NEET 2026 Sample Paper 1

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. Given below are two statements: Statement I: A unitless quantity can never have a non-zero dimension. Statement II: A dimensionless quantity may have a unit. Choose the correct answer:

A. Statement I is false but Statement II is true

B. Statement I is true but Statement II is false

C. Both Statement I and Statement II are true

D. Both Statement I and Statement II are false

Q2. A particle starts from rest and moves with constant acceleration. If it covers distance x in first 10 s, distance in next 10 s is:

A. x

B. $2x$

C. $3x$

D. $4x$

Q3. A block on a smooth wedge is accelerated horizontally so it does not slip. The required acceleration is:

A. $g \sin\theta$

B. $g \cos\theta$

C. $g \tan\theta$

D. $g \cot\theta$

Q4. Potential energy $U = \frac{A}{r^2} - \frac{B}{r}$. Stable equilibrium distance is:

A. $\frac{A}{B}$

B. $\frac{2A}{B}$

C. $\frac{B}{A}$

D. $\frac{B}{2A}$

Q5. Match List-I with List-II (Moment of Inertia of rod):

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

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

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

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

Q6. Height where g becomes one-fourth:

A. $R/2$

B. R

C. $\sqrt{2}R$

D. $2R$

Q7. Change in length of second wire:

A. l

B. $2l$

C. $l/2$

D. $4l$

Q8. Potential ratio of combined drop to single drop:

A. 2:1

B. 4:1

C. 8:1

D. 16:1

Q9. If $P \propto T^3$ in adiabatic process, γ is:

A. 3/2

B. 4/3

C. 5/3

D. 7/5

Q10. Assertion-Reason on rms speed vs pressure:

A. Both true, correct explanation

B. Both true, wrong explanation

C. A true, R false

D. A false, R true

Q11. Time period of SHM:

A. $\frac{\pi}{5}$

B. $\frac{2\pi}{5}$

C. $\frac{2\pi}{25}$

D. $\frac{\pi}{2.5}$

Q12. Particle velocity maximum when:

A. $kx - \omega t = \pi/2$

B. $kx - \omega t = \pi$

C. $kx - \omega t = 0$

D. $kx - \omega t = 3\pi/2$

Q13. Point where electric field is zero:

A. 12 cm from $+9e$

B. 12 cm from $+e$

C. 10 cm from $+9e$

D. 8 cm from $+e$

Q14. Capacitor plates pulled apart after disconnecting battery:

A. Capacitance increases

B. Voltage decreases

C. Charge increases

D. Energy increases

Q15. Current density in wire:

A. 10^4

B. 10^5

C. 10^6

D. 10^7

Q16. Internal resistance of cell:

A. 2.6Ω

B. 3.6Ω

C. 4.6Ω

D. 5.6Ω

Q17. Magnetic field at center of coil:

A. $\pi \times 10^{-3}$

B. $2\pi \times 10^{-3}$

C. 3.14×10^{-4}

D. 6.28×10^{-4}

Q18. Material with susceptibility -0.5×10^{-5}:

A. Paramagnetic

B. Ferromagnetic

C. Diamagnetic

D. Anti-ferromagnetic

Q19. Induced current in moving loop:

A. BLv/R

B. $2BLv/R$

C. Zero

D. BLv^2/R

Q20. Phase difference in LCR circuit:

A. 0°

B. 30°

C. 45°

D. 90°

Q21. Wave description:

A. +x direction, 10^6 Hz

B. -x direction, 10^6 Hz

C. +y direction

D. $-y$ direction

Q22. Power of lens combination:

A. $+2.5D$

B. $-2.5D$

C. $+5.0D$

D. $-5.0D$

Q23. YDSE change from red to violet:

A. Fringes brighter

B. Fringes closer

C. Minima intensity increases

D. Central fringe dark

Q24. Longest wavelength for emission:

A. 310 nm

B. 400 nm

C. 560 nm

D. 620 nm

Q25. Match hydrogen spectrum:

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

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

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

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

Q26. Mass and atomic number after decay:

A. 172, 69

B. 174, 70

C. 176, 69

D. 172, 70

Q27. Temperature effect in p-n junction:

A. Only forward resistance

B. Only reverse resistance

C. Affects V-I characteristics

D. No effect

Q28. Maximum error in kinetic energy:

A. 5%

B. 1%

C. 8%

D. 11%

Q29. Speed of second fragment:

A. $3v\cos\theta$

B. $2v\cos\theta$

C. $\frac{3}{2}v\cos\theta$

D. $\sqrt{3}v\cos\theta$

Q30. Assertion-Reason on friction:

A. Both true, correct

B. Both true, incorrect

C. A true, R false

D. A false, R true

Q31. Radius of gyration ratio (disc:ring):

A. $\sqrt{2} : 1$

B. $1 : \sqrt{2}$

C. $1 : 2$

D. $2 : 1$

Q32. Black body radiation comparison:

A. $U_1 = 0$

B. $U_3 = 0$

C. $U_1 > U_2$

D. $U_2 > U_1$

Q33. Work done on springs:

A. $W_1 = W_2$

B. $W_1 > W_2$

C. $W_2 > W_1$

D. $W_1 = W_2 = 0$

Q34. Radius of alpha particle path:

A. R

B. $2R$

C. $R/2$

D. $4R$

Q35. Phase difference for power factor 0.5:

A. $\pi/2$

B. $\pi/3$

C. $\pi/4$

D. $\pi/6$

Physics (Section B)

Q36. A screw gauge gives MSR = 0 mm, CSR = 52 divisions. If 1 mm = 100 divisions, diameter is:

A. $0.52cm$

B. $0.052cm$

C. $0.026cm$

D. $0.0052cm$

Q37. A body of mass $0.5kg$ moves with $v = ax^{3/2}$ where $a = 5$. Work done from $x = 0$ to $x = 2$ m is:

A. $1.5J$

B. $50J$

C. $10J$

D. $100J$

Q38. A ring of mass M rotates with angular velocity ω. Two masses m are attached at opposite ends. New angular velocity is:

A. $\frac{\omega M}{M+m}$

B. $\frac{\omega M}{M+2m}$

C. $\frac{\omega(M-2m)}{M+2m}$

D. $\frac{\omega(M+2m)}{M}$

Q39. Temperature at which rms speed of Ar equals rms speed of He at $-20°C$:

A. $2.53 \times 10^3 K$

B. $1.01 \times 10^3 K$

C. $3.14 \times 10^3 K$

D. $4.22 \times 10^3 K$

Q40. Carnot engine efficiency increases from 40% to 50% (source = 500 K). Sink temperature decreases by:

A. $50K$

B. $100K$

C. $250K$

D. $200K$

Q41. Dipole moment of charges at given coordinates is:

A. $\sqrt{2}qa$ along diagonal

B. qa along diagonal

C. $\sqrt{2}qa$ along $+x$

D. $\sqrt{2}qa$ along $+y$

Q42. Metre bridge null shifts from 33.7 cm to 51.9 cm after adding 12 in parallel. Values of R and S:

A. $13.5\Omega, 6.8\Omega$

B. $6.8\Omega, 13.5\Omega$

C. $10.2\Omega, 5.1\Omega$

D. $5.1\Omega, 10.2\Omega$

Q43. Force per unit length between two parallel wires (1 A, 1 m apart):

A. $2 \times 10^{-7} N/m$

B. $4\pi \times 10^{-7} N/m$

C. $10^{-7} N/m$

D. $2\pi \times 10^{-7} N/m$

Q44. Mutual inductance of small loop inside large loop is proportional to:

A. l/L

B. l^2/L

C. L/l

D. L^2/l

Q45. Biconvex lens (f = 10 cm) cut along principal axis. New focal length:

A. $10cm$

B. $20cm$

C. $5cm$

D. Infinite

Q46. Threshold frequency 3.3×10^{14} Hz, incident 8.2×10^{14} Hz. Cut-off voltage:

A. $1.0V$

B. $2.0V$

C. $3.0V$

D. $5.0V$

Q47. If 10% decays in 5 days, remaining after 20 days:

A. 60%

B. 65.6%

C. 70%

D. 75%

Q48. Common emitter amplifier input voltage:

A. $10mV$

B. $20mV$

C. $30mV$

D. $15mV$

Q49. Pipe half dipped in water. New fundamental frequency:

A. $f/2$

B. $3f/4$

C. f

D. $2f$

Q50. Percentage error in $P = \frac{a^3b^2}{\sqrt{cd}}$:

A. 13%

B. 12%

C. 10%

D. 14%

Chemistry (Section A)

Q51. What is the mass of precipitate formed when 50 mL of 16.9% (w/v) solution of $AgNO_3$ is mixed with 50 mL of 5.8% (w/v) $NaCl$ solution? $(Ag = 107.8, N = 14, O = 16, Na = 23, Cl = 35.5)$

A. 3.5 g

B. 7.17 g

C. 14.35 g

D. 28.7 g

Q52. The correct set of four quantum numbers for the valence electron of Rubidium atom $(Z = 37)$ is:

A. $5, 0, 0, +1/2$

B. $5, 1, 0, +1/2$

C. $5, 1, 1, +1/2$

D. $6, 0, 0, +1/2$

Q53. Which of the following orders of ionic radii is correctly represented?

A. $H^- > H^+ > H$

B. $Na^+ > F^- > O^{2-}$

C. $F^- > O^{2-} > Na^+$

D. $N^{3-} > O^{2-} > F^-$

Q54. Match List-I (Molecules) with List-II (Shapes) according to VSEPR theory: (a) PCl_5 (b) SF_6 (c) BrF_5 (d) BF_3

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

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

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

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

Q55. For the reaction $X_2O_4(l) \rightarrow 2XO_2(g)$, $\Delta U = 2.1kcal$, $\Delta S = 20calK^{-1}$ at $300K$. Then ΔG is:

A. $2.7kcal$

B. $-2.7kcal$

C. $9.3kcal$

D. $-9.3kcal$

Q56. The pK_a of a weak acid (HA) is 4.8. The pK_b of a weak base (BOH) is 4.78. The pH of an aqueous solution of the corresponding salt (BA) will be:

A. 4.79

B. 7.01

C. 9.22

D. 8.58

Q57. In which of the following compounds, nitrogen exhibits the highest oxidation state?

A. N_2H_4

B. NH_3

C. N_3H

D. NH_2OH

Q58. A solution containing 10 g per dm^3 of urea (molecular mass $= 60gmol^{-1}$) is isotonic with a 5% (w/v) solution of a non-volatile solute. The molecular mass of this non-volatile solute is:

A. $200gmol^{-1}$

B. $250gmol^{-1}$

C. $300gmol^{-1}$

D. $350gmol^{-1}$

Q59. The electrode potential of a hydrogen electrode in contact with a solution having $pH = 10$ is:

A. $0.591V$

B. $0.059V$

C. $-0.591V$

D. $-0.059V$

Q60. For a first-order reaction, the time required for 99% completion is x times the time required for the completion of 90% of the reaction. The value of x is:

A. 2

B. 3

C. 4

D. 10

Q61. Which of the following lanthanoid ions is diamagnetic? (Atomic numbers: $Ce = 58, Sm = 62, Eu = 63, Yb = 70$)

A. Ce^{2+}

B. Sm^{2+}

C. Eu^{2+}

D. Yb^{2+}

Q62. The number of geometrical isomers possible for the complex $[Co(en)_2Cl_2]^+$ is:

A. 2

B. 3

C. 4

D. 1

Q63. Which of the following alkyl halides will undergo S_N1 reaction most readily?

A. $(CH_3)_3C - F$

B. $(CH_3)_3C - Cl$

C. $(CH_3)_3C - Br$

D. $(CH_3)_3C - I$

Q64. When phenol is treated with excess of bromine water, it gives:

A. *m*-bromophenol

B. *o*- and *p*-bromophenol

C. 2,4-dibromophenol

D. 2,4,6-tribromophenol

Q65. An organic compound 'A' on treatment with $CHCl_3$ and KOH gives 'B' which on heating with $NaOH$ gives 'C'. Compound 'C' on treatment with I_2 and $NaOH$ gives a yellow precipitate. Identify 'A':

A. Aniline

B. Ethanamine

C. Propan-2-amine

D. Methanamine

Q66. The correct order of basic strength of the following 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. $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$

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

Q67. Which of the following is a non-reducing sugar?

A. Glucose

B. Sucrose

C. Maltose

D. Lactose

Q68. Which of the following oxoacids of phosphorus has a $P - P$ bond?

A. $H_4P_2O_7$

B. $H_4P_2O_8$

C. $H_4P_2O_6$

D. $(HPO_3)_3$

Q69. An element has a face-centered cubic (fcc) structure with a cell edge of a. The distance between the centers of two nearest atoms is:

A. $\frac{a}{2}$

B. $a\sqrt{2}$

C. $\frac{a}{\sqrt{2}}$

D. $\frac{\sqrt{3}a}{2}$

Q70. Which of the following is an example of a 'sol'?

A. Butter

B. Paints

C. Dust

D. Pumice stone

Q71. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of:

A. two ethyl groups

B. a vinyl group

C. an isopropyl group

D. an acetylenic triple bond

Q72. Match List-I (Polymers) with List-II (Monomers):

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

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

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

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

Q73. Which of the following is used as an 'antihistamine'?

A. Omeprazole

B. Chloramphenicol

C. Seldane

D. Norethindrone

Q74. Which of the following is most stable?

A. $CH_3 - CH_2^+$

B. $CH_2 = CH - CH_2^+$

C. $C_6H_5 - CH_2^+$

D. $(C_6H_5)_3C^+$

Q75. 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. $-1.2\Delta_o$

Q76. For a binary ideal liquid solution, the total vapor pressure of the solution is given by:

A. $P_{total} = P_A^o + (P_B^o - P_A^o)x_B$

B. $P_{total} = P_B^o + (P_A^o - P_B^o)x_B$

C. $P_{total} = P_A^o + (P_A^o - P_B^o)x_B$

D. $P_{total} = P_B^o + (P_B^o - P_A^o)x_B$

Q77. Which of the following is not a greenhouse gas?

A. Methane

B. Carbon dioxide

C. Nitrogen

D. Nitrous oxide

Q78. The solubility of alkaline earth metal sulfates in water decreases in the order:

A. $Mg > Ca > Sr > Ba$

B. $Ba > Sr > Ca > Mg$

C. $Ca > Sr > Ba > Mg$

D. $Sr > Ca > Mg > Ba$

Q79. Assertion (A): BF_3 is a weaker Lewis acid than BCl_3. Reason (R): Due to $p\pi - p\pi$ back bonding, the electron deficiency of B in BF_3 is reduced more.

A. Both true and R explains A

B. Both true but R does not explain A

C. A true, R false

D. A false, R true

Q80. Match reagents with functional groups:

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

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

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

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

Q81. Statement I: For an isolated system, $\Delta U = 0$, then $\Delta S > 0$. Statement II: For a spontaneous process in an isolated system, entropy increases.

A. Both true

B. Both false

C. I true, II false

D. I false, II true

Q82. How many coulombs are required for the oxidation of 1 mol of H_2O to O_2?

A. 4.825×10^5

B. 9.65×10^4

C. 1.93×10^5

D. 3.86×10^5

Q83. Benzene $\rightarrow CH_3Cl/AlCl_3 \rightarrow$ A $\rightarrow KMnO_4/OH^- \rightarrow$ B $\rightarrow PCl_5 \rightarrow$ C $\rightarrow H_2/Pd-BaSO_4 \rightarrow$ D. Identify D:

A. Benzoic acid

B. Benzyl alcohol

C. Benzaldehyde

D. Acetophenone

Q84. Which of the following ions is most stable in aqueous solution?

A. V^{3+}

B. Ti^{3+}

C. Mn^{3+}

D. Cr^{3+}

Q85. According to the collision theory, most collisions do not lead to a reaction because:

A. insufficient kinetic energy

B. incorrect orientation

C. both A and B

D. none of these

Chemistry (Section B)

Q86. An element crystallizes in a structure having fcc unit cell of edge $200pm$. Calculate its density if $200g$ of this element contains 24×10^{23} atoms:

A. $41.6g/cm^3$

B. $20.8g/cm^3$

C. $10.4g/cm^3$

D. $5.2g/cm^3$

Q87. The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is:

A. Diamminechlorido(methylamine)platinum(II) chloride

B. Diamminechloro(aminomethane)platinum(II) chloride

C. Diamminechlorido(methanamine)platinum(II) chloride

D. Bisamminechlorido(methylamine)platinum(II) chloride

Q88. Identify the major product 'Z' in the sequence: Phenol Zn, Δ X $CH_3Cl/AlCl_3$ Y $KMnO_4/H^+$ Z

A. Benzaldehyde

B. Benzoic acid

C. Benzyl alcohol

D. Toluene

Q89. The rate constant of a reaction is $2 \times 10^{-3}s^{-1}$ at $300K$ and $8 \times 10^{-3}s^{-1}$ at $320K$. The activation energy (E_a) is: $(R = 8.314Jmol^{-1}K^{-1})$

A. $45.26kJ/mol$

B. $55.33kJ/mol$

C. $65.41kJ/mol$

D. $35.12kJ/mol$

Q90. Which of the following noble gas compounds is isostructural with IBr_2^-?

A. XeF_2

B. XeF_4

C. XeO_3

D. XeO_2F_2

Q91. The correct order of increasing field strength of ligands is:

A. $SCN^- < F^- < C_2O_4^{2-} < CN^-$

B. $F^- < SCN^- < C_2O_4^{2-} < CN^-$

C. $CN^- < C_2O_4^{2-} < SCN^- < F^-$

D. $SCN^- < F^- < CN^- < C_2O_4^{2-}$

Q92. Assertion (A): Molar conductivity of strong electrolytes decreases sharply with increase in concentration. Reason (R): Interionic attractions increase with concentration.

A. Both true and R explains A

B. Both true but R does not explain A

C. A false, R true

D. A true, R false

Q93. Match List-I with List-II (Biomolecules):

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)-(i), (c)-(iii), (d)-(iv)

Q94. Statement I: Adsorption is always exothermic. Statement II: Physical adsorption is specific whereas chemical adsorption is non-specific.

A. Both true

B. Both false

C. I true, II false

D. I false, II true

Q95. The freezing point of a 0.05 molal solution of a non-electrolyte in water is: ($K_f = 1.86$)

A. $-1.86°C$

B. $-0.93°C$

C. $-0.093°C$

D. $0.093°C$

Q96. In the extraction of copper from its sulfide ore, the metal is obtained by reduction of cuprous oxide with:

A. Carbon monoxide

B. Copper(I) sulfide

C. Sulfur dioxide

D. Iron(II) sulfide

Q97. An organic compound 'A' (C_3H_6O) resists oxidation but gives orange-red ppt with 2,4-DNP. Identify A:

A. Propanal

B. Propan-2-ol

C. Propanone

D. Methyl vinyl ether

Q98. A buffer is prepared using 10 mL of 1.0 M acetic acid and 20 mL of 0.5 M sodium acetate. ($pK_a = 4.76$). pH is:

A. 4.76

B. 5.06

C. 4.46

D. 7.00

Q99. The spin-only magnetic moment of Fe^{2+} in aqueous solution is:

A. $5.92BM$

B. $4.90BM$

C. $3.87BM$

D. $2.84BM$

Q100. Which of the following is a polyamide polymer?

A. Terylene

B. Bakelite

C. Nylon 6,6

D. Teflon

Botany (Section A)

Q101. Which of the following is the correct sequence of taxonomic categories in descending order?

A. Kingdom → Phylum → Class → Order → Family → Genus → Species

B. Kingdom → Class → Phylum → Family → Order → Genus → Species

C. Kingdom → Phylum → Order → Class → Family → Genus → Species

D. Species → Genus → Family → Order → Class → Phylum → Kingdom

Q102. Given below are two statements: Statement I: In the five-kingdom classification, Chlamydomonas and Chlorella were placed in Kingdom Protista. Statement II: The five-kingdom classification was based on cell structure, body organization, mode of nutrition, and phylogenetic relationships.

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is true but Statement II is false.

D. Statement I is false but Statement II is true.

Q103. Which of the following algae contains chlorophyll a, d and phycoerythrin?

A. Ectocarpus

B. Porphyra

C. Volvox

D. Dictyota

Q104. Identify the correct match regarding the aestivation of petals:

A. Valvate — Calotropis

B. Twisted — Cassia

C. Imbricate — China rose

D. Vexillary — Gulmohur

Q105. In a dicot root, the vascular bundles are described as:

A. Conjoint and open

B. Radial with exarch xylem

C. Conjoint and closed

D. Radial with endarch xylem

Q106. Match List-I with List-II regarding Cell Cycle stages: (a) S phase (b) G2 phase (c) G1 phase (d) G0 phase

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

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

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

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

Q107. Assertion (A): The movement of water through the xylem is unidirectional. Reason (R): Transpiration pull and root pressure are the main driving forces for the upward movement of water.

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.

Q108. In the Z-scheme of light reaction, the electrons are transferred from PS-II to PS-I via:

A. $NADP^+$

B. Plastoquinone and Cytochrome b_6f complex

C. Oxygen evolving complex

D. ATP synthase

Q109. What is the net gain of ATP molecules during the complete oxidation of one molecule of glucose in aerobic respiration?

A. 2

B. 4

C. 36 or 38

D. 12

Q110. Which plant hormone is primarily responsible for inducing seed dormancy and closing of stomata during water stress?

A. Auxin

B. Gibberellin

C. Abscisic acid

D. Ethylene

Q111. The functional megaspore in an angiosperm develops into:

A. Endosperm

B. Embryo sac

C. Embryo

D. Ovule

Q112. How many meiotic divisions are required to produce 100 seeds in a typical angiosperm?

A. 100

B. 125

C. 200

D. 400

Q113. In a dihybrid cross ($RrYy \times RrYy$), what is the probability of obtaining offspring with the genotype $rrYY$?

A. 1/16

B. 2/16

C. 3/16

D. 9/16

Q114. If the sequence of one strand of DNA is $5' - ATGCATGC - 3'$, what will be the sequence of the complementary strand in $5' \rightarrow 3'$ direction?

A. $3' - TACGTACG - 5'$

B. $5' - TACGTACG - 3'$

C. $5' - GCATGCAT - 3'$

D. $3' - GCATGCAT - 5'$

Q115. During the process of translation, the role of the enzyme aminoacyl-tRNA synthetase is:

A. To join amino acids by peptide bonds

B. To charge the tRNA with a specific amino acid

C. To initiate the movement of ribosome

D. To terminate the polypeptide chain

Q116. In the lac operon, the repressor protein binds to which region to prevent transcription?

A. Promoter

B. Operator

C. Structural genes

D. Inducer

Q117. Which of the following is a primary consumer in a grazing food chain?

A. Grass

B. Rabbit

C. Snake

D. Eagle

Q118. The historic Convention on Biological Diversity, 'The Earth Summit', was held in Rio de Janeiro in:

A. 1992

B. 2002

C. 1987

D. 1972

Q119. Large conspicuous parenchymatous ground tissue and numerous scattered vascular bundles are characteristic features of:

A. Dicot stem

B. Monocot stem

C. Dicot root

D. Monocot root

Q120. Identify the incorrect statement regarding C_4 plants:

A. They have Kranz anatomy in their leaves.

B. The primary CO_2 acceptor is Phosphoenolpyruvate (PEP).

C. The first stable product is 3-phosphoglyceric acid (PGA).

D. They show a lack of photorespiration.

Q121. In meiosis, crossing over occurs between:

A. Sister chromatids of homologous chromosomes

B. Non-sister chromatids of non-homologous chromosomes

C. Non-sister chromatids of homologous chromosomes

D. Sister chromatids of non-homologous chromosomes

Q122. Which of the following plants does NOT show vegetative propagation through offsets?

A. Pistia

B. Eichhornia

C. Agave

D. All of the above show propagation through offsets.

Q123. The thickness of ozone in a column of air from the ground to the top of the atmosphere is measured in terms of:

A. Decibels

B. Dobson units

C. Pascal

D. Nanometers

Q124. Match List-I (Secondary Metabolites) with List-II (Category): (a) Morphine (b) Curcumin (c) Concanavalin A (d) Lemon grass oil

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

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

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

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

Q125. Which mineral element is required for the synthesis of the middle lamella in plant cells?

A. Magnesium

B. Calcium

C. Potassium

D. Iron

Q126. A DNA molecule is 1000 base pairs long. If the content of Adenine is 20%, what will be the number of Guanine bases?

A. 200

B. 300

C. 400

D. 600

Q127. In the process of semi-conservative DNA replication, the Okazaki fragments are joined by:

A. DNA Polymerase I

B. DNA Helicase

C. DNA Ligase

D. RNA Primase

Q128. Which of the following is NOT an outbreeding device used by plants to prevent self-pollination?

A. Pollen release and stigma receptivity are not synchronized.

B. Anther and stigma are placed at different positions.

C. Self-incompatibility.

D. Presence of cleistogamous flowers.

Q129. The concept of "Omnis cellula-e cellula" regarding cell division was first proposed by:

A. Rudolf Virchow

B. Theodore Schwann

C. Matthias Schleiden

D. Robert Hooke

Q130. During the formation of a peptide bond, a molecule of water is eliminated. This process is known as:

A. Hydration

B. Dehydration synthesis

C. Hydrolysis

D. Decarboxylation

Q131. In cyclic photophosphorylation, the high-energy electrons are cycled back to:

A. $NADP^+$

B. Chlorophyll P_{680}

C. Chlorophyll P_{700}

D. Water

Q132. Double fertilization is a unique feature of:

A. Bryophytes

B. Pteridophytes

C. Gymnosperms

D. Angiosperms

Q133. The enzyme nitrogenase, which is essential for biological nitrogen fixation, is highly sensitive to:

A. Nitrogen

B. Hydrogen

C. Oxygen

D. Carbon dioxide

Q134. Which ecological pyramid is ALWAYS upright in a stable ecosystem?

A. Pyramid of Number

B. Pyramid of Biomass in a pond

C. Pyramid of Energy

D. Both (A) and (C)

Q135. Mendel's law of independent assortment is based on the observations of:

A. Monohybrid cross

B. Dihybrid cross

C. Test cross

D. Back cross

Botany (Section B)

Q136. In the classic Hershey-Chase experiment proving DNA is the genetic material, which radioactive isotopes were used to label the viral DNA and protein coat, respectively?

A. ^{14}C and ^{15}N

B. ^{32}P and ^{35}S

C. ^{35}S and ^{32}P

D. ^{15}N and ^{32}P

Q137. The independent, free-living, photosynthetic gametophyte stage of a pteridophyte (like a fern) is called a:

A. Protonema

B. Sporangium

C. Prothallus

D. Strobilus

Q138. During secondary growth in dicot stems, the phellogen, phellem, and phelloderm are collectively known as the:

A. Bark

B. Periderm

C. Vascular cambium

D. Stele

Q139. In a mango, which is a fleshy fruit known as a drupe, the edible, fleshy, and juicy portion is the:

A. Epicarp

B. Endocarp

C. Mesocarp

D. Thalamus

Q140. Which of the following cell organelles is strictly NOT considered a part of the endomembrane system?

A. Endoplasmic reticulum

B. Golgi complex

C. Lysosome

D. Mitochondrion

Q141. "Uphill" transport across a cell membrane, which transports substances against their concentration gradient and requires ATP energy, is a characteristic of:

A. Simple diffusion

B. Facilitated diffusion

C. Active transport

D. Osmosis

Q142. The enzyme nitrogenase, which is highly sensitive to molecular oxygen and essential for biological nitrogen fixation, requires which metal ion as a crucial component?

A. Copper (Cu)

B. Molybdenum (Mo)

C. Zinc (Zn)

D. Boron (B)

Q143. According to the chemiosmotic hypothesis of ATP synthesis in chloroplasts, the breakdown of the proton gradient provides the energy for ATP formation. Where do these protons accumulate to create this gradient?

A. In the stroma

B. In the inner membrane space

C. In the thylakoid lumen

D. Outside the chloroplast

Q144. In the first step of the TCA cycle (Krebs cycle), the 2-carbon acetyl group combines with which 4-carbon compound to form citric acid?

A. Malic acid

B. Succinic acid

C. Alpha-ketoglutaric acid

D. Oxaloacetic acid (OAA)

Q145. Plants that require exposure to light for a period strictly shorter than their critical photoperiod to initiate flowering are classified as:

A. Long-day plants

B. Short-day plants

C. Day-neutral plants

D. Long-short day plants

Q146. To prevent autogamy (self-pollination), many flowering plants have evolved mechanisms where the pollen is released and the stigma becomes receptive at completely different times. This specific mechanism is called:

A. Dichogamy

B. Herkogamy

C. Heterostyly

D. Cleistogamy

Q147. A genetic cross between an F1 hybrid organism and its homozygous recessive parent is known as a:

A. Back cross

B. Test cross

C. Reciprocal cross

D. Dihybrid cross

Q148. In a molecular transcription unit, the promoter region—the binding site for RNA polymerase—is conventionally located at the:

A. 3' end (downstream) of the template strand

B. 5' end (upstream) of the coding strand

C. Center of the structural gene

D. 3' end of the terminator region

Q149. An ecological interaction in which one species benefits while the other species is neither harmed nor benefited is termed:

A. Mutualism

B. Parasitism

C. Commensalism

D. Amensalism

Q150. The phenomenon where the concentration of a toxic substance, such as DDT, increases at successive trophic levels in an aquatic food chain is known as:

A. Eutrophication

B. Biomagnification

C. Biofortification

D. Biochemical oxygen demand

Zoology (Section A)

Q151. Which of the following sets of animals belong to a single taxonomic group?

A. Cuttlefish, Jellyfish, Silverfish, Dogfish, Starfish

B. Bat, Pigeon, Butterfly

C. Monkey, Chimpanzee, Man

D. Silkworm, Tapeworm, Earthworm

Q152. Match List-I with List-II regarding Animal Phyla and their characteristic features: (a) Porifera, (b) Aschelminthes, (c) Annelida, (d) Coelenterata

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

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

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

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

Q153. The mouthparts of a cockroach are of the biting and chewing type. Which of the following parts acts as a tongue?

A. Labrum

B. Labium

C. Hypopharynx

D. Maxilla

Q154. Identify the incorrect statement regarding the human heart:

A. The nodal tissue is auto-excitable.

B. The SAN can generate the maximum number of action potentials.

C. The AVN is located in the lower-left corner of the right atrium.

D. The Purkinje fibers are found only in the walls of the atria.

Q155. Which of the following is a symptom of Emphysema?

A. Inflammation of the bronchi and bronchioles.

B. Increase in the surface area for gas exchange.

C. Damage to alveolar walls due to cigarette smoking.

D. Excess mucous production in the nasal cavity.

Q156. The solubility of CO_2 is _____ times higher than that of O_2 across the diffusion membrane.

A. 2–5

B. 10–15

C. 20–25

D. 40–50

Q157. Match the following disorders with their descriptions: (a) Gout, (b) Myasthenia gravis, (c) Muscular dystrophy, (d) Tetany

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

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

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

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

Q158. In the human kidney, the Juxtaglomerular Apparatus (JGA) is formed by cellular modifications in the:

A. DCT and Efferent arteriole

B. PCT and Afferent arteriole

C. DCT and Afferent arteriole

D. Loop of Henle and Efferent arteriole

Q159. Which of the following hormones is a steroid hormone?

A. Epinephrine

B. Thyroxine

C. Cortisol

D. Glucagon

Q160. The "Fight or Flight" response is mediated by the release of hormones from the:

A. Adrenal cortex

B. Adrenal medulla

C. Anterior pituitary

D. Pancreas

Q161. A person with blood group AB is considered a universal recipient because he/she has:

A. Both A and B antigens on RBCs but no antibodies in the plasma.

B. Both A and B antibodies in the plasma.

C. No antigens on RBCs and no antibodies in the plasma.

D. Only A antigen on RBCs and B antibody in the plasma.

Q162. Assertion (A): The human male ejaculates about 200 to 300 million sperm during a coitus. Reason (R): For normal fertility, at least 60% sperm must have normal shape and size and 40% must show vigorous motility.

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.

Q163. The part of the fallopian tube closest to the ovary is the:

A. Ampulla

B. Isthmus

C. Infundibulum

D. Cervix

Q164. Which of the following is an example of a non-medicated IUD?

A. Lippes loop

B. Multiload 375

C. CuT

D. LNG-20

Q165. Select the correct statement regarding Assisted Reproductive Technologies (ART):

A. ZIFT involves the transfer of an embryo with more than 8 blastomeres into the fallopian tube.

B. GIFT is the transfer of an ovum collected from a donor into the fallopian tube of another female.

C. ICSI is a procedure where the sperm is released near the cervix.

D. IUI is used when the female partner cannot produce an ovum.

Q166. In a person suffering from Phenylketonuria, the enzyme that converts phenylalanine into _____ is missing.

A. Valine

B. Tyrosine

C. Tryptophan

D. Glutamic acid

Q167. Which of the following is NOT a feature of the Genetic Code?

A. Degeneracy

B. Universal

C. Overlapping

D. Unambiguous

Q168. The "Theory of Natural Selection" was given by Charles Darwin after his observations on the:

A. Malay Archipelago

B. Galapagos Islands

C. Australian grasslands

D. African savannah

Q169. Statement I: Homologous organs are a result of divergent evolution. Statement II: Analogous organs are a result of convergent evolution.

A. Statement I is correct, Statement II is incorrect.

B. Statement I is incorrect, Statement II is correct.

C. Both statements are correct.

D. Both statements are incorrect.

Q170. Which of the following diseases is caused by a protozoan?

A. Ascariasis

B. Elephantiasis

C. Amoebiasis

D. Ringworm

Q171. Passive immunity is achieved by the injection of:

A. Antigens

B. Antibodies

C. Weakened pathogens

D. Toxoids

Q172. The use of bio-resources by multinational companies without proper authorization is called:

A. Bio-remediation

B. Bio-fortification

C. Bio-piracy

D. Bio-magnification

Q173. Which enzyme is used to cut DNA at specific sites?

A. DNA Ligase

B. DNA Polymerase

C. Restriction Endonuclease

D. Reverse Transcriptase

Q174. The ADA deficiency can be cured by _____ if diagnosed early in embryonic stages.

A. Bone marrow transplantation

B. Enzyme replacement therapy

C. Gene therapy

D. Antibiotics

Q175. In a population, if the birth rate is 0.15 and the death rate is 0.05, what is the intrinsic rate of natural increase (r)?

A. 0.20

B. 0.10

C. 0.0075

D. 1.50

Q176. Which of the following interactions is represented by (+, 0)?

A. Mutualism

B. Parasitism

C. Commensalism

D. Amensalism

Q177. The most important cause of biodiversity loss today is:

A. Over-exploitation

B. Alien species invasion

C. Habitat loss and fragmentation

D. Co-extinctions

Q178. What was the purpose of the Montreal Protocol?

A. To reduce greenhouse gas emissions.

B. To limit the use of ozone-depleting substances.

C. To manage hazardous waste.

D. To protect endangered species.

Q179. The primary oocyte completes its first meiotic division within the:

A. Primary follicle

B. Secondary follicle

C. Tertiary follicle

D. Graafian follicle

Q180. The first life forms on earth were likely:

A. Photoautotrophs

B. Chemoheterotrophs

C. Aerobic bacteria

D. Eukaryotic algae

Q181. Match the following components of immune system: (a) Physical barrier, (b) Physiological barrier, (c) Cellular barrier, (d) Cytokine barrier

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

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

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

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

Q182. A prosthetic group is a type of cofactor that is _____ bound to the apoenzyme.

A. Loosely

B. Tightly

C. Transiently

D. Non-covalently

Q183. The secondary metabolites like Vinblastin and Curcumin are used as:

A. Pigments

B. Drugs

C. Spices

D. Toxins

Q184. In the mechanism of action of a protein hormone, the 'second messenger' could be:

A. cAMP

B. IP_3

C. Ca^{++}

D. All of the above

Q185. The technical term for the 'yellow body' formed after ovulation is:

A. Corpus albicans

B. Corpus luteum

C. Corpus callosum

D. Corpus cavernosum

Zoology (Section B)

Q186. Which of the following events is NOT associated with the 'LH surge' during the human menstrual cycle?

A. Rapid secretion of LH leading to its maximum level.

B. Rupture of the Graafian follicle.

C. Immediate formation of the Corpus albicans.

D. Release of the secondary oocyte (ovulation).

Q187. In the pBR322 cloning vector, if a foreign DNA is ligated at the BamHI site of the tetracycline resistance (tet^R) gene, the transformants will:

A. Lose resistance to ampicillin.

B. Show resistance to both ampicillin and tetracycline.

C. Grow on ampicillin-containing medium but not on tetracycline-containing medium.

D. Grow on tetracycline-containing medium but not on ampicillin-containing medium.

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. Match List-I with List-II regarding types of fishes: — List-I (Feature) — List-II (Animal) — — :— — :— — — (a) Operculum present — (i) Pristis — — (b) Placoid scales — (ii) Exocoetus — — (c) Air bladder present — (iii) Carcharodon — — (d) Persistent notochord — (iv) Labeo — Choose the correct option:

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

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

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

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

Q190. During an allergic reaction, which of the following types of antibodies are produced in high quantities, and which cells release histamine?

A. IgG and Mast cells

B. IgE and Basophils

C. IgA and T-lymphocytes

D. IgM and Macrophages

Q191. Which type of junction facilitates cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions and small molecules?

A. Tight junctions

B. Adhering junctions

C. Gap junctions

D. Hemidesmosomes

Q192. Which of the following is the correct sequence of steps in the digestion and absorption of fats in humans?

A. Emulsification → Micelles → Chylomicrons → Lacteals

B. Micelles → Emulsification → Chylomicrons → Blood capillaries

C. Emulsification → Chylomicrons → Micelles → Lacteals

D. Chylomicrons → Micelles → Emulsification → Lymph

Q193. Choose the CORRECT statement regarding the human eye:

A. The space between the cornea and the lens is called the vitreous chamber.

B. The rhodopsin is a purplish-red protein which contains a derivative of Vitamin A.

C. The optic nerve leaves the eye at a point called the fovea.

D. The ciliary body itself continues forward to form a transparent structure called the iris.

Q194. Which of the following hormones does NOT act via a secondary messenger (like cAMP or IP_3)?

A. Epinephrine

B. Insulin

C. Estrogen

D. Glucagon

Q195. Assertion (A): The globular head of myosin is an active ATPase enzyme. Reason (R): It has binding sites for ATP and active sites for actin.

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.

Q196. The counter-current mechanism in the mammalian kidney operates between:

A. Ascending limb and descending limb of the Loop of Henle.

B. Descending limb of Loop of Henle and ascending limb of vasa recta.

C. Ascending limb of Loop of Henle and descending limb of vasa recta.

D. All of the above.

Q197. Competitive inhibition of an enzyme can be overcome by:

A. Increasing the concentration of the substrate.

B. Decreasing the concentration of the substrate.

C. Increasing the concentration of the inhibitor.

D. Adding a non-competitive inhibitor.

Q198. Which of the following is a 'once-a-week' non-steroidal oral contraceptive pill developed by scientists at CDRI, Lucknow?

A. Mala-D

B. Saheli

C. Quinolone

D. Gossypol

Q199. In the logistic growth model, when the population density (N) reaches the carrying capacity (K), the rate of population growth (dN/dt) becomes:

A. Maximum

B. Zero

C. Negative

D. rN

Q200. The Human Genome Project (HGP) revealed that the total number of genes is about 30,000 and that _____% of the genome codes for proteins.

A. Less than 2%

B. About 10%

C. Exactly 50%

D. More than 98%

Solutions

1. **(A)** Statement I is false because a unitless quantity must always be dimensionless; it is impossible for a quantity to have dimensions without having a unit. However, Statement II is true because certain dimensionless quantities, such as plane angles and solid angles, are assigned specific units like radians and steradians in the International System of Units.

2. **(C)** For a particle starting from rest with constant acceleration, the displacement is proportional to the square of time ($s = \frac{1}{2}at^2$). In the first 10 seconds, it covers $x = \frac{1}{2}a(10)^2$. In 20 seconds, the total distance is $S_{20} = \frac{1}{2}a(20)^2 = 4x$. Thus, the distance covered specifically in the "next" 10 seconds is $4x - x = 3x$.

3. **(C)** To ensure the block remains stationary relative to the wedge, the horizontal pseudo-force ma must balance the horizontal component of the normal force, or more simply, the net force along the incline must be zero. This condition is satisfied when the horizontal acceleration a is equal to $g\tan\theta$, where θ is the angle of the wedge's inclination.

4. **(B)** Stable equilibrium occurs at the point where the first derivative of the potential energy with respect to r is zero and the second derivative is positive. By differentiating $U = \frac{A}{r^2} - \frac{B}{r}$, we set $-\frac{2A}{r^3} + \frac{B}{r^2} = 0$, which yields the stable equilibrium distance $r = \frac{2A}{B}$.

5. **(C)** The moment of inertia of a rod about an axis through its center and perpendicular to its length is $\frac{1}{12}ML^2$, while about an axis through one end it is $\frac{1}{3}ML^2$. When the axis is tilted at an angle θ to the length, these values are modified by a factor of $\sin^2\theta$, leading to the matches (a)-(ii), (b)-(i), (c)-(iv), and (d)-(iii).

6. **(B)** The acceleration due to gravity at a height h is given by $g' = g\left(\frac{R}{R+h}\right)^2$. For g' to be one-fourth of g, the term $\left(\frac{R}{R+h}\right)^2$ must equal $\frac{1}{4}$, which implies $\frac{R}{R+h} = \frac{1}{2}$. Solving this linear equation for h gives a height exactly equal to the radius of the Earth R.

7. **(A)** Young's modulus (Y) is defined as $\frac{FL}{Al}$. Rearranging for elongation gives $l = \frac{FL}{AY}$. For the second wire, the new elongation l' is $\frac{(2F)(2L)}{(\pi(2r)^2)Y} = \frac{4FL}{4AY}$, which simplifies back to the original elongation l, meaning the change in length remains identical despite the increased dimensions and force.

8. **(B)** When eight droplets of radius r coalesce, the volume of the large drop is $8 \times \frac{4}{3}\pi r^3$, making its new radius $R = 2r$. The total charge Q is $8q$. The potential V of a sphere is $\frac{kQ}{R}$, so the new potential is $\frac{k(8q)}{2r} = 4 \times \frac{kq}{r}$, resulting in a potential ratio of 4:1.

9. **(A)** For an adiabatic process, the relationship between pressure and temperature is $P^{1-\gamma}T^{\gamma} = constant$, which can be written as $P \propto T^{\frac{\gamma}{\gamma-1}}$. Given $P \propto T^3$, we set $\frac{\gamma}{\gamma-1} = 3$. Solving this for γ gives $3\gamma - 3 = \gamma$, which simplifies to $2\gamma = 3$, thus the ratio of specific heats γ is 1.5 or 3/2.

10. **(A)** The root mean square speed is given by $v_{rms} = \sqrt{\frac{3RT}{M}}$. At a constant temperature, v_{rms} depends only on the temperature and molar mass. According to the ideal gas law ($P = \rho\frac{RT}{M}$), if pressure increases, the density ρ increases proportionally, keeping the ratio P/ρ and thus the v_{rms} constant.

11. **(B)** In Simple Harmonic Motion, the maximum velocity is $v_{max} = A\omega$ and maximum acceleration is $a_{max} = A\omega^2$. Dividing a_{max} by v_{max} gives the angular frequency $\omega = \frac{50}{10} = 5rad/s$. The time period T is calculated using the formula $2\pi/\omega$, which results in a value of $\frac{2\pi}{5} seconds$.

12. **(C)** The particle velocity in a transverse wave is the partial derivative of the displacement with respect to time, $v_p = \frac{\partial y}{\partial t} = -A\omega\cos(kx - \omega t)$. The magnitude of this velocity is at its maximum when the cosine term is equal to ± 1, which corresponds to a phase angle $kx - \omega t$ of 0 or π.

13. **(A)** The electric field is zero at a point between the charges where $\frac{k(9e)}{x^2} = \frac{k(e)}{(16-x)^2}$. Taking the square root of both sides gives $\frac{3}{x} = \frac{1}{16-x}$. Solving for x leads to $48 - 3x = x$, which results in $x = 12cm$ measured from the larger $+9e$ charge.

14. **(D)** When the battery is disconnected, the charge Q remains constant. Pulling the plates apart increases the distance d, which decreases the capacitance ($C = \frac{\epsilon_0 A}{d}$). Since the electrostatic energy is $U = \frac{Q^2}{2C}$, a decrease in capacitance C directly leads to an increase in the stored potential energy of the capacitor.

15. **(B)** Current density J is equal to σE, where σ is the conductivity. Resistance $R = \frac{L}{\sigma A}$, so $\sigma = \frac{L}{RA}$. Substituting the values, $\sigma = \frac{10}{10 \cdot 10^{-4}} = 10^4 S/m$. Therefore, the current density $J = 10^4 \times 10 = 10^5 A/m^2$, assuming the area A is derived from the given radius.

16. **(B)** The internal resistance r of a cell is determined by the formula $r = R\left(\frac{l_1}{l_2} - 1\right)$. Substituting the balancing lengths $l_1 = 560cm$ (open circuit) and $l_2 = 412cm$ (with external resistance $R = 10\Omega$), we get $r = 10\left(\frac{560}{412} - 1\right) \approx 10(1.359 - 1) = 3.59\Omega$, which is approximately 3.6Ω.

17. **(A)** The magnetic field at the center of a circular coil is $B = \frac{\mu_0 NI}{2R}$. Substituting the constants and given values, $B = \frac{4\pi \times 10^{-7} \cdot 100 \cdot 5}{2 \cdot 0.1}$. This simplifies to $B = \frac{2\pi \times 10^{-5} \cdot 5}{0.1} = \pi \times 10^{-3} Tesla$.

18. **(C)** Magnetic susceptibility (χ) is a dimensionless constant that indicates how a material responds to an applied magnetic field. Diamagnetic materials are characterized by a small, negative susceptibility, meaning they develop an induced magnetic moment in a direction opposite to the applied field.

19. **(C)** In a uniform and constant magnetic field, the magnetic flux through a moving loop of constant area and orientation does not change ($\frac{d\Phi}{dt} = 0$). According to Faraday's law of electromagnetic induction, the induced electromotive force and current are both zero.

20. **(A)** The phase difference ϕ is given by $\tan\phi = \frac{V_L - V_C}{V_R}$. In this case, $V_L = V_C$, so $\tan\phi = 0$, meaning $\phi = 0°$.

21. **(A)** The wave function is $E = E_0\cos(\omega t - kx)$. From $(2\pi \times 10^6)t$, we get $f = 10^6 Hz$. The negative sign indicates propagation in the positive x-direction.

22. **(A)** Power of lens $P = 1/f$. $P_1 = +5D, P_2 = -2.5D$. Total $P = +2.5D$.

23. **(B)** Fringe width decreases with decrease in wavelength. Violet ¡ Red, so fringes get closer.

24. **(A)** $\lambda_0 = \frac{1240}{4.0} = 310nm$.

25. **(A)** Lyman $\rightarrow$ UV, Balmer $\rightarrow$ Visible, Paschen/Brackett $\rightarrow$ IR.

26. **(A)** Final nucleus: $A = 172, Z = 69$.

27. **(C)** Temperature changes V-I characteristics due to carrier variation.

28. **(C)**

29. **(A)** $v' = 3v\cos\theta$.

30. **(C)** Static friction ¿ kinetic friction.

31. **(B)** Ratio $1 : \sqrt{2}$.

32. **(D)** $\lambda_m = 1000nm$.

33. **(C)** $W_2 > W_1$.

34. **(B)** $R_\alpha = 2R$.

35. **(B)** $\phi = 60°$.

36. **(B)** The least count is $\frac{Pitch}{Number of divisions} = \frac{1mm}{100} = 0.01mm$. The reading is $MSR + (CSR \times LC) = 0 + (52 \times 0.01) = 0.52mm$. To convert this to centimeters, we divide by 10, resulting in a final diameter measurement of $0.052cm$.

37. **(B)** According to the work-energy theorem, work done equals the change in kinetic energy ($W = \frac{1}{2}m(v_f^2 - v_i^2)$). At $x = 0, v_i = 0$. At $x = 2, v_f = 5(2)^{3/2} = 5\sqrt{8}$. Thus, $v_f^2 = 25 \times 8 = 200$. The work done is $\frac{1}{2}(0.5)(200 - 0) = 0.25 \times 200 = 50 Joules$.

38. **(B)** Angular momentum $L = I\omega$ is conserved. Initial $I_1 = MR^2$. Final $I_2 = MR^2 + 2mR^2$ because two masses m are added at distance R. From $I_1\omega = I_2\omega'$, we get $MR^2\omega = (M + 2m)R^2\omega'$. Solving for the final angular velocity ω' gives the expression $\frac{\omega M}{M+2m}$.

39. **(A)** Rms speed is proportional to $\sqrt{T/M}$. For $v_{rms}(Ar) = v_{rms}(He)$, we have $T_{Ar}/M_{Ar} = T_{He}/M_{He}$. Substituting absolute temperatures and masses, $T_{Ar}/39.9 = 253/4.0$. Solving for T_{Ar} gives $T_{Ar} = \frac{39.9\times253}{4} \approx 2523K$, which is approximately $2.53 \times 10^3 K$.

40. **(A)** Efficiency $\eta = 1 - T_2/T_1$. Initially, $0.4 = 1 - T_2/500$, giving $T_2 = 300K$. For $\eta = 0.5$, $0.5 = 1 - T_2'/500$, giving $T_2' = 250K$. The sink temperature must be lowered from $300K$ to $250K$, which is a decrease of exactly $50K$.

41. **(A)** The charge $-2q$ can be split into $-q$ and $-q$. This creates two dipoles of magnitude qa: one along the x-axis and one along the y-axis. The resultant dipole moment is the vector sum $\sqrt{(qa)^2 + (qa)^2} = \sqrt{2}qa$. The direction is at $45°$ to both axes, which is along the line joining $(0, 0, 0)$ and $(a, a, 0)$.

42. **(B)** In a metre bridge, $R/S = l/(100-l)$. Initially, $R/S = 33.7/66.3$. After adding 12Ω in parallel to S, the new resistance is $S' = \frac{12S}{12+S}$, and $R/S' = 51.9/48.1$. By solving these two equations simultaneously, we find that $R \approx 6.8\Omega$ and $S \approx 13.5\Omega$.

43. **(A)** The force per unit length between two parallel currents is $\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi d}$. Substituting the values $I_1 = 1, I_2 = 1, d = 1$ and $\mu_0 = 4\pi \times 10^{-7}$, the force is $\frac{4\pi\times10^{-7}\cdot1\cdot1}{2\pi\cdot1} = 2 \times 10^{-7} N/m$. Since the currents are in the same direction, the force is attractive.

44. **(B)** Mutual inductance M is defined as Φ/I. The magnetic field B at the center of the large loop is proportional to I/L. The flux Φ linked with the small loop is $B \times area = B \times l^2$. Thus, $\Phi \propto (I/L) \times l^2$, which means $M = \Phi/I$ is proportional to l^2/L.

45. **(A)** Cutting a lens along its principal axis does not change the radius of curvature of the surfaces or the refractive index of the material. Since the lens parameters that determine focal length in the lens maker's formula remain unchanged, each resulting half of the lens will retain the original focal length of $10cm$.

46. **(B)** Einstein's photoelectric equation is $K_{max} = h(f - f_0)$. Calculating the energy, $K_{max} = 6.63\times10^{-34}(8.2-3.3)\times10^{14} \approx 3.25\times10^{-19} J$. Converting to electron-volts, $V_0 = \frac{3.25\times10^{-19}}{1.6\times10^{-19}} \approx 2.03V$. Thus, the cut-off or stopping voltage is approximately $2.0V$.

47. **(B)** After 5 days, 90% of the material remains ($N = 0.9N_0$). The amount remaining after n intervals is $N = N_0(0.9)^n$. In 20 days, there are $n = 20/5 = 4$ intervals. The remaining amount is $N_0(0.9)^4 = 0.6561N_0$, which is approximately 65.6% of the original radioactive material.

48. **(A)** The voltage gain A_v is given by $\beta\frac{R_c}{R_b} = 100 \times \frac{2000}{1000} = 200$. The input signal voltage V_i is $\frac{V_{out}}{A_v}$. Substituting the output signal of $2V$, we get $V_i = \frac{2}{200} = 0.01V$. Converting this to millivolts results in an input signal of exactly $10mV$.

49. **(C)** An open pipe of length L has $f = v/2L$. When half-submerged, it becomes a closed pipe of length $L/2$. The fundamental frequency of a closed pipe is $v/4L'$. Substituting $L' = L/2$, we get $f' = \frac{v}{4(L/2)} = \frac{v}{2L}$. Therefore, the fundamental frequency remains identical to the original frequency f.

50. **(A)** The percentage error in P is given by the sum of individual errors multiplied by their powers: $\frac{\Delta P}{P} = 3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{1}{2}\frac{\Delta c}{c} + \frac{\Delta d}{d}$. Substituting the values: $3(1\%) + 2(3\%) + \frac{1}{2}(4\%) + 2\% = 3\% + 6\% + 2\% + 2\% = 13\%$.

51. **(B)** Silver nitrate and sodium chloride react in a 1:1 molar ratio to produce a white precipitate of silver chloride. Based on the molar mass of the reactants and the given concentrations, there are 0.05 moles of each reactant available in the mixture, which yields exactly 7.175 grams of silver chloride precipitate upon the completion of the reaction.

52. **(A)** Rubidium is an alkali metal located in the fifth period of the periodic table with an atomic number of 37. Its outermost valence electron occupies the 5s orbital, which corresponds to the principal quantum number $n = 5$, azimuthal quantum number $l = 0$, magnetic quantum number $m = 0$, and a spin quantum number of $+1/2$.

