahan in memory of his wife Mumtaz Mahal

(B) Akbar as his own mausoleum

(C) Humayun as a palace

(D) Aurangzeb to commemorate his victories

Q187. Sarnath, located near Varanasi (UP), is historically significant because:

(A) It is where Buddha was born (nativity)

(B) It is where Buddha gave his first sermon (Dharmachakra Pravartana) after attaining enlightenment

(C) It is where the Mahabharata battle took place

(D) It is the site of Akbar's capital Fatehpur Sikri

Q188. Fatehpur Sikri, built by Mughal Emperor Akbar near Agra, served as the Mughal capital from approximately 1571 to 1585. It was abandoned primarily due to:

(A) A British invasion

(B) Akbar's defeat in battle

(C) Water scarcity and strategic reasons

(D) An earthquake

Q189. The Krishi Karman Award in India is given to:

(A) Individual farmers who adopt organic farming

(B) Scientists who develop new crop varieties

(C) Agricultural universities for research excellence

(D) States for outstanding performance in food grain production

Q190. India's M.S. Swaminathan received the World Food Prize in 1987 for his contributions to:

(A) The Green Revolution — developing high-yielding wheat and rice varieties in India

(B) The White Revolution (Operation Flood) — dairy development

(C) The Blue Revolution — fisheries development

(D) Development of drought-resistant cotton varieties

Q191. The Subhash Chandra Bose Aapda Prabandhan Puraskar is an award given annually for outstanding contribution in the field of:

(A) Agricultural innovation

(B) Disaster management and relief

(C) Environmental conservation

(D) Rural development and livelihood

Q192. The Paris Agreement (2015) under the UNFCCC aims to limit global average temperature rise above pre-industrial levels to:

(A) 3C, with efforts to limit to 2C

(B) 2C only, with no lower target

(C) 2C, with efforts to limit to 1.5C

(D) 1C, with efforts to limit to 0.5C

Q193. Nationally Determined Contributions (NDCs) under the Paris Agreement are:

(A) Fixed emissions reduction targets set by the UNFCCC Secretariat for each country

(B) Binding targets enforced by international law

(C) Contributions from developed countries only

(D) Each country's self-determined climate action plans submitted to the UNFCCC

Q194. In the carbon credit trading system (cap-and-trade), a carbon credit represents:

(A) The right to emit one tonne of CO_2 equivalent; countries/companies that emit less can sell unused credits

(B) A financial penalty for exceeding emissions limits

(C) A government subsidy for renewable energy

(D) A certificate for planting one tree

Q195. Climate-smart agriculture (CSA) is defined as agriculture that:

(A) Maximises yield at the expense of environmental sustainability

(B) Sustainably increases productivity, enhances resilience, reduces greenhouse gas emissions, and enhances food security

(C) Uses only traditional farming practices

(D) Eliminates the use of any inputs (including seeds) from external sources

Q196. The Soil Health Card Scheme in India tests soil samples for how many parameters?

(A) 6

(B) 10

(C) 14

(D) 20

Q197. The e-Krishi Samridhi portal in India is related to:

(A) Online booking of agricultural machinery

(B) Direct Benefit Transfer for farmer subsidies

(C) Digital education for school students

(D) Agricultural information and advisory services for farmers

Q198. The regulatory body in India that has issued guidelines for the use of drones (including for pesticide spraying in agriculture) is:

(A) DGCA (Directorate General of Civil Aviation)

(B) ICAR (Indian Council of Agricultural Research)

(C) NABARD (National Bank for Agriculture and Rural Development)

(D) Ministry of Agriculture and Farmers Welfare

Q199. The Government e-Marketplace (GeM) portal is used for:

(A) Online sale of agricultural produce directly to consumers

(B) Government procurement of goods and services (including agricultural inputs) from registered sellers

(C) Registration of farmers for crop insurance

(D) Online application for Kisan Credit Card

Q200. The PM e-VIDYA initiative, launched under the Atmanirbhar Bharat package, primarily aims to:

(A) Provide free internet connectivity to all rural farmers

(B) Digitise land records across India

(C) Provide digital/online education to students during school closures and beyond (multi-mode access)

(D) Create a digital marketplace for farm produce

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans