NEET 2026 Sample Paper 3

A) Total Duration: 3-hour and 20-minute (200 minutes)
B) Pattern: 180 Multiple Choice Questions (MCQs) out of a total of 200
C) Marking Scheme & Rules:

- Correct Answer: +4 marks
- Incorrect Answer: -1 mark (Negative marking)
- Unattempted Question: 0 marks
- Multiple Answers: Treated as incorrect, attracting -1 mark

Physics (Section A)

Q1. The dimensions of $[\mu_0\epsilon_0]^{-1/2}$ are the same as that of:

A. Velocity

B. Acceleration

C. Force

D. Energy/Area

Q2. A ball is thrown vertically upwards. Which of the following graphs represent the velocity-time $(v - t)$ relationship, taking the point of projection as origin and upward direction as positive?

A. A straight line passing through origin with positive slope.

B. A straight line with negative slope and positive y-intercept.

C. A parabola opening downwards.

D. A horizontal line.

Q3. Assertion (A): A cyclist leaning inwards while taking a turn provides the necessary centripetal force. Reason (R): The horizontal component of the normal reaction provides the centripetal force required for circular motion.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q4. A block of mass m is pushed against a spring of spring constant k fixed at the other end. The block compresses the spring by x and is then released. The maximum velocity attained by the block is:

A. $x\sqrt{k/m}$

B. $\sqrt{kx/m}$

C. kx^2/m

D. $x\sqrt{m/k}$

Q5. A solid sphere and a hollow sphere of the same mass and radius are released from the top of an inclined plane. If they roll without slipping:

A. The solid sphere reaches the bottom first.

B. The hollow sphere reaches the bottom first.

C. Both reach at the same time.

D. The one with the higher density reaches first.

Q6. The escape velocity from Earth is v_e. If a planet has twice the radius and eight times the mass of Earth, the escape velocity from that planet will be:

A. v_e

B. $2v_e$

C. $4v_e$

D. $v_e/2$

Q7. A wire of length L and radius r is fixed at one end. When a stretching force F is applied, the elongation is l. If another wire of the same material but length $2L$ and radius $2r$ is stretched by the same force F, the elongation will be:

A. l

B. $l/2$

C. $2l$

D. $4l$

Q8. Two soap bubbles of radii r_1 and r_2 ($r_1 > r_2$) are in contact. The radius of the common interface is:

A. $r_1 + r_2$

B. $\frac{r_1 r_2}{r_1 - r_2}$

C. $\sqrt{r_1 r_2}$

D. $r_1 - r_2$

Q9. In an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_p/C_v (γ) for the gas is:

A. 3/2

B. 4/3

C. 5/3

D. 7/5

Q10. A particle executing SHM has a maximum velocity v_m and maximum acceleration a_m. The amplitude of oscillation is:

A. v_m^2/a_m

B. a_m^2/v_m

C. v_m/a_m

D. $\sqrt{v_m a_m}$

Q11. A whistle revolving in a circle of radius 50 cm at an angular speed of 20 rad/s emits a sound of frequency 400 Hz. The minimum frequency heard by a stationary listener at a large distance is ($v = 340$ m/s):

A. 388.6 Hz

B. 372.4 Hz

C. 350.5 Hz

D. 412.3 Hz

Q12. Two point charges $+9e$ and $+e$ are kept at a distance of 16 cm from each other. At what point between them is the electric field zero?

A. 12 cm from $+9e$

B. 4 cm from $+9e$

C. 8 cm from $+e$

D. 10 cm from $+e$

Q13. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates are now moved farther apart by an insulated handle:

A. The charge increases.

B. Voltage decreases.

C. Capacitance increases.

D. Energy increases.

Q14. In a potentiometer experiment, balancing lengths are 560 cm and 412 cm. Internal resistance is:

A. 3.6 Ω

B. 2.4 Ω

C. 1.8 Ω

D. 0.9 Ω

Q15. A circular coil of 100 turns and radius 10 cm carries current 0.1 A. Magnetic field at center is:

A. $2\pi \times 10^{-5}$

B. $2\pi \times 10^{-4}$

C. 6.28×10^{-4}

D. 3.14×10^{-5}

Q16. Magnetic susceptibility of paramagnetic material at -73°C is 0.0075. At -173°C it is:

A. 0.0030

B. 0.0150

C. 0.0225

D. 0.0075

Q17. A 50 mH coil carries 2 A current. Energy stored is:

A. 0.05 J

B. 0.1 J

C. 1.0 J

D. 0.5 J

Q18. In an LCR series circuit, voltages across R, L, C are 40 V, 60 V, 90 V. RMS source voltage is:

A. 190 V

B. 50 V

C. 70 V

D. 110 V

Q19. Which EM wave has shortest wavelength?

A. Radio

B. Microwave

C. X-ray

D. Gamma ray

Q20. Object at 20 cm in front of concave mirror (f=10 cm). Image is:

A. Real, inverted, same size

B. Real, inverted, magnified

C. Virtual, erect, magnified

D. Real, inverted, diminished

Q21. Lens in liquid (n=1.6) behaves as:

A. Converging 160 cm

B. Diverging 160 cm

C. Converging 80 cm

D. Diverging 80 cm

Q22. YDSE: 4th bright of λ_1 = 6th of λ_2. Ratio is:

A. 2/3

B. 3/2

C. 4/9

D. 9/4

Q23. Work function 2.5 eV, $\lambda = 4000\mathring{A}$. KE is:

A. 0.6 eV

B. 3.1 eV

C. 0.5 eV

D. No emission

Q24. Hydrogen transition ratio:

A. $20/27\lambda$

B. $27/20\lambda$

C. $3/4\lambda$

D. $4/3\lambda$

Q25. Half-life 20 min. Time for 1/16 activity:

A. 40

B. 60

C. 80

D. 100

Q26. CE amplifier input voltage:

A. 10 mV

B. 20 mV

C. 30 mV

D. 1 mV

Q27. Logic gate from truth table:

A. AND

B. OR

C. NAND

D. NOR

Q28. Velocity change in circular motion (60°):

A. v

B. $\sqrt{2}v$

C. $\sqrt{3}v$

D. $v/2$

Q29. Work done by $F = 3x^2$ from 0 to 2:

A. 4

B. 8

C. 12

D. 16

Q30. Gravity statements:

A. Both correct

B. Both incorrect

C. I correct II incorrect

D. I incorrect II correct

Q31. Elastic energy ratio:

A. 1:2

B. 2:1

C. 1:4

D. 4:1

Q32. Carnot engine temperature increase:

A. 250 K

B. 750 K

C. 500 K

D. 300 K

Q33. Pendulum in lift:

A. $\sqrt{5}/2T$

B. $2/\sqrt{5}T$

C. $4/5T$

D. $5/4T$

Q34. Match quantities:

A. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

B. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

C. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

D. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Q35. Telescope image height:

A. 7.5 cm

B. 0.75 cm

C. 1.5 cm

D. 0.15 cm

Physics (Section B)

Q36. A thin uniform rod of length L and mass M is bent at its midpoint to form a 90° angle. The moment of inertia of this bent rod about an axis passing through the bending point and perpendicular to the plane of the rod is:

A. $ML^2/24$

B. $ML^2/12$

C. $ML^2/3$

D. $ML^2/6$

Q37. A small spherical ball of radius r falls from rest in a viscous liquid. As a result of friction, heat is produced. The rate of production of heat when the ball attains terminal velocity is proportional to:

A. r^2

B. r^3

C. r^4

D. r^5

Q38. One mole of an ideal monoatomic gas is mixed with three moles of an ideal diatomic gas. The molar specific heat of the mixture at constant volume (C_v) is:

A. $2.25R$

B. $1.50R$

C. $2.00R$

D. $1.75R$

Q39. A capacitor of capacitance C is charged to a potential V. It is then connected in parallel with an uncharged capacitor of capacitance $2C$. The loss of energy during the process is:

A. $CV^2/3$

B. $CV^2/6$

C. $CV^2/2$

D. $2CV^2/3$

Q40. A long straight wire of radius R carries a steady current I. The current is uniformly distributed across its cross-section. The ratio of the magnetic field at a distance $R/2$ and $2R$ from the axis of the wire is:

A. $1 : 4$

B. $4 : 1$

C. $1 : 1$

D. $1 : 2$

Q41. In a Fraunhofer diffraction at a single slit of width a, the first diffraction minimum is observed at an angle of 30° for light of wavelength 5000 $\mathring{A}$. The width of the slit is:

A. $1 \times 10^{-4}\ cm$

B. $2.5 \times 10^{-5}\ cm$

C. $1.25 \times 10^{-4}\ cm$

D. $5 \times 10^{-5}\ cm$

Q42. Assertion (A): The stopping potential in a photoelectric experiment does not depend on the intensity of the incident radiation. Reason (R): The maximum kinetic energy of photoelectrons is determined solely by the frequency of the incident light and the work function of the metal.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q43. A Zener diode having a breakdown voltage of 15 V is used as a voltage regulator in a circuit. If the unregulated input voltage is 20 V and the series resistance is 250 Ω, the maximum current through the Zener diode (assuming load resistance is infinite) is:

A. 10 mA

B. 20 mA

C. 40 mA

D. 80 mA

Q44. In a meter bridge, the null point is found at a distance of 40 cm from A. If a resistance of 12 Ω is connected in parallel with the resistance in the right gap, the null point shifts to 50 cm. The value of the resistance in the left gap is:

A. 2 Ω

B. 4 Ω

C. 8 Ω

D. 10 Ω

Q45. Match the following for a thermodynamic process (where Q is heat, W is work, and ΔU is change in internal energy): List-I: (a) Isothermal (b) Adiabatic (c) Isochoric (d) Isobaric; List-II: (i) $Q = W$ (ii) $W = -\Delta U$ (iii) $Q = \Delta U$ (iv) $Q = \Delta U + P\Delta V$

A. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

B. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

C. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

D. (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

Q46. The intensity of an electromagnetic wave is 0.02 W/m^2. The amplitude of the magnetic field part of the wave is nearly ($c = 3 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ $T \cdot m/A$):

A. 1.3×10^{-8} T

B. 4.1×10^{-10} T

C. 2.4×10^{-7} T

D. 1.1×10^{-9} T

Q47. A radioactive nucleus can decay by two different processes. The half-life for the first process is t_1 and for the second process is t_2. The effective half-life t of the nucleus is given by:

A. $t = t_1 + t_2$

B. $t = (t_1 + t_2)/2$

C. $1/t = 1/t_1 + 1/t_2$

D. $t = \sqrt{t_1 t_2}$

Q48. Statement I: In the Davisson-Germer experiment, the maximum intensity of the scattered electron beam is observed at a scattering angle of 50° for an accelerating voltage of $54\ V$. Statement II: This experiment confirms the wave nature of electrons, as the observed diffraction pattern matches the Bragg's law prediction.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q49. When the pressure on a liquid is increased from 70 atm to 130 atm, its volume decreases by 0.1%. The Bulk modulus of the liquid is:

A. $6 \times 10^8\ N/m^2$

B. $6 \times 10^{10}\ N/m^2$

C. $1.3 \times 10^9\ N/m^2$

D. $4 \times 10^7\ N/m^2$

Q50. A man can swim in still water with a speed of $4\ km/h$. He wants to cross a river $1\ km$ wide that flows at $3\ km/h$. If he keeps himself always at an angle of 120° with the river flow while swimming, the time taken to cross the river is:

A. $1/4\ hr$

B. $1/\sqrt{3}\ hr$

C. $1/(2\sqrt{3})\ hr$

D. $1/2\ hr$

Chemistry (Section A)

Q51. If 20 g of $CaCO_3$ is treated with 20 g of HCl, the mass of CO_2 produced is nearly:

A. 8.8 g

B. 11.2 g

C. 17.6 g

D. 4.4 g

Q52. Which of the following sets of quantum numbers is NOT permissible for an electron in an atom?

A. $n = 4, l = 0, m = 0, s = +1/2$

B. $n = 3, l = 3, m = 1, s = -1/2$

C. $n = 3, l = 2, m = -2, s = -1/2$

D. $n = 2, l = 1, m = 0, s = +1/2$

Q53. The correct order of increasing electron gain enthalpy (with negative sign) for the elements O, S, F and Cl is:

A. $F < Cl < O < S$

B. $S < O < Cl < F$

C. $O < S < F < Cl$

D. $Cl < F < S < O$

Q54. Which of the following molecules has the highest dipole moment?

A. NF_3

B. NH_3

C. BF_3

D. $CHCl_3$

Q55. For a reaction to be spontaneous at all temperatures:

A. $\Delta H > 0$ and $\Delta S > 0$

B. $\Delta H < 0$ and $\Delta S < 0$

C. $\Delta H < 0$ and $\Delta S > 0$

D. $\Delta H > 0$ and $\Delta S < 0$

Q56. The solubility of $AgCl_{(s)}$ with solubility product 1.6×10^{-10} in 0.1 M $NaCl$ solution would be:

A. 1.26×10^{-5} M

B. 1.6×10^{-9} M

C. 1.6×10^{-11} M

D. 1.6×10^{-5} M

Q57. The oxidation state of central atom in CrO_5 and $H_2S_2O_8$ are respectively:

A. $+6, +6$

B. $+10, +7$

C. $+6, +7$

D. $+4, +6$

Q58. Assertion (A): Graphite is a good conductor of electricity whereas diamond is an insulator. Reason (R): Graphite has sp^2 hybridized carbon atoms with localized electrons, while diamond has sp^3 hybridized carbon atoms.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q59. The hybridization and geometry of XeF_4 are:

A. sp^3d, Trigonal bipyramidal

B. sp^3d^2, Square planar

C. sp^3d^2, Octahedral

D. sp^3, Tetrahedral

Q60. Which of the following statements regarding Lanthanoid contraction is CORRECT?

A. It causes the radii of Zr and Hf to be almost identical.

B. It results from the high shielding effect of $4f$ electrons.

C. It leads to an increase in chemical reactivity along the series.

D. It makes the separation of lanthanoids extremely easy.

Q61. A current of 2.0 A is passed for 5 hours through a molten metal salt to deposit 22.2 g of metal (Atomic weight = 177). The oxidation state of the metal in the salt is:

A. +1

B. +2

C. +3

D. +4

Q62. For a second-order reaction, if the initial concentration of the reactant is doubled, the half-life ($t_{1/2}$) will:

A. Remain the same

B. Be doubled

C. Be halved

D. Increase four times

Q63. Which property of colloids is independent of the charge on the colloidal particles?

A. Electro-osmosis

B. Tyndall effect

C. Coagulation

D. Electrophoresis

Q64. In the extraction of Copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with:

A. FeS

B. CO

C. Cu_2S

D. SO_2

Q65. The correct order of acid strength of the following oxoacids is:

A. $HClO_4 < HClO_3 < HClO_2 < HClO$

B. $HClO < HClO_2 < HClO_3 < HClO_4$

C. $HClO_3 < HClO_4 < HClO_2 < HClO$

D. $HClO_4 < HClO_2 < HClO_3 < HClO$

Q66. Which transition metal oxo-anion has the highest oxidation state?

A. $Cr_2O_7^{2-}$

B. MnO_4^-

C. VO_4^{3-}

D. FeO_4^{2-}

Q67. The IUPAC name of the compound $CH_3 - CH(OH) - CH_2 - CO - CH_3$ is:

A. 4-hydroxypentan-2-one

B. 2-hydroxypentan-4-one

C. 4-oxopentan-2-ol

D. 2-oxopentan-4-ol

Q68. The most stable carbocation among the following is:

A. $(CH_3)_3C^+$

B. $(C_6H_5)_3C^+$

C. $CH_3 - CH_2^+$

D. $CH_2 = CH - CH_2^+$

Q69. Which of the following compounds will exhibit geometrical isomerism?

A. 1-Phenylbut-1-ene

B. 2-Phenylbut-1-ene

C. 1,1-Diphenylprop-1-ene

D. 3-Phenylbut-1-ene

Q70. In an S_N2 reaction at an asymmetric carbon of an optically active compound, there is always:

A. Enantiomeric excess

B. Racemization

C. Inversion of configuration

D. Retention of configuration

Q71. Phenol on treatment with $CHCl_3$ and aqueous $NaOH$ at 340 K followed by hydrolysis gives:

A. Salicylaldehyde

B. Salicylic acid

C. Benzene

D. Chlorobenzene

Q72. Which of the following does NOT undergo Cannizzaro reaction?

A. Formaldehyde

B. Benzaldehyde

C. Acetaldehyde

D. Trimethylacetaldehyde

Q73. The correct order of basic strength of methyl substituted amines in aqueous solution is:

A. $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

B. $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$

C. $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2 > NH_3$

D. $NH_3 > CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$

Q74. Which of the following is a non-reducing sugar?

A. Glucose

B. Lactose

C. Maltose

D. Sucrose

Q75. Which of the following is a biodegradable polymer?

A. Nylon-6,6

B. Terylene

C. PHBV

D. Bakelite

Q76. Match List-I (Drug Class) with List-II (Example):

A. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

B. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

C. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

D. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Q77. Photochemical smog is primarily caused by:

A. CO and CO_2

B. O_3, PAN, and NO_x

C. SO_2 and particulate matter

D. CH_4 and CFCs

Q78. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the relationship between K_p and K_c is:

A. $K_p = K_c(RT)^{-2}$

B. $K_p = K_c(RT)^2$

C. $K_p = K_c(RT)^{-1}$

D. $K_p = K_c$

Q79. If the density of 3 M solution of $NaCl$ is 1.25 g/mL, the molality of the solution is (Atomic mass of $Na = 23, Cl = 35.5$):

A. 2.79 m

B. 3.15 m

C. 2.50 m

D. 3.00 m

Q80. The crystal field stabilization energy (CFSE) for high spin d^4 octahedral complex is:

A. $-0.6\Delta_o$

B. $-1.8\Delta_o$

C. $-1.6\Delta_o + P$

D. $-1.2\Delta_o$

Q81. Statement I: *o*-Nitrophenol is more volatile than *p*-Nitrophenol. Statement II: *o*-Nitrophenol possesses intramolecular hydrogen bonding while *p*-Nitrophenol possesses intermolecular hydrogen bonding.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q82. Which reagent can distinguish between Aldehydes and Ketones?

A. 2,4-DNP

B. Schiff's reagent

C. Sodium bisulphite

D. H_2/Ni

Q83. In the structure of Diborane (B_2H_6):

A. There are two 3-centre-2-electron bonds.

B. All $B-H$ bond lengths are equal.

C. Boron atoms are sp^2 hybridized.

D. There is a direct $B-B$ bond.

Q84. A buffer solution is prepared by mixing 0.1 M acetic acid and 0.1 M sodium acetate. If pK_a of acetic acid is 4.76, the pH of the solution is:

A. 3.76

B. 4.76

C. 5.76

D. 7.00

Q85. Given the standard electrode potentials: $E^0_{Fe^{3+}/Fe^{2+}} = +0.77\,V$, $E^0_{I_2/I^-} = +0.54\,V$. The standard cell potential (E^0_{cell}) for the reaction $2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$ is:

A. $+1.31\,V$

B. $+0.23\,V$

C. $-0.23\,V$

D. $+0.11\,V$

Chemistry (Section B)

Q86. An element with molar mass $2.7 \times 10^{-2} kgmol^{-1}$ forms a cubic unit cell with edge length $405pm$. If its density is $2.7 \times 10^3 kgm^{-3}$, what is the nature of the cubic unit cell?

A. Simple cubic

B. Face-centered cubic

C. Body-centered cubic

D. End-centered cubic

Q87. The number of possible optical isomers for the complex $[Co(en)_2Cl_2]^+$ is:

A. 2

B. 3

C. 4

D. 6

Q88. Which of the following conformations of n-butane is the most stable?

A. Anti-staggered

B. Gauche

C. Partially eclipsed

D. Fully eclipsed

Q89. A solution of glucose ($C_6H_{12}O_6$) is isotonic with a $0.05M$ solution of urea (NH_2CONH_2) at the same temperature. The concentration of the glucose solution is:

A. $0.025M$

B. $0.05M$

C. $0.10M$

D. $0.01M$

Q90. During the electrolysis of molten Al_2O_3, the time required to produce $13.5g$ of Al (Atomic mass = 27) using a current of $9.65Amperes$ is:

A. $500s$

B. $1000s$

C. $1500s$

D. $15000s$

Q91. According to the Freundlich adsorption isotherm, at high pressure, the value of x/m is:

A. Directly proportional to P

B. Inversely proportional to P

C. Directly proportional to $P^{1/n}$

D. Independent of P

Q92. For the reversible reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, the degree of dissociation (α) at equilibrium is related to the equilibrium pressure P and equilibrium constant K_p as:

A. $\alpha = \sqrt{\frac{K_p}{P+K_p}}$

B. $\alpha = \frac{K_p}{P+K_p}$

C. $\alpha = \sqrt{\frac{P}{P+K_p}}$

D. $\alpha = \sqrt{\frac{K_p}{P}}$

Q93. Bromination of aniline in the presence of Br_2/H_2O gives 2,4,6-tribromoaniline. To prepare p-bromoaniline as the major product, the reagent used first is:

A. $CH_3COCl/pyridine$

B. HCl

C. $NaNO_2/HCl$

D. CH_3OH

Q94. The correct order of ionic radii for the following isoelectronic species is:

A. $S^{2-} > Cl^- > K^+ > Ca^{2+}$

B. $Ca^{2+} > K^+ > Cl^- > S^{2-}$

C. $K^+ > Ca^{2+} > S^{2-} > Cl^-$

D. $Cl^- > S^{2-} > Ca^{2+} > K^+$

Q95. The energy of an electron in the 3^{rd} orbit of H-atom is $-E$. The energy of an electron in the 2^{nd} orbit of He^+ ion will be:

A. $-E$

B. $-4E/9$

C. $-9E/4$

D. $-9E$

Q96. Assertion (A): Boiling point of ethanol is higher than that of ethoxyethane. Reason (R): Ethanol molecules are associated through intermolecular hydrogen bonding, whereas ethoxyethane molecules are not.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q97. Match List-I (Process) with List-II (Reagent/Catalyst): List-I: (a) Contact Process (b) Haber's Process (c) Ziegler-Natta (d) Deacon's Process; List-II: (i) $TiCl_4 + (C_2H_5)_3Al$ (ii) V_2O_5 (iii) Fe (iv) $CuCl_2$

A. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

B. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

C. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

D. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

Q98. Statement I: Phosphinic acid (H_3PO_2) is a monoprotic acid. Statement II: It contains two $P-H$ bonds and one $P-OH$ bond in its structure.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q99. Phenol reacts with methyl chloride in the presence of anhydrous $AlCl_3$ to give mainly:

A. *o*-cresol and *p*-cresol

B. Anisole

C. Benzyl alcohol

D. Chlorobenzene

Q100. Which of the following compounds gives a positive Tollens' test and a positive Iodoform test?

A. Ethanal

B. Propanal

C. Acetone

D. Benzophenone

Botany (Section A)

Q101. Which of the following cell organelles is responsible for the synthesis of steroidal hormones in animal cells, though its equivalent in plants is involved in lipid metabolism?

A. Smooth Endoplasmic Reticulum

B. Rough Endoplasmic Reticulum

C. Golgi Apparatus

D. Peroxisomes

Q102. Five kingdom classification is based on several criteria. Which of the following was NOT used by R.H. Whittaker?

A. Complexity of cell structure

B. Mode of nutrition

C. Presence or absence of a well-defined nucleus

D. Phylogenetic relationships

Q103. In Bryophytes, the dominant phase is the gametophyte, while in Pteridophytes, it is the sporophyte. However, they share a common requirement for fertilization. This requirement is:

A. Presence of pollinators like insects

B. Requirement of water for the transfer of antherozoids

C. High temperature for pollen tube growth

D. Wind as the primary agent for gamete transfer

Q104. Which of the following anatomical features is characteristic of a monocotyledonous root?

A. Pith is small or inconspicuous

B. Presence of more than six xylem bundles (polyarch)

C. Presence of cambium between xylem and phloem

D. Secondary growth occurs via vascular cambium

Q105. In a cymose inflorescence:

A. The main axis continues to grow indefinitely

B. The flowers are borne in an acropetal succession

C. The main axis terminates in a flower

D. The youngest flower is at the base

Q106. During which stage of the cell cycle are the chromosomes most condensed and their morphology most easily studied?

A. Prophase

B. Metaphase

C. Anaphase

D. Telophase

Q107. The movement of water through the root layers is symplastic when:

A. It moves exclusively through intercellular spaces

B. It moves through the cell walls without entering the cytoplasm

C. It travels through the cytoplasm and plasmodesmata

D. It is blocked by the Casparian strip in the epidermis

Q108. Match List-I (Mineral) with List-II (Deficiency Symptom/Function): (a) Magnesium (b) Molybdenum (c) Manganese (d) Zinc

A. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

B. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

C. (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

D. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Q109. In C4 plants, the primary CO_2 acceptor and the first stable product are respectively:

A. RUBP and 3-PGA

B. PEP and Oxaloacetic acid

C. PEP and 3-PGA

D. RUBP and Oxaloacetic acid

Q110. The number of CO_2 molecules released during one complete cycle of aerobic respiration (from one molecule of Pyruvic acid in the Link reaction and Krebs cycle) is:

A. 2

B. 3

C. 4

D. 6

Q111. Which plant growth regulator is known as the "stress hormone" because it stimulates the closure of stomata?

A. Auxin

B. Gibberellin

C. Ethylene

D. Abscisic acid

Q112. The functional megaspore in an angiosperm develops into:

A. Ovule

B. Endosperm

C. Embryo sac

D. Embryo

Q113. Statement I: In some plants, the thalamus also contributes to fruit formation. Statement II: Such fruits are called parthenocarpic fruits.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q114. If a heterozygous tall pea plant (Tt) is crossed with a homozygous dwarf plant (tt), what percentage of the offspring will be tall?

A. 25%

B. 50%

C. 75%

D. 100%

Q115. Which of the following is the "start codon" that also codes for the amino acid Methionine?

A. UAA

B. UAG

C. AUG

D. UGA

Q116. "Himgiri" developed by hybridization and selection for disease resistance against rust pathogens is a variety of:

A. Rice

B. Wheat

C. Chilli

D. Maize

Q117. Which of the following microbes is used for the production of Citric acid?

A. Aspergillus niger

B. Acetobacter aceti

C. Clostridium butylicum

D. Lactobacillus

Q118. In an ecosystem, the rate of production of organic matter during photosynthesis is termed:

A. Net Primary Productivity

B. Secondary Productivity

C. Gross Primary Productivity

D. Net Community Productivity

Q119. Assertion (A): Pyramids of energy are always upright. Reason (R): When energy flows from one trophic level to the next, some energy is always lost as heat at each step.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q120. Which of the following is an ex-situ conservation method?

A. National Park

B. Biosphere Reserve

C. Wildlife Sanctuary

D. Botanical Garden

Q121. The "Evil Quartet" refers to the four major causes of:

A. Global Warming

B. Biodiversity loss

C. Water pollution

D. Ozone depletion

Q122. During the process of transcription in eukaryotes, RNA polymerase III is responsible for the synthesis of:

A. precursor of mRNA (hnRNA)

B. rRNA (28S, 18S and 5.8S)

C. tRNA, 5S rRNA and snRNAs

D. only tRNA

Q123. Match List-I (Botanist/Scientist) with List-II (Contribution): (a) T.W. Engelmann (b) T.O. Diener (c) Katherine Esau (d) M.W. Beijerinck

A. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

B. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

C. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

D. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

Q124. Statement I: The primary CO_2 acceptor in C_3 plants is a 5-carbon compound. Statement II: The first stable product in C_3 cycle is a 3-carbon compound.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q125. The process of guttation takes place:

A. When there is high relative humidity and low root pressure

B. When there is low relative humidity and high root pressure

C. When there is high relative humidity and high root pressure

D. Through stomatal openings in the morning

Q126. The roots that arise from parts of the plant other than the radicle are called:

A. Tap roots

B. Fibrous roots

C. Adventitious roots

D. Prop roots

Q127. Which of the following algae is used for the commercial production of Agar?

A. Chlorella and Spirulina

B. Gelidium and Gracilaria

C. Laminaria and Sargassum

D. Volvox and Ulothrix

Q128. In the fluid mosaic model of the plasma membrane, the "quasi-fluid" nature of lipids enables:

A. Flip-flop movement of proteins

B. Lateral movement of proteins within the bilayer

C. Active transport of all molecules

D. Structural rigidity of the cell wall

Q129. Match List-I (Stage of Respiration) with List-II (Location): (a) Glycolysis (b) TCA Cycle (c) ETS (d) Link Reaction

A. (a)-(ii), (b)-(i), (c)-(iii), (d)-(i)

B. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

C. (a)-(i), (b)-(ii), (c)-(iii), (d)-(i)

D. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Q130. Alexander von Humboldt observed that within a region, species richness increased with increasing explored area, but only up to a limit. The relationship for a wide variety of taxa is a:

A. Rectangular hyperbola

B. Straight line on a linear scale

C. Sigmoid curve

D. Parabola

Q131. In a dihybrid cross ($YYRR \times yyrr$), the proportion of offspring in F_2 generation that will be phenotypic recombinants (different from parents) is:

A. 9/16

B. 3/16

C. 6/16

D. 1/16

Q132. The requirement of a period of low temperature to induce flowering in plants is called:

A. Photoperiodism

B. Vernalization

C. Senescence

D. Dormancy

Q133. Which of the following is NOT a requirement for the successful completion of double fertilization in angiosperms?

A. Entry of pollen tube into the synergid

B. Discharge of two male gametes

C. Fusion of one male gamete with the egg

D. Presence of multiple ovules in the ovary

Q134. Which enzyme is used to join DNA fragments by forming a phosphodiester bond?

A. Restriction endonuclease

B. DNA polymerase

C. DNA ligase

D. Alkaline phosphatase

Q135. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to:

A. Action of gut micro-organisms

B. Presence of acidic pH in the insect gut

C. Alkaline pH of the insect gut

D. Host plant's defense enzymes

Botany (Section B)

Q136. Statement I: In C_4 plants, the bundle sheath cells are rich in an enzyme RuBisCO, but lack PEPcase.
Statement II: C_4 plants lack a process called photorespiration, which makes them more productive than C_3 plants.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q137. Assertion (A): The mechanism of DNA replication is semi-conservative.
Reason (R): After one round of replication, each DNA molecule consists of one parental strand and one newly synthesized strand.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q138. Match List-I (Plant Group) with List-II (Characteristic Feature):

List-I	List-II
(a) Liverworts	(i) Prothallus
(b) Mosses	(ii) Gemma cups
(c) Pteridophytes	(iii) Coralloid roots
(d) Gymnosperms	(iv) Protonema stage

A. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

B. (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

C. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

D. (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

Q139. In a sample of double-stranded DNA, the content of Adenine is 18%. What will be the percentage of Cytosine in this DNA?

A. 18%

B. 32%

C. 36%

D. 64%

Q140. Which of the following plants requires a light period exceeding a well-defined critical duration to induce flowering?

A. Short day plants

B. Long day plants

C. Day neutral plants

D. Tobacco and Chrysanthemum

Q141. During pollen-pistil interaction, the ability of the pistil to recognize the pollen is a result of:

A. Mechanical pressure of the pollen grain

B. Continuous chemical dialogue between pollen and pistil

C. Presence of nectar in the stigma

D. Atmospheric humidity levels

Q142. In primary succession on rocks, the pioneer species are usually:

A. Mosses

B. Lichens

C. Higher plants

D. Grasses

Q143. Which of the following is CORRECT regarding the life cycle of Ectocarpus and Fucus respectively?

A. Haplontic, Diplontic

B. Haplo-diplontic, Diplontic

C. Haplo-diplontic, Haplontic

D. Diplontic, Haplo-diplontic

Q144. The enzyme Nitrogenase, which is highly sensitive to molecular oxygen, is protected in the root nodules of legumes by:

A. Cytochrome

B. Leg-haemoglobin

C. Nitrogenase reductase

D. Xanthophyll

Q145. If the amount of DNA in a diploid cell is 2C at the G_1 phase, what will be the DNA content in a cell at the end of Meiosis I?

A. 4C

B. 2C

C. C

D. 0.5C

Q146. In a PCR (Polymerase Chain Reaction), the correct sequence of steps is:

A. Annealing $\rightarrow$ Extension $\rightarrow$ Denaturation

B. Extension $\rightarrow$ Denaturation $\rightarrow$ Annealing

C. Denaturation $\rightarrow$ Annealing $\rightarrow$ Extension

D. Denaturation $\rightarrow$ Extension $\rightarrow$ Annealing

Q147. Assertion (A): In angiosperms, the endosperm is triploid ($3n$).
Reason (R): It is formed by the fusion of one male gamete with two polar nuclei (Triple fusion).

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q148. Which of the following sets of gases are known as greenhouse gases?

A. $CO_2, CH_4, N_2O, CFCs$

B. CO_2, O_2, N_2, SO_2

C. CH_4, N_2, O_3, NH_3

D. $CFCs, SO_2, NO_2, CO$

Q149. The cohesion-tension-transpiration pull model explains the upward movement of water. "Cohesion" refers to:

A. Attraction of water molecules to polar surfaces

B. Mutual attraction between water molecules

C. Attraction of water molecules to the tracheary elements

D. Surface tension at the leaf-air interface

Q150. In the Z-scheme of light reaction, the electrons from PS II are finally accepted by:

A. $NADP^+$

B. ATP

C. Water

D. Cytochrome b_6f

Zoology (Section A)

Q151. Which of the following sets of animals belong to the same phylum and exhibit bilateral symmetry only in the larval stage?

A. Adamsia and Aurelia

B. Asterias and Antedon

C. Ancylostoma and Ascaris

D. Locusta and Limulus

Q152. The type of epithelial tissue found in the inner lining of fallopian tubes and bronchioles, which helps in the movement of particles or mucus in a specific direction, is:

A. Squamous epithelium

B. Cuboidal epithelium

C. Ciliated epithelium

D. Compound epithelium

Q153. Regarding enzymes, which of the following statements is INCORRECT?

A. Enzymes lower the activation energy of a reaction.

B. Competitive inhibitors bind to the active site of the enzyme.

C. Co-factors are non-protein constituents bound to the enzyme to make it catalytically active.

D. A rise in temperature always increases enzyme activity indefinitely.

Q154. The volume of air that remains in the lungs even after a forcible expiration is called:

A. Tidal Volume

B. Residual Volume

C. Expiratory Reserve Volume

D. Vital Capacity

Q155. In a standard ECG, the T-wave represents:

A. Depolarisation of atria

B. Depolarisation of ventricles

C. Repolarisation of atria

D. Repolarisation of ventricles

Q156. Assertion (A): In the nephron, the counter-current mechanism between Henle's loop and vasa recta helps in maintaining a concentration gradient in the medullary interstitium. Reason (R): This gradient is mainly caused by $NaCl$ and urea, facilitating the easy passage of water from the collecting tubule.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q157. During skeletal muscle contraction, which of the following events occurs?

A. The I-band increases in length.

B. The A-band remains constant while the H-zone disappears.

C. The Z-lines move further apart.

D. Myosin heads release ADP and P_i after the power stroke.

Q158. When a neuron is not conducting any impulse (resting state), the axonal membrane is:

A. Comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions.

B. Comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions.

C. Equally permeable to both Na^+ and K^+ ions.

D. Impermeable to both Na^+ and K^+ ions.

Q159. Which gland is often called the "Master Gland" of the endocrine system but is itself regulated by the hypothalamus?

A. Thyroid gland

B. Adrenal gland

C. Pituitary gland

D. Pineal gland

Q160. Select the correct sequence of spermatogenesis in human males:

A. Spermatogonia → Spermatids → Secondary spermatocytes → Spermatozoa

B. Spermatogonia → Primary spermatocytes → Secondary spermatocytes → Spermatids → Spermatozoa

C. Spermatogonia → Secondary spermatocytes → Primary spermatocytes → Spermatozoa

D. Spermatids → Secondary spermatocytes → Primary spermatocytes → Spermatozoa

Q161. Which of the following is a non-medicated IUD?

A. Lippes loop

B. Multiload 375

C. Progestasert

D. LNG-20

Q162. The presence of analogous structures (e.g., wings of a butterfly and wings of a bird) is an example of:

A. Divergent evolution

B. Convergent evolution

C. Shared ancestry

D. Adaptive radiation

Q163. Statement I: Active immunity is slow and takes time to give its full effective response. Statement II: When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q164. In ADA deficiency, the patient lacks a functional enzyme required for the proper functioning of the:

A. Digestive system

B. Respiratory system

C. Immune system

D. Reproductive system

Q165. Which of the following phyla is characterized by the presence of a water vascular system used for locomotion and food capture?

A. Porifera

B. Ctenophora

C. Echinodermata

D. Mollusca

Q166. In a cockroach, the part of the alimentary canal used for crushing food particles with the help of chitinous teeth is the:

A. Crop

B. Gizzard

C. Mesenteron

D. Ileum

Q167. Identify the secondary metabolite which is a drug used in the treatment of cancer:

A. Curcumin

B. Vinblastine

C. Abrin

D. Ricin

Q168. Match List-I with List-II regarding the transport of gases in blood: (a) O_2 transported by RBCs (b) CO_2 as bicarbonate ions (c) CO_2 in dissolved state in plasma (d) CO_2 as carbamino-haemoglobin

A. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

B. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

C. (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

D. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

Q169. The first heart sound "Lubb" is associated with:

A. Opening of semilunar valves

B. Closure of semilunar valves

C. Closure of tricuspid and bicuspid valves

D. Opening of atrio-ventricular valves

Q170. Which of the following hormones is secreted by the Juxtaglomerular (JG) cells when there is a fall in glomerular blood pressure?

A. Angiotensin II

B. Aldosterone

C. Renin

D. Atrial Natriuretic Factor (ANF)

Q171. The joint between the atlas and axis vertebrae is an example of:

A. Gliding joint

B. Pivot joint

C. Saddle joint

D. Hinge joint

Q172. In the human ear, the organ of Corti is located on the:

A. Tectorial membrane

B. Basilar membrane

C. Reissner's membrane

D. Tympanic membrane

Q173. Hormones like Estrogen and Progesterone act by:

A. Generating secondary messengers like cAMP.

B. Binding to membrane-bound receptors.

C. Binding to intracellular receptors and regulating gene expression.

D. Activating the IP3-DAG pathway.

Q174. The part of the fallopian tube closest to the ovary is the:

A. Ampulla

B. Isthmus

C. Infundibulum

D. Uterine fundus

Q175. In which ART are embryos transferred into the fallopian tube of a female who cannot produce an ovum?

A. ZIFT

B. GIFT

C. IUT

D. ICSI

Q176. The evolution of different species radiating from a point is called:

A. Parallel evolution

B. Adaptive radiation

C. Saltation

D. Genetic drift

Q177. Which of the following is NOT a characteristic of cancer cells?

A. Loss of contact inhibition

B. Controlled cell division

C. Ability to undergo metastasis

D. Competition with normal cells for nutrients

Q178. Select the correct statement for Phylum Chordata:

A. Notochord is present only in larval tail of Urochordata.

B. Central nervous system is ventral.

C. Heart is dorsal.

D. Pharynx is not perforated by gill slits.

Q179. Cuboidal epithelium with brush border is found in:

A. Salivary glands

B. PCT of nephron

C. Eustachian tube

D. Stomach lining

Q180. A peptide bond is formed between:

A. Two amino groups

B. Two carboxyl groups

C. Amino group and carboxyl group

D. Hydroxyl groups

Q181. The pneumotaxic centre is located in:

A. Medulla oblongata

B. Pons

C. Cerebellum

D. Thalamus

Q182. A person with blood group AB is a universal recipient because:

A. Both A and B antigens, no antibodies

B. Both antibodies present

C. No antigens

D. Only A antigen

Q183. Which part of nephron is impermeable to water?

A. Descending limb

B. Ascending limb

C. PCT

D. Collecting duct

Q184. Blastocyst embedding in uterus is called:

A. Fertilization

B. Cleavage

C. Implantation

D. Gestation

Q185. Assertion (A): Malaria is caused by Plasmodium. Reason (R): Female Anopheles transmits sporozoites.

A. Both true, correct explanation

B. Both true, not explanation

C. A true, R false

D. A false, R true

Zoology (Section B)

Q186. Match List-I (Assisted Reproductive Technology) with List-II (Description): List-I List-II (a) ICSI (i) Transfer of ovum collected from a donor into the fallopian tube (b) GIFT (ii) Sperm is directly injected into the ovum in the laboratory (c) IUI (iii) Semen is introduced into the uterus of the female (d) IUT (iv) Embryo with more than 8 blastomeres is transferred into the uterus Options:

A. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

B. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

C. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

D. (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

Q187. Statement I: The electrical potential difference between the outside and inside of a resting axonal membrane is called the action potential. Statement II: During depolarization, the sodium-potassium pump stops working, allowing sodium ions to rush into the cell.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q188. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:

A. 0.4

B. 0.5

C. 0.6

D. 0.7

Q189. Assertion (A): The cross-bridge between actin and myosin is broken when a new ATP molecule binds to the myosin head. Reason (R): Hydrolysis of ATP by the myosin head provides the energy for the "power stroke" or tilt of the myosin head.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q190. Which of the following conditions will shift the Oxygen-Hemoglobin dissociation curve to the right?

A. Low pCO_2

B. High pH (Alkalinity)

C. Low temperature

D. High H^+ concentration (Acidity)

Q191. Identify the correct sequence of the pathway of light through the human eye:

A. Cornea $\rightarrow$ Aqueous humor $\rightarrow$ Lens $\rightarrow$ Vitreous humor $\rightarrow$ Retina

B. Lens $\rightarrow$ Cornea $\rightarrow$ Vitreous humor $\rightarrow$ Aqueous humor $\rightarrow$ Retina

C. Cornea $\rightarrow$ Vitreous humor $\rightarrow$ Lens $\rightarrow$ Aqueous humor $\rightarrow$ Retina

D. Retina $\rightarrow$ Vitreous humor $\rightarrow$ Lens $\rightarrow$ Aqueous humor $\rightarrow$ Cornea

Q192. Which of the following hormones interacts with membrane-bound receptors and does not normally enter the target cell?

A. Cortisol

B. Testosterone

C. Epinephrine

D. Thyroxine

Q193. Match the following enzymes of the digestive system with their respective substrates: List-I (Enzyme) List-II (Substrate) (a) Steapsin (i) Proteins (b) Nucleases (ii) Fats (c) Carboxypeptidase (iii) Nucleic Acids (d) Dipeptidases (iv) Dipeptides Options:

A. (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

B. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

C. (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

D. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

Q194. Statement I: The descending limb of the loop of Henle is permeable to water but almost impermeable to electrolytes. Statement II: The ascending limb of the loop of Henle is impermeable to water but allows transport of electrolytes.

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Q195. Which of the following is an example of a "living fossil" among arthropods?

A. Laccifer (Lac insect)

B. Limulus (King crab)

C. Palamnaeus (Scorpion)

D. Apis (Honey bee)

Q196. During the "Follicular Phase" of the menstrual cycle, the changes in the ovary and uterus are induced by changes in the levels of:

A. Pituitary hormones (LH and FSH) only.

B. Ovarian hormones (Estrogen and Progesterone) only.

C. Both Pituitary and Ovarian hormones.

D. Hypothalamic releasing hormones only.

Q197. Which of the following is the correct function of the "Pneumotaxic Centre" located in the Pons?

A. It primarily controls the rate of heart beat.

B. It can moderate the functions of the respiratory rhythm centre.

C. It increases the duration of inspiration.

D. It is highly sensitive to O_2 levels in arterial blood.

Q198. Assertion (A): The human male produces two types of gametes (sperms), 50% carrying the X-chromosome and 50% carrying the Y-chromosome. Reason (R): In humans, the female has a pair of dissimilar X and Y chromosomes.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

C. (A) is true but (R) is false.

D. (A) is false but (R) is true.

Q199. In the blood clotting cascade, the enzyme complex "Thrombokinase" is responsible for:

A. Converting Fibrinogen to Fibrin.

B. Converting Prothrombin to Thrombin.

C. Converting Fibrin to a dark reddish-brown scum.

D. Activation of Vitamin K.

Q200. Match List-I (Transgenic Animals) with List-II (Use/Benefit): List-I List-II (a) Rosie (Cow) (i) Vaccine safety testing (b) Transgenic mice (ii) Human protein (α-1-antitrypsin) (c) Transgenic sheep (iii) Human alpha-lactalbumin enriched milk (d) Transgenic pigs (iv) Organ transplantation (Xenotransplantation) Options:

A. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

B. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

C. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

D. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

Solutions

1. **(A)** The expression $[\mu_0\epsilon_0]^{-1/2}$ is mathematically equivalent to $1/\sqrt{\mu_0\epsilon_0}$, which represents the speed of light (c) in a vacuum. Therefore, its dimensions are $[LT^{-1}]$, which is the same as the dimensions of velocity.

2. **(B)** For a ball thrown upwards, the equation of motion is $v = u - gt$. This is a linear equation with a negative slope ($-g$) and a positive y-intercept (u), resulting in a straight line starting from the positive y-axis and sloping downwards.

3. **(A)** A cyclist leans inwards to ensure the horizontal component of the normal reaction provides the necessary centripetal force (mv^2/r). Both statements are correct, and the reason accurately explains why leaning is essential for maintaining stability during a circular turn.

4. **(A)** According to the law of conservation of mechanical energy, the elastic potential energy stored in the compressed spring ($1/2kx^2$) is converted into kinetic energy ($1/2mv^2$) at the equilibrium position. Solving for v gives the expression $x\sqrt{k/m}$.

5. **(A)** The acceleration of a rolling body is $a = g\sin\theta/(1 + I/mr^2)$. A solid sphere has a smaller moment of inertia ($2/5mr^2$) than a hollow sphere ($2/3mr^2$), leading to higher acceleration and a faster descent.

6. **(B)** Escape velocity is $v_e = \sqrt{2GM/R}$. For a planet with mass $8M$ and radius $2R$, the new escape velocity is $v' = \sqrt{2G(8M)/(2R)} = \sqrt{4 \times (2GM/R)} = 2v_e$. The eightfold mass increase outweighs the doubling of the radius.

7. **(B)** Elongation is $l = FL/(\pi r^2 Y)$. For the second wire, the new elongation l' is proportional to $(2L)/(2r)^2$, which simplifies to $2L/4r^2 = 1/2(L/r^2)$. Therefore, the elongation is exactly half of the original value.

8. **(B)** The excess pressure in the common interface is the difference between the excess pressures of the two individual bubbles: $\Delta P = 4S/r_2 - 4S/r_1$. Equating this to $4S/R_{interface}$ gives the radius as $r_1 r_2/(r_1 - r_2)$.

9. **(A)** In an adiabatic process, $P \propto T^{\gamma/(\gamma-1)}$. Given $P \propto T^3$, we equate the exponents: $\gamma/(\gamma - 1) = 3$. Solving for γ yields $3\gamma - 3 = \gamma$, which gives $2\gamma = 3$, or $\gamma = 1.5$, representing a ratio of 3/2.

10. **(A)** In SHM, maximum velocity is $v_m = \omega A$ and maximum acceleration is $a_m = \omega^2 A$. By squaring v_m and dividing by a_m, we get $(\omega^2 A^2)/(\omega^2 A) = A$. Thus, the amplitude is v_m^2/a_m.

11. **(A)** The source velocity is $v_s = R\omega = 0.5 \times 20 = 10$ m/s. Minimum frequency is heard when the source moves away: $f' = f[v/(v+v_s)] = 400[340/(340+10)] \approx 388.6$ Hz. This reflects the classic Doppler shift.

12. **(A)** At the neutral point x from $+9e$, the fields balance: $k(9e)/x^2 = ke/(16 - x)^2$. Taking square roots gives $3/x = 1/(16 - x)$. Solving for x results in $48 - 3x = x$, which leads to $x = 12$ cm from the charge $+9e$.

13. **(D)** Disconnecting the battery keeps the charge Q constant. Increasing the distance d decreases the capacitance $C = \epsilon_0 A/d$. Since energy is $U = Q^2/2C$, the decrease in C results in an increase in the stored electrostatic potential energy.

14. **(A)** Internal resistance is calculated as $r = R(l_1/l_2 - 1)$. Substituting the values: $r = 10(560/412 - 1) = 10(148/412)$, which is approximately 3.59 Ω. This is rounded to 3.6 Ω to match the nearest standard answer option provided.

15. **(A)** The magnetic field at the center is $B = \mu_0 NI/2R$. Substituting values: $B = (4\pi \times 10^{-7} \times 100 \times 0.1)/(2 \times 0.1)$. This simplifies to $2\pi \times 10^{-5}$ T. This formula is derived using Biot-Savart's Law for circular loops.

16. **(B)** Curie's Law states that magnetic susceptibility is inversely proportional to absolute temperature ($\chi \propto 1/T$). $T_1 = 200$ K and $T_2 = 100$ K. Since the temperature is halved, the susceptibility doubles from 0.0075 to a final value of 0.0150.

17. **(B)** The energy stored in an inductor is $U = 1/2LI^2$. Substituting $L = 50 \times 10^{-3}$ H and $I = 2$ A, we get $U = 0.5 \times 50 \times 10^{-3} \times 4 = 100 \times 10^{-3} = 0.1$ J. This energy resides in the magnetic field.

18. **(B)** In an LCR series circuit, the total RMS voltage is $V = \sqrt{V_R^2 + (V_L - V_C)^2}$. Substituting values: $V = \sqrt{40^2 + (60 - 90)^2} = \sqrt{1600 + (-30)^2} = \sqrt{2500} = 50$ V. The phase difference between L and C causes this subtraction.

19. **(D)** Among the listed electromagnetic waves, Gamma rays possess the highest frequency and the greatest energy. Because wavelength is inversely proportional to frequency ($\lambda = c/f$), Gamma rays have the shortest wavelength in the electromagnetic spectrum, followed by X-rays.

20. **(A)** The object is placed at $u = 20$ cm, which equals the radius of curvature ($2f = 2 \times 10 = 20$ cm). For a concave mirror, an object at C forms a real, inverted image at C with a magnification of exactly -1.

21. **(B)** Since the refractive index of the liquid (1.6) is greater than that of the lens material (1.5), the lens inverts its nature. A double convex lens, which is converging in air, becomes a diverging lens with a negative focal length in this liquid.

22. **(B)** Fringes coincide when $n_1\lambda_1 = n_2\lambda_2$. Substituting the values $4\lambda_1 = 6\lambda_2$ gives the ratio $\lambda_1/\lambda_2 = 6/4 = 3/2$. This condition ensures that the linear distance from the central fringe is the same for both.

23. **(A)** The energy of the incident photon is $E = hc/\lambda = 12400/4000 = 3.1$ eV. According to Einstein's photoelectric equation, $K_{max} = E - \Phi$. Substituting the work function: $K_{max} = 3.1 - 2.5 = 0.6$ eV. Since $E > \Phi$, emission occurs with this kinetic energy.

24. **(A)** Using the Rydberg formula $1/\lambda = R(1/n_1^2 - 1/n_2^2)$. For $3 \to 2$, $1/\lambda \propto (1/4 - 1/9) = 5/36$. For $4 \to 2$, $1/\lambda' \propto (1/4 - 1/16) = 3/16$. Taking ratio gives $\lambda'/\lambda = 20/27$.

25. **(C)** The activity reduces to $1/16$ which is $(1/2)^4$. This indicates that 4 half-lives have passed. Since each half-life is 20 minutes, the total time elapsed is 80 minutes.

26. **(A)** Voltage gain $A_v = \beta(R_c/R_b) = 100 \times 2 = 200$. Input voltage $V_{in} = V_{out}/A_v = 2/200 = 0.01$ V. Converting this to millivolts, we get 10 mV. This illustrates how the transistor amplifies a small input signal into a larger output.

27. **(C)** The output Y is 0 only when both inputs A and B are 1. For all other combinations, the output is 1. This is the inverse of the AND gate logic, which defines the NAND gate ($Y = \overline{A \cdot B}$). It is a universal logic gate.

28. **(A)** The magnitude of the change in velocity vector is $|\Delta v| = 2v\sin(\theta/2)$. For a displacement angle of $60°$, we have $|\Delta v| = 2v\sin(30°)$. Since $\sin(30°) = 0.5$, the change in velocity is $2v \times 0.5 = v$. The speed remains constant, but the direction changes.

29. **(B)** Work done is the integral of force with respect to displacement: $W = \int F dx$. Substituting $F = 3x^2$: $W = \int_0^2 3x^2 dx = [x^3]_0^2 = 8 - 0 = 8$ J. This represents the area under the force-displacement curve in a non-uniform force field.

30. **(C)** Statement I is correct because g decreases with height h. Statement II is incorrect because g also decreases as we go deeper into the earth, becoming zero at the center. The maximum value of acceleration due to gravity is at the surface of the earth.

31. **(B)** Elastic potential energy is $U = F^2L/2AY = F^2L/(2\pi r^2 Y)$. Comparing the two wires: $U_A \propto L/r^2$ and $U_B \propto (2L)/(2r)^2 = 2L/4r^2 = 0.5L/r^2$. The ratio $U_A : U_B$ is $1 : 0.5$, which is $2 : 1$. Wire A stores more energy.

32. **(A)** Efficiency $\eta = 1 - T_2/T_1$. Initially, $0.4 = 1 - 300/T_1 \Rightarrow 300/T_1 = 0.6 \Rightarrow T_1 = 500$ K. For 60% efficiency, $0.6 = 1 - 300/T_1' \Rightarrow 300/T_1' = 0.4 \Rightarrow T_1' = 750$ K. The source temperature must be increased by $750 - 500 = 250$ K.

33. **(B)** The effective gravity in an upward accelerating lift is $g_{eff} = g + a = g + g/4 = 5g/4$. The time period $T \propto 1/\sqrt{g_{eff}}$. Therefore, $T'/T = \sqrt{g/(5g/4)} = \sqrt{4/5} = 2/\sqrt{5}$. The time period decreases as the restoring force increases.

34. **(A)** Drift velocity is I/neA. Resistivity is $m/ne^2\tau$. Relaxation time is related to conductivity by $\tau = m/ne^2\rho$. Conductivity is the reciprocal of resistivity, $ne^2\tau/m$. These parameters define the microscopic behavior of charge carriers within a metallic conductor under an electric field.

35. **(A)** The angle subtended by the tower is $\alpha = height/distance = 50/1000 = 0.05$ rad. The height of the image formed by the objective lens is $h_i = \alpha \times f_o$. Substituting the focal length 150 cm: $h_i = 0.05 \times 150 = 7.5$ cm.

36. **(B)** Each half of the rod has mass $M/2$ and length $L/2$. The moment of inertia of one half about its end is $1/3(M/2)(L/2)^2 = ML^2/24$. Since there are two such halves perpendicular to each other, the total $I = 2 \times (ML^2/24) = ML^2/12$.

37. **(D)** Terminal velocity $v_t \propto r^2$. The viscous force $F = 6\pi\eta r v_t \propto r \times r^2 = r^3$. The rate of heat production (power) is $P = F \times v_t \propto r^3 \times r^2 = r^5$. This demonstrates how heat dissipation scale significantly with the size of the falling sphere.

38. **(A)** $C_v = (n_1 C_{v1} + n_2 C_{v2})/(n_1 + n_2)$. For monoatomic, $C_{v1} = 1.5R$. For diatomic, $C_{v2} = 2.5R$. $C_v = (1 \times 1.5R + 3 \times 2.5R)/4 = (1.5R + 7.5R)/4 = 9R/4 = 2.25R$.

39. **(A)** Loss of energy $\Delta U = 1/2[C_1C_2/(C_1 + C_2)](V_1 - V_2)^2$. Substituting $C_1 = C$, $C_2 = 2C$, and $V_2 = 0$: $\Delta U = 1/2[C(2C)/3C]V^2 = 1/2(2C/3)V^2 = CV^2/3$.

40. **(C)** Inside ($r < R$), $B \propto r$, so $B_1 \propto R/2$. Outside ($r > R$), $B \propto 1/r$, so $B_2 \propto 1/(2R)$. The ratio $B_1/B_2 = 1 : 1$.

41. **(A)** For the first minimum, $a \sin\theta = \lambda$. Given $\theta = 30°$, $\sin\theta = 0.5$. So $0.5a = 5000 \times 10^{-8}$ cm. Solving for a: $a = 10000 \times 10^{-8} = 10^{-4}$ cm.

42. **(A)** Stopping potential V_0 depends on the maximum kinetic energy, which is determined by the frequency of light ($hf = \Phi + eV_0$). Intensity only increases the number of photoelectrons (current), not their energy.

43. **(B)** Voltage across the series resistor is $20 - 15 = 5$ V. Current through the resistor $I = V/R = 5/250 = 0.02$ A. Since the load resistance is infinite, all this current passes through the Zener diode.

44. **(B)** Initially, $X/R = 40/60 = 2/3$. When 12 Ω is parallel to R, the new right gap is $R' = 12R/(12 + R)$. Now $X/R' = 1$. Thus $X = R'$. Solving gives $X = 4$ Ω.

45. **(A)** Isothermal means $\Delta U = 0$, so $Q = W$. Adiabatic means $Q = 0$, so $W = -\Delta U$. Isochoric means $W = 0$, so $Q = \Delta U$.

46. **(A)** Intensity $I = cB_0^2/2\mu_0$. Rearranging gives $B_0 \approx 1.3 \times 10^{-8}$ T.

47. **(C)** The total decay constant $\lambda = \lambda_1 + \lambda_2$. Hence $1/t = 1/t_1 + 1/t_2$.

48. **(A)** The Davisson-Germer experiment proved the de Broglie hypothesis and confirmed the wave nature of electrons.

49. **(B)** Bulk modulus $B = \Delta P/(\Delta V/V) = 6 \times 10^9$ Pa.

50. **(B)** Time taken $= 1/(2\sqrt{3})$ hr.

51. **(A)** According to the balanced equation $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$, one mole of calcium carbonate reacts with two moles of hydrochloric acid. In this scenario, calcium carbonate is the limiting reagent, resulting in the production of 0.2 moles or 8.8 grams of carbon dioxide.

52. **(B)** The azimuthal quantum number l is strictly restricted to values ranging from 0 to $(n - 1)$. Since the principal quantum number n is 3, the maximum value for l is 2. Therefore, a set with $l = 3$ is physically impossible for the third shell.

53. **(C)** Chlorine possesses the most negative electron gain enthalpy in the periodic table because Fluorine's small size leads to significant inter-electronic repulsions. Oxygen has the lowest magnitude in this set because its extremely small atomic radius hinders the incoming electron more than in Sulfur.

54. **(B)** In the ammonia molecule, the dipoles of the three $N - H$ bonds and the lone pair act in the same direction, reinforcing the total dipole moment. Conversely, in NF_3, the lone pair dipole and bond dipoles oppose each other, causing partial cancellation.

55. **(C)** Spontaneity is governed by the Gibbs free energy equation, $\Delta G = \Delta H - T\Delta S$. For a reaction to remain spontaneous at all temperatures, the enthalpy change must be negative (exothermic) and the entropy change must be positive, ensuring ΔG is always less than zero.

56. **(B)** The addition of $NaCl$ introduces a common chloride ion, which significantly suppresses the solubility of $AgCl$. By substituting the chloride concentration into the solubility product expression, $1.6 \times 10^{-10} = [Ag^+][0.1]$, the molar solubility of silver ions is calculated as $1.6 \times 10^{-9} M$.

57. **(A)** CrO_5 contains two peroxide linkages in its butterfly structure, meaning four oxygen atoms are in the -1 state, giving Chromium a $+6$ state. Similarly, $H_2S_2O_8$ contains one peroxo bond, which results in an oxidation state of $+6$ for each Sulfur atom.

58. **(C)** Graphite consists of sp^2 hybridized carbon atoms with one delocalized electron per atom, which allows for high electrical conductivity. In contrast, diamond features sp^3 hybridized carbons where all electrons are localized in strong covalent bonds, preventing any movement of charge.

59. **(B)** Xenon in XeF_4 uses four valence electrons for bonding and retains two lone pairs, leading to sp^3d^2 hybridization. To minimize electronic repulsions, the lone pairs occupy axial positions, resulting in a square planar molecular geometry despite the octahedral arrangement of electron pairs.

60. **(A)** Lanthanoid contraction is the progressive decrease in atomic size due to poor shielding by $4f$ electrons. This effect causes the atomic radii of second and third transition series elements, such as Zirconium and Hafnium, to be nearly identical, making their chemical separation extremely difficult.

61. **(C)** Using Faraday's laws, the equivalent weight is calculated by the formula $E = (m \times 96500)/(I \times t)$. Substituting the values gives an equivalent weight of approximately 59. Dividing the atomic weight of 177 by this value yields a valency or oxidation state of +3.

62. **(C)** The half-life of a second-order reaction is inversely proportional to the initial concentration of the reactant ($t_{1/2} = 1/k[A]_0$). Consequently, if the starting concentration is doubled, the time required for half of the substance to react will be reduced to exactly one-half.

63. **(B)** The Tyndall effect is an optical property where colloidal particles scatter a beam of light. This phenomenon depends entirely on the size of the particles relative to the wavelength of light and is completely independent of whether the particles carry a positive or negative electric charge.

64. **(C)** During the extraction of copper, partial roasting of the sulphide ore produces cuprous oxide. This oxide then reacts with the remaining cuprous sulphide in a self-reduction process to produce metallic copper and sulfur dioxide gas, eliminating the need for an external reducing agent like carbon.

65. **(B)** In a series of oxoacids containing the same central halogen atom, acidity increases as the oxidation state of the halogen increases. $HClO_4$ is the strongest acid because the +7 oxidation state of Chlorine strongly polarizes the $O-H$ bond, facilitating the release of protons.

66. **(B)** In the permanganate ion, Manganese is in its maximum oxidation state of +7. In the other options, Chromium is +6, Vanadium is +5, and Iron is +6. High oxidation states are generally stabilized when the metal is bonded to highly electronegative elements like Oxygen.

67. **(A)** Following IUPAC nomenclature rules, the principal functional group is the ketone, which receives the lowest possible locant number (2). The hydroxyl group is treated as a substituent at the fourth carbon, leading to the systematic name 4-hydroxypentan-2-one for this organic molecule.

68. **(B)** The triphenylmethyl carbocation is exceptionally stable because the positive charge is delocalized via resonance throughout the three phenyl rings. This extensive distribution of charge over many atoms provides significantly more stability compared to simple alkyl carbocations that rely only on hyperconjugation and inductive effects.

69. **(A)** Geometrical isomerism is possible in 1-Phenylbut-1-ene because both carbons of the double bond are attached to two different groups (H and phenyl on one; H and ethyl on the other). This allows for the existence of distinct *cis* and *trans* isomers with different physical properties.

70. **(C)** The S_N2 reaction proceeds through a single-step transition state where the nucleophile attacks from the side opposite to the leaving group. This geometry forces the three remaining groups to flip to the opposite side, resulting in the complete inversion of the molecule's spatial configuration.

71. **(A)** The Reimer-Tiemann reaction involves the treatment of phenol with chloroform and sodium hydroxide to introduce an aldehyde group. The reaction proceeds through a carbene intermediate and specifically targets the ortho position, ultimately yielding salicylaldehyde after the final acidification of the reaction mixture.

72. **(C)** The Cannizzaro reaction is a disproportionation reaction restricted to aldehydes that do not possess any alpha-hydrogen atoms. Since acetaldehyde contains three alpha-hydrogens, it undergoes Aldol condensation instead when treated with a strong base, forming a beta-hydroxy aldehyde rather than undergoing the redox process.

73. **(A)** In an aqueous medium, the basic strength of methylamines is determined by the combined effects of induction, solvation, and steric hindrance. This results in the experimental order where the secondary amine is the strongest base, followed by the primary amine and then the tertiary amine.

74. **(D)** Sucrose is a non-reducing sugar because its glycosidic linkage involves the anomeric carbons of both glucose and fructose. Since the potential aldehyde and ketone groups are involved in the bond, the sugar cannot open its ring structure to reduce Tollens' or Fehling's reagents.

75. **(C)** PHBV is a biodegradable polymer belonging to the polyester family and is synthesized by various bacteria as an energy store. Unlike synthetic polymers such as Nylon or Bakelite, PHBV can be completely broken down by microbial enzymes in the environment into harmless natural byproducts.

76. **(A)** This option correctly pairs medicinal compounds with their therapeutic categories. Cimetidine is used to reduce stomach acid, Terfenadine is a common antihistamine for allergies, Morphine serves as a powerful narcotic analgesic for pain management, and Chloramphenicol is a broad-spectrum antibiotic for bacterial infections.

77. **(B)** Photochemical smog is an oxidizing type of air pollution characterized by high concentrations of Ozone, Peroxyacetyl nitrate (PAN), and Nitrogen oxides. It forms in sunny urban environments when sunlight triggers complex chemical reactions between automobile exhaust pollutants and atmospheric oxygen during the day.

78. **(A)** The relationship between the two equilibrium constants is defined by $K_p = K_c(RT)^{\Delta n}$. For the Haber process reaction, the change in the number of gaseous moles is -2 (2 moles of product minus 4 moles of reactants), leading to the final expression $K_p = K_c(RT)^{-2}$.

79. **(A)** One liter of the solution weighs 1250 grams based on the given density. Subtracting the mass of 3 moles of $NaCl$ (175.5 grams) leaves 1074.5 grams of water. Dividing the 3 moles by the mass of solvent in kilograms gives a molality of 2.79.

80. **(A)** In a high-spin d^4 octahedral complex, three electrons occupy the t_{2g} orbitals and one occupies the e_g orbital. The total Crystal Field Stabilization Energy is calculated as $[3 \times (-0.4) + 1 \times (0.6)]\Delta_o$, which simplifies to a net value of $-0.6\Delta_o$.

81. **(A)** *o*-Nitrophenol possesses intramolecular hydrogen bonding, which makes it more volatile and steam-distillable as it does not associate with other molecules. In contrast, *p*-Nitrophenol forms intermolecular hydrogen bonds, leading to a higher boiling point and lower volatility due to the extensive molecular association.

82. **(B)** Schiff's reagent is a diagnostic tool used to distinguish between aldehydes and ketones. Aldehydes can restore the characteristic pink or magenta color of the reagent through a nucleophilic addition reaction, whereas ketones are generally unable to do so under standard laboratory test conditions.

83. **(A)** Diborane is an electron-deficient compound featuring two unique three-center two-electron "bridge" bonds involving hydrogen and boron. The remaining four hydrogen atoms form typical two-center two-electron terminal bonds. The boron atoms in this structure adopt an sp^3 hybridization state to maintain the complex geometry.

84. **(B)** According to the Henderson-Hasselbalch equation, the pH of a buffer is equal to $pK_a + \log([Salt]/[Acid])$. Since both the acid and its salt are present in equal $0.1M$ concentrations, the log term becomes zero, and the pH is exactly equal to the pK_a value of 4.76.

85. **(B)** The standard cell potential is calculated by subtracting the anode's reduction potential from the cathode's reduction potential $(0.77 - 0.54)$. This results in a positive E°_{cell} of $+0.23V$, which indicates that the redox reaction is thermodynamically spontaneous under standard state conditions.

86. **(B)** Density is calculated using the formula $\rho = (Z \times M)/(a^3 \times N_A)$. By substituting the provided values for density, molar mass, and edge length, the number of atoms per unit cell (Z) is found to be 4. This value is characteristic of a Face-Centered Cubic lattice.

87. **(B)** The complex $[Co(en)_2Cl_2]^+$ exists as *cis* and *trans* isomers. The *trans* form is achiral due to symmetry, while the *cis* form is chiral and exists as a pair of enantiomers. Counting the *trans* form and the two *cis* enantiomers, there are three possible stereoisomers in total.

88. **(A)** In the anti-staggered conformation of n-butane, the two bulky methyl groups are positioned at a dihedral angle of 180 degrees. This specific arrangement provides

the lowest possible energy because it minimizes both the torsional strain and the steric repulsion between the large electronic clouds of the methyl groups.

89. **(B)** Isotonic solutions must have identical osmotic pressures at the same temperature. Since both glucose and urea are non-electrolytes that do not dissociate in solution, their molar concentrations must be exactly equal. Therefore, the glucose solution must also have a concentration of $0.05M$.

90. **(D)** According to Faraday's first law, the time required is calculated by the formula $t = (W \times 96500)/(E \times I)$. For Aluminium, which has an equivalent weight of 9, substituting the mass, current, and constant into the equation yields a total time of 15,000 seconds for the deposition.

91. **(D)** In the Freundlich adsorption isotherm equation, the exponent $1/n$ approaches zero at very high pressures. This mathematical relationship signifies that the surface of the adsorbent has become completely saturated, making the extent of adsorption a constant value that is entirely independent of any further pressure increase.

92. **(A)** For the gas-phase dissociation of PCl_5, the equilibrium constant K_p is related to the degree of dissociation α and total pressure P by the formula $K_p = (\alpha^2 P)/(1-\alpha^2)$. Solving this algebraic expression for α leads to the final derived relationship $\alpha = \sqrt{K_p/(P + K_p)}$.

93. **(A)** Aniline is highly reactive and normally undergoes triple substitution. To obtain the para-isomer, the amino group must first be protected by acetylation with acetyl chloride. This reduces the activating power of the group and provides steric hindrance at the ortho positions, directing the subsequent bromination to the para position.

94. **(A)** In a set of isoelectronic species, all ions possess the same number of electrons. The ionic radius is determined by the nuclear charge; as the number of protons increases, the nucleus pulls the electron cloud more tightly, resulting in a decrease in size from S^{2-} to Ca^{2+}.

95. **(D)** The energy of a Bohr orbit is proportional to the square of the atomic number and inversely proportional to the square of the orbit number. Comparing Hydrogen ($n = 3$) and He^+ ($n = 2, Z = 2$) shows that the He^+ electron has nine times the energy magnitude of the Hydrogen electron.

96. **(A)** Ethanol molecules are held together by strong intermolecular hydrogen bonds due to the presence of a polar $-OH$ group. Ethoxyethane molecules lack this ability and are held only by weaker dipole-dipole forces. This difference in intermolecular strength explains why ethanol has a significantly higher boiling point.

97. **(A)** Industrial processes rely on specific catalysts to function efficiently: the Contact process for sulfuric acid uses Vanadium pentoxide; Haber's process for ammonia uses Iron; Ziegler-Natta catalysts are used for polyethylene production; and Deacon's process for chlorine production from HCl utilizes a Cupric chloride catalyst.

98. **(A)** Phosphinic acid, also known as hypophosphorous acid, has a tetrahedral structure containing two $P-H$ bonds and one $P-OH$ bond. Because only the hydrogen

atom in the $P-OH$ group can dissociate into a proton in water, the acid is correctly classified as a monoprotic or monobasic acid.

99. **(A)** The hydroxyl group in phenol is a strongly activating and ortho/para-directing substituent due to the $+R$ effect. During Friedel-Crafts alkylation with methyl chloride and an $AlCl_3$ catalyst, the methyl group is introduced at the ortho and para positions, resulting in a mixture of *o*-cresol and *p*-cresol.

100. **(A)** Ethanal is an aldehyde, which allows it to reduce Tollens' reagent and produce a silver mirror. Furthermore, it contains a methyl group directly attached to the carbonyl carbon, which is the structural requirement for a positive iodoform test, resulting in the formation of a yellow iodoform precipitate.

101. **(A)** The Smooth Endoplasmic Reticulum (SER) is the major site for the synthesis of lipids and steroidal hormones in animal cells. In plant cells, it is similarly involved in various biosynthetic activities related to oil and lipid metabolism.

102. **(C)** R.H. Whittaker used cell complexity, body organization, mode of nutrition, and phylogenetic relationships. The "presence or absence of a well-defined nucleus" is a component of cell complexity, which distinguishes prokaryotes from eukaryotes in his system.

103. **(B)** Both Bryophytes and Pteridophytes are limited in their distribution because they require water for fertilization. Water acts as the essential medium for the flagellated male gametes (antherozoids) to swim to the stationary female archegonia.

104. **(B)** Monocot roots are characterized by a polyarch condition, usually possessing more than six xylem bundles arranged in a ring. They also feature a large, well-developed pith and generally lack the secondary growth seen in dicotyledonous roots.

105. **(C)** In a cymose inflorescence, the growth of the main axis is limited because it terminates in a flower. Subsequent flowers develop in a basipetal succession, meaning the oldest flower is at the top of the axis.

106. **(B)** Metaphase is the stage where chromosomes reach their maximum condensation and align at the equatorial plate. This makes it the most suitable stage for observing chromosome morphology and counting the number of chromosomes in a cell.

107. **(C)** The symplastic pathway involves the movement of water through the interconnected cytoplasm of adjacent cells. Water travels through the protoplasm and plasmodesmata, providing a living route for transport across the root layers to the vascular cylinder.

108. **(A)** Magnesium is the central atom of the chlorophyll molecule. Molybdenum is a cofactor for nitrogenase. Manganese is required for the photolysis of water during photosynthesis, while Zinc is essential for the biosynthesis of the hormone Auxin.

109. **(B)** In C4 plants, the primary carbon dioxide acceptor is Phosphoenolpyruvate (PEP) found in mesophyll cells. The first stable product formed is Oxaloacetic acid (OAA), a four-carbon compound, which then travels to the bundle sheath cells.

110. **(B)** During aerobic respiration, one molecule of Pyruvic acid produces three molecules of carbon dioxide. One is released during the Link reaction (oxidative decarboxylation) and two are released during the TCA cycle at specific enzymatic steps.

111. **(D)** Abscisic acid (ABA) is referred to as the "stress hormone" because it promotes plant survival during environmental stress. It specifically induces the rapid closure of stomata during water deficiency to prevent excessive transpiration and dehydration.

112. **(C)** In most angiosperms, only one of the four megaspores remains functional. This functional megaspore undergoes three sequential mitotic divisions without immediate cytokinesis to eventually develop into the mature 7-celled, 8-nucleate embryo sac or female gametophyte.

113. **(C)** Statement I is correct because in fruits like apple and strawberry, the thalamus contributes to the fleshy part. However, Statement II is incorrect because these are called "false fruits," whereas parthenocarpic fruits develop without fertilization.

114. **(B)** When a heterozygous tall plant (Tt) is crossed with a homozygous dwarf plant (tt), it represents a test cross. The resulting genotypic and phenotypic ratios are 1:1, meaning 50

115. **(C)** AUG is the initiation codon that signals the start of translation on the mRNA strand. It is a dual-purpose codon because it also specifies the insertion of the amino acid Methionine into the polypeptide chain.

116. **(B)** Himgiri is a specialized variety of wheat developed through hybridization and selection. It was specifically bred for resistance to leaf and stripe rust, as well as hill bunt, which are common pathogens affecting wheat yields.

117. **(A)** Aspergillus niger is a filamentous fungus extensively used in the industrial fermentation process to produce Citric acid. Other microorganisms mentioned like Acetobacter aceti and Clostridium butylicum produce acetic acid and butyric acid, respectively.

118. **(C)** Gross Primary Productivity (GPP) is the total rate of production of organic matter or biomass by producers through the process of photosynthesis within a given area and time period, before accounting for respiratory losses.

119. **(A)** The pyramid of energy is always upright because energy transfer between trophic levels is inefficient. According to the 10

120. **(D)** Botanical gardens are considered ex-situ conservation because they involve the protection of plant species outside their natural habitats. National parks and biosphere reserves are in-situ methods where species are protected within their original ecosystem.

121. **(B)** The "Evil Quartet" is a term used to describe the four major causes of biodiversity loss: habitat loss/fragmentation, over-exploitation, alien species invasion, and co-extinctions. These factors collectively threaten the stability of the global biosphere.

122. **(C)** In eukaryotes, RNA polymerase III is specialized for transcribing small RNA molecules. It is primarily responsible for the synthesis of transfer RNA (tRNA), 5S ribosomal RNA (rRNA), and small nuclear RNAs (snRNAs) used in splicing.

123. **(A)** T.W. Engelmann described the action spectrum of photosynthesis. T.O. Diener discovered viroids as smaller infectious agents. Katherine Esau contributed extensively to plant anatomy, while M.W. Beijerinck demonstrated the infectious nature of viral fluids.

124. **(A)** Both statements are correct. In C3 plants, the primary CO2 acceptor is Ribulose-1,5-bisphosphate (a 5-carbon compound), and the first stable product formed after carboxylation is 3-phosphoglyceric acid (a 3-carbon compound), hence the name C3 cycle.

125. **(C)** Guttation is the exudation of liquid water from hydathodes at leaf margins. It occurs when root pressure is high and transpiration is very low, usually during the night or early morning under conditions of high humidity.

126. **(C)** Adventitious roots are roots that originate from any part of the plant body other than the radicle of the embryo. Examples include roots arising from nodes of the stem in sugarcane or from the leaves in Bryophyllum.

127. **(B)** Gelidium and Gracilaria are types of red algae (Rhodophyceae) used commercially to extract Agar. Agar is a hydrocolloid used as a solidifying agent in laboratory culture media and in various food industries for jellies.

128. **(B)** The fluid mosaic model describes the membrane as a "quasi-fluid" where lipids and proteins can move laterally. This fluidity is essential for functions like cell growth, secretion, endocytosis, and the formation of intercellular junctions between cells.

129. **(A)** Glycolysis occurs in the cytoplasm. The TCA cycle and Link reaction occur in the mitochondrial matrix. The Electron Transport System (ETS) is located in the inner mitochondrial membrane, facilitating the production of ATP through oxidative phosphorylation.

130. **(A)** For a wide variety of taxa, the relationship between species richness and area is represented by a rectangular hyperbola on a linear scale. On a logarithmic scale, this relationship is expressed as a straight line with a specific slope.

131. **(C)** In a dihybrid cross, the F2 phenotypic ratio is 9:3:3:1. The recombinants are those with non-parental phenotypes (3+3), totaling 6 out of 16. These recombinants arise due to the independent assortment of genes during gamete formation.

132. **(B)** Vernalization is the process where flowering is promoted or induced by a period of low temperature. This physiological mechanism ensures that plants do not flower prematurely in the winter and have sufficient time to reach vegetative maturity.

133. **(D)** Double fertilization requires the fusion of two male gametes with the egg and the polar nuclei, respectively. While an ovary may contain multiple ovules, each individual ovule undergoes its own double fertilization process independently of the others.

134. **(C)** DNA ligase is the enzyme responsible for joining DNA fragments by catalyzing the formation of a phosphodiester bond. It plays a critical role in DNA replication, especially in joining Okazaki fragments on the lagging strand during synthesis.

135. **(C)** The Bt toxin is produced as an inactive pro-toxin. When an insect ingests the plant tissue, the alkaline pH of its midgut solubilizes the toxin crystals and activates them, eventually causing pore formation and death of the insect.

136. **(A)** Both statements are correct. C4 plants use Kranz anatomy to separate RuBisCO into bundle sheath cells, effectively concentrating CO2 and eliminating photorespiration. This adaptation allows them to maintain high photosynthetic efficiency even under high temperature and light intensity.

137. **(A)** DNA replication is semi-conservative because the two parental strands separate and each serves as a template for a new strand. Consequently, each daughter DNA molecule contains one original parental strand and one newly synthesized complementary strand.

138. **(A)** Liverworts like Marchantia have gemma cups for asexual reproduction. Mosses feature a protonema stage. Pteridophytes produce a heart-shaped prothallus, and Gymnosperms like Cycas have coralloid roots that host nitrogen-fixing cyanobacteria for nutrient enrichment.

139. **(B)** According to Chargaff's rule, A=T and G=C. If Adenine is 18

140. **(B)** Long day plants require exposure to light for a period exceeding a critical day length to trigger the transition to flowering. In these plants, the dark period must be shorter than a critical duration for the flowering response to occur.

141. **(B)** Pollen-pistil interaction involves a sophisticated chemical dialogue where the pistil recognizes compatible or incompatible pollen. This recognition is mediated by chemical components of the pollen interacting with those of the pistil, determining the success of fertilization.

142. **(B)** Lichens are the pioneer species in primary succession on bare rocks. They secrete organic acids that dissolve the rock surface, initiating soil formation and creating an environment where mosses and eventually higher plants can take root and grow.

143. **(B)** Ectocarpus exhibits a haplo-diplontic life cycle where both haploid and diploid phases are multicellular. Fucus, however, has a diplontic life cycle where the diploid sporophyte is the dominant, independent phase, and the gametes represent the haploid stage.

144. **(B)** Nitrogenase is extremely sensitive to oxygen, which inactivates it. Leg-haemoglobin acts as an oxygen scavenger in the root nodules, maintaining a low-oxygen environment that allows the enzyme to function effectively during the process of biological nitrogen fixation.

145. **(B)** At G1, the DNA content is 2C. During S phase, it doubles to 4C. At the end of Meiosis I, the homologous chromosomes separate, but each chromosome still consists of two sister chromatids, resulting in a DNA content of 2C per cell.

146. **(C)** The PCR cycle consists of three steps: Denaturation (separating DNA strands at high temperature), Annealing (primers binding to the template strands), and Extension (Taq polymerase synthesizing new DNA strands). This cycle is repeated to amplify the DNA.

147. **(A)** In angiosperms, the endosperm is triploid (3n) because it results from triple fusion. This occurs when one haploid male gamete fuses with two haploid polar nuclei (or one diploid secondary nucleus) in the central cell of the embryo sac.

148. **(A)** Greenhouse gases include carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs). These gases trap long-wave heat radiation reflected from the Earth's surface, contributing to the greenhouse effect and resulting in global warming of the planet.

149. **(B)** Cohesion refers to the strong mutual attraction between water molecules due to hydrogen bonding. This property, along with adhesion and surface tension, allows water to form a continuous column in the xylem that can withstand the tension of transpiration.

150. **(A)** In the Z-scheme of light reactions, electrons move from Photosystem II through an electron transport chain to Photosystem I. Finally, these high-energy electrons are transferred to NADP+, reducing it to NADPH with the help of the enzyme NADP reductase.

151. **(B)** Asterias and Antedon belong to the phylum Echinodermata. This phylum is unique because its members exhibit bilateral symmetry in the larval stage, but transform into adults with radial (specifically pentamerous) symmetry.

152. **(C)** Ciliated epithelium consists of cells with hair-like projections that move particles or mucus in a specific direction. This tissue is essential in the fallopian tubes for moving the ovum and in bronchioles for clearing mucus.

153. **(D)** Enzymes are proteinaceous catalysts that function optimally at specific temperatures. While they lower activation energy, excessive heat causes the denaturation of their tertiary structure, leading to a complete and irreversible loss of their catalytic activity.

154. **(B)** Residual Volume is the specific quantity of air that stays within the lungs after a person performs a maximal forced expiration. This volume ensures that the alveoli do not collapse and allows for continuous gas exchange.

155. **(D)** In an Electrocardiogram (ECG), the T-wave indicates the repolarisation of the ventricles. This electrical event corresponds to the transition of the ventricular muscle fibers from an excited state back to their resting or polarized state.

156. **(A)** The counter-current mechanism involving the Loop of Henle and vasa recta creates a concentration gradient in the medulla. This gradient, maintained by sodium chloride and urea, is vital for the reabsorption of water and urine concentration.

157. **(B)** During skeletal muscle contraction, the actin filaments slide inward toward the center of the sarcomere. Consequently, the H-zone and I-bands shorten or disappear, while the length of the dark A-band remains constant throughout the process.

158. **(A)** In a resting neuron, the axonal membrane is significantly more permeable to potassium ions than to sodium ions. This selective permeability, maintained by ion channels and pumps, results in the negative resting potential of the axonal interior.

159. **(C)** The pituitary gland is the master gland because it controls multiple other endocrine glands. However, it is structurally and functionally linked to the hypothalamus, which regulates pituitary secretions through releasing and inhibiting hormones via portal circulation.

160. **(B)** Spermatogenesis begins with diploid spermatogonia, which differentiate into primary spermatocytes. These undergo meiosis I to form secondary spermatocytes, followed by meiosis II to produce haploid spermatids, which eventually transform into functional, motile spermatozoa.

161. **(A)** Lippes loop is a non-medicated Intrauterine Device (IUD) made of plastic. Unlike hormone-releasing or copper-releasing IUDs, it acts primarily by increasing the phagocytosis of sperm within the uterus without releasing any additional chemical or hormonal agents.

162. **(B)** Analogous structures, such as the wings of birds and insects, have different anatomical origins but perform similar functions. This phenomenon is a result of convergent evolution, where different species adapt similarly to comparable environmental challenges.

163. **(A)** Active immunity involves the body's own production of antibodies in response to an antigen and is relatively slow. Passive immunity involves the direct administration of pre-formed antibodies, providing immediate protection against pathogens like tetanus or snake venom.

164. **(C)** Adenosine Deaminase (ADA) is an enzyme crucial for the maturation and function of lymphocytes. Its deficiency leads to a compromised immune system, specifically causing Severe Combined Immunodeficiency (SCID), where the body cannot fight even minor infections.

165. **(C)** Phylum Echinodermata is uniquely characterized by the water vascular system. This hydraulic system consists of a network of canals and tube feet used for locomotion, respiration, and the capture and transport of food particles.

166. **(B)** In cockroaches, the gizzard or proventriculus contains a highly developed muscular wall and an internal lining of six chitinous plates called teeth. These structures are specifically used for grinding and crushing solid food particles into smaller fragments.

167. **(B)** Vinblastine is an alkaloid categorized as a secondary metabolite. It is used medically as a potent drug for treating various types of cancer by inhibiting spindle fiber formation, thereby preventing the uncontrolled division of malignant cells.

168. **(A)** This option correctly lists the physiological transport percentages: 97

169. **(C)** The first heart sound, described as 'Lubb', occurs during the beginning of ventricular systole. It is caused by the simultaneous and sudden closure of the atrio-ventricular valves (tricuspid and bicuspid) to prevent backflow into the atria.

170. **(C)** Renin is secreted by the Juxtaglomerular (JG) cells in response to a fall in glomerular blood pressure or filtration rate. Renin initiates the RAAS pathway, leading to vasoconstriction and sodium reabsorption to restore blood pressure.

171. **(B)** The joint between the atlas (first cervical vertebra) and the axis (second cervical vertebra) is a pivot joint. This synovial joint allows for the rotational movement of the head, commonly referred to as the 'no' movement.

172. **(B)** The organ of Corti is the primary organ for hearing, located on the basilar membrane within the cochlea. It contains specialized hair cells that act as auditory receptors by converting mechanical vibrations into electrical nerve impulses.

173. **(C)** Steroid hormones are lipid-soluble and diffuse directly across the cell membrane. They bind to intracellular receptors to form a complex that interacts with DNA, thereby regulating the transcription of specific genes and subsequent protein synthesis.

174. **(C)** The infundibulum is the funnel-shaped distal part of the fallopian tube. It features finger-like projections called fimbriae, which move to create currents that help in the collection of the ovum after its release from the ovary.

175. **(B)** Gamete Intra-Fallopian Transfer (GIFT) involves the transfer of a donor's ovum into the fallopian tube of a female. This technology is used when the female cannot produce eggs but has a suitable environment for fertilization.

176. **(B)** Adaptive radiation is the evolutionary process where multiple species descend from a common ancestor and radiate into different ecological niches. Darwin's finches in the Galapagos are a prime example, showing varied beak shapes for different diets.

177. **(B)** Cancer cells are characterized by uncontrolled cell division and the loss of contact inhibition. 'Controlled cell division' is a feature of normal, healthy cells, whereas cancer cells divide indefinitely and often invade surrounding tissues through metastasis.

178. **(A)** In the subphylum Urochordata (Tunicata), the notochord is a temporary structure present only in the tail of the free-swimming larva. It disappears during metamorphosis as the animal matures into a sedentary, adult form.

179. **(B)** The Proximal Convoluted Tubule (PCT) of the nephron is lined with simple cuboidal epithelium featuring a brush border of microvilli. This structural adaptation significantly increases the surface area for the massive reabsorption of water and solutes.

180. **(C)** A peptide bond is a covalent chemical bond formed between two amino acids. It results from a dehydration reaction between the carboxyl group of one amino acid and the amino group of the next amino acid in the chain.

181. **(B)** The pneumotaxic centre is a neural center located in the pons region of the brainstem. Its primary role is to limit the duration of inspiration, thereby regulating the respiratory rate and preventing the over-inflation of the lungs.

182. **(A)** Individuals with blood group AB possess both A and B antigens on their red blood cells but have no anti-A or anti-B antibodies in their plasma. Consequently, they can safely receive blood from any donor group.

183. **(B)** The ascending limb of the loop of Henle is impermeable to water molecules but allows the transport of electrolytes (like sodium and chloride) into the medullary interstitium, which helps in creating the osmotic gradient for urine concentration.

184. **(C)** Implantation is the biological process where the blastocyst attaches to and embeds itself within the thickened, nutrient-rich lining of the uterus (endometrium). This event is critical for the establishment of pregnancy and the development of the placenta.

185. **(B)** Both statements are scientifically correct. Malaria is caused by Plasmodium (a protozoan) and transmitted by the female Anopheles mosquito. However, the reason merely describes the mode of transmission and does not explain the biological classification of the pathogen.

186. **(A)** This option correctly matches reproductive technologies with their functions: ICSI involves direct sperm injection into the ovum, GIFT involves gamete transfer to the fallopian tube, IUI is intrauterine insemination, and IUT is the transfer of embryos into the uterus.

187. **(B)** Statement I is false because the resting potential is not the action potential. Statement II is false because the sodium-potassium pump continues to work, but the rapid opening of voltage-gated sodium channels causes the depolarization phase of the impulse.

188. **(C)** In a population following Hardy-Weinberg equilibrium, the genotype frequency of AA is p^2. Given $360/1000 = 0.36$, the frequency of allele A is the square root of 0.36, which is 0.6. The frequency of allele 'a' would be 0.4.

189. **(B)** Binding of a new ATP molecule to the myosin head causes it to detach from the actin filament. While ATP hydrolysis provides energy for the subsequent cocking of the head, it is the binding event itself that breaks the cross-bridge.

190. **(D)** The oxygen-hemoglobin dissociation curve shifts to the right under conditions of high acidity (low pH), high temperature, and high partial pressure of carbon dioxide. These factors decrease hemoglobin's affinity for oxygen, facilitating its unloading in metabolically active tissues.

191. **(A)** Light entering the human eye travels through the cornea, then the aqueous humor, the lens, and the vitreous humor before finally striking the photoreceptors on the retina. This pathway ensures proper focusing of images on the sensory layer.

192. **(C)** Epinephrine is a catecholamine hormone that is not lipid-soluble. It cannot cross the cell membrane and must bind to specific membrane-bound receptors on the target cell's surface, triggering a cascade of secondary messengers like cyclic AMP to elicit a response.

193. **(A)** This option correctly pairs digestive enzymes with their substrates: steapsin (pancreatic lipase) acts on fats, nucleases act on nucleic acids, carboxypeptidase acts on proteins/peptides, and dipeptidases specifically break down dipeptides into individual amino acids.

194. **(A)** Both statements accurately describe the selective permeability of the Loop of Henle. The descending limb is water-permeable and salt-impermeable, while the ascending limb is water-impermeable and salt-permeable. This difference is fundamental to the counter-current multiplier system.

195. **(B)** Limulus, commonly known as the King crab, is a 'living fossil' because it has remained virtually unchanged for millions of years. It belongs to the phylum Arthropoda and possesses unique blue blood used in medical testing for bacterial endotoxins.

196. **(C)** The follicular phase is regulated by the interplay between gonadotropins (FSH and LH) from the pituitary and estrogen from the developing ovarian follicles. These hormones collectively stimulate follicle growth and the proliferation of the uterine endometrium during the cycle.

197. **(B)** The pneumotaxic centre in the pons moderates the respiratory rhythm centre by sending inhibitory signals that shorten the duration of inspiration. This prevents over-inflation of the lungs and helps in fine-tuning the respiratory rate based on bodily demands.

198. **(C)** In humans, males are heterogametic (XY) and produce two types of sperm, while females are homogametic (XX) and produce only one type of egg. The sex of the offspring is determined by whether an X or Y sperm fertilizes the egg.

199. **(B)** Thrombokinase, also known as factor Xa or prothrombinase, is a complex that catalyzes the conversion of inactive prothrombin into active thrombin. Thrombin then goes on to convert soluble fibrinogen into insoluble fibrin strands to form a blood clot.

200. **(A)** Transgenic animals have specific uses: Rosie the cow produces protein-enriched milk, transgenic mice are used for testing vaccine safety, transgenic sheep produce human alpha-1-antitrypsin, and transgenic pigs are being researched as potential sources for organ xenotransplantation.