53. **(D)** For isoelectronic species, which have the same number of electrons, the ionic radius increases as the nuclear charge (atomic number) decreases. Therefore, the nitride ion is the largest, followed by the oxide ion, with the fluoride ion being the smallest among them because it has the highest effective nuclear charge pulling the electrons inward.

54. **(A)** According to VSEPR theory, molecular shapes are determined by the repulsion between electron pairs: phosphorus pentachloride is trigonal bipyramidal, sulfur hexafluoride is octahedral, bromine pentafluoride is square pyramidal, and boron trifluoride is trigonal planar due to the specific arrangement of its three bonding pairs and the absence of lone pairs on the central atom.

55. **(B)** The change in Gibbs free energy is calculated using the enthalpy and entropy changes at the given temperature. By determining the change in enthalpy from the internal energy and the work done by the expanding gases ($\Delta H = \Delta U + \Delta n_g RT$), the resulting free energy change ($\Delta G = \Delta H - T\Delta S$) is found to be negative 2.7 kilocalories.

56. **(B)** The pH of a salt solution derived from a weak acid and a weak base is essentially independent of the concentration and depends on the specific pK_a and pK_b values. Using the provided values of 4.8 and 4.78 in the standard formula $pH = 7 + \frac{1}{2}(pK_a - pK_b)$, the calculated pH is 7.01, which indicates a nearly neutral solution.

57. **(C)** In the compound hydrazoic acid (HN_3), nitrogen has an average oxidation state of negative one-third. This value is mathematically higher than the oxidation states found in ammonia (negative three), hydrazine (negative two), or hydroxylamine (negative one), where the nitrogen atoms are more reduced and carry a more significant negative charge.

58. **(C)** Isotonic solutions are characterized by having identical osmotic pressures and molar concentrations at the same temperature. By setting the molarity of the urea solution equal to that of the unknown 5

59. **(C)** The potential of a hydrogen electrode is directly related to the pH of the solution according to the Nernst equation at standard temperature. At a pH of 10, the electrode potential is determined by multiplying negative 0.0591 by the pH value, resulting in a calculated reduction potential of negative 0.591 volts for the half-cell.

60. **(A)** In first-order chemical kinetics, the time required for a specific percentage of completion is determined by the logarithmic ratio of initial to final concentrations. Since 99

61. **(D)** The Yb^{2+} ion has a completely filled 4f subshell containing a total of fourteen electrons. Because all of these electrons are paired within the stable electronic configuration, the ion does not possess a net magnetic moment and is therefore classified as a diamagnetic species, unlike other lanthanoid ions that often have unpaired f-electrons.

62. **(A)** The octahedral coordination complex $[Co(en)_2Cl_2]^+$ can exist in two distinct geometrical arrangements: the trans isomer, where the chlorine ligands are positioned opposite each other, and the cis isomer, where they are adjacent. The cis form is also chiral and exists as a pair of enantiomers, while the trans form is achiral.

63. **(D)** The rate of S_N1 reactions depends on the stability of the carbocation intermediate and the efficiency of the leaving group. Among the alkyl halides, the iodide ion is the most effective leaving group because the carbon-iodine bond is the weakest and most polarizable, allowing the reaction to proceed with the highest velocity.

64. **(D)** Phenol is highly reactive toward electrophilic aromatic substitution because the hydroxyl group is a powerful activating group. When treated with an excess of bromine water, phenol undergoes rapid triple substitution at both ortho positions and the para position to form 2,4,6-tribromophenol, which precipitates out of the solution as a white solid.

65. **(C)** Propan-2-amine is a primary amine that reacts with chloroform and base in the carbylamine test to form a foul-smelling isocyanide. This product can be further processed through hydrolysis and oxidation to yield a compound that gives a positive iodoform test, which is characterized by the formation of a distinct yellow precipitate.

66. **(A)** The basicity of methylamines in aqueous solution is determined by the combined effects of inductive electron donation, steric hindrance, and the extent of solvation. These factors result in a specific strength order where the secondary amine is the strongest base, followed by the primary amine, then the tertiary amine, and finally ammonia.

67. **(B)** Sucrose is classified as a non-reducing sugar because its glycosidic linkage involves the anomeric carbons of both the glucose and fructose units. Since these reducing functional groups are locked in the bond, they cannot open into a free aldehyde or ketone form to react with reagents like Tollen's or Fehling's solutions.

68. **(C)** Hypophosphoric acid ($H_4P_2O_6$) is unique among the common phosphorus oxoacids because it contains a direct covalent bond between the two phosphorus atoms. Most other related acids, such as pyrophosphoric acid, instead contain a bridging oxygen atom that connects the phosphorus centers in a characteristic P-O-P linkage rather than a P-P bond.

69. **(C)** In a face-centered cubic lattice, the nearest neighbor atoms touch each other along the diagonal of the unit cell face. The distance between the centers of these two adjacent atoms is equal to the face diagonal ($a\sqrt{2}$) divided by two, which simplifies to the cell edge length divided by the square root of two.

70. **(B)** A sol is a type of colloidal dispersion where solid particles are distributed throughout a liquid medium. Common examples of sols include paints, where fine pigment particles are suspended in a liquid binder. This distinguishes them from other colloids like emulsions (butter), aerosols (dust), or solid foams (pumice stone).

71. **(B)** The formation of formaldehyde (methanal) during the process of ozonolysis is a diagnostic test for the presence of a terminal double bond or vinyl group. When ozone cleaves the carbon-carbon double bond at the end of a chain, it always produces a one-carbon aldehyde as one of the reaction products.

72. **(A)** Polymers are identified by their specific repeating units and monomers: Nylon 6 is made from caprolactam; Buna-N is a copolymer of 1,3-butadiene and acrylonitrile; Neoprene is formed from the polymerization of chloroprene; and Terylene is produced from the condensation of ethylene glycol and terephthalic acid.

73. **(C)** Seldane, also known by its generic name terfenadine, is a medication classified as an antihistamine. It works by blocking histamine receptors in the body to alleviate allergy symptoms. This differs from other listed drugs like chloramphenicol, which is an antibiotic, or norethindrone, which is used in hormonal birth control.

74. **(D)** The triphenylmethyl carbocation is exceptionally stable because the positive charge is delocalized through resonance over three phenyl rings. This extensive delocalization significantly lowers the energy of the cation compared to simpler primary, secondary, or even resonance-stabilized allylic or benzylic carbocations, making it one of the most stable known carbocations.

75. **(A)** In a high-spin octahedral d^4 complex, three electrons occupy the lower energy t_{2g} orbitals while one electron enters the higher energy e_g orbital. The crystal field stabilization energy is calculated as three times negative 0.4 plus one times 0.6, resulting in a net value of negative 0.6 Δ_o.

76. **(A)** For an ideal binary solution, the total vapor pressure is the sum of the partial pressures of its components according to Raoult's Law. This relationship is expressed as $P_{total} = P_A^o x_A + P_B^o x_B$, which can be rearranged as a linear function of the mole fraction of one of the components.

77. **(C)** Greenhouse gases are those that absorb and emit infrared radiation, such as carbon dioxide, methane, and nitrous oxide. Nitrogen gas, which makes up about 78

78. **(A)** The solubility of group 2 sulfates decreases as you move down the group because the hydration energy of the metal ions decreases more rapidly than the lattice energy of the sulfate crystals. Consequently, magnesium sulfate is highly soluble, while barium sulfate is notoriously insoluble and forms a precipitate in water.

79. **(A)** Boron trifluoride is a weaker Lewis acid than boron trichloride due to effective $p\pi - p\pi$ back-bonding between the 2p orbitals of fluorine and boron. This electron donation from fluorine partially satisfies boron's electron deficiency, making it less inclined to accept an electron pair from an external Lewis base donor.

80. **(A)** These reagents are standard for identifying organic groups: Tollen's identifies aldehydes; neutral ferric chloride detects phenols; the Hinsberg reagent distinguishes between primary, secondary, and tertiary amines; and the carbylamine test is a specific diagnostic for identifying primary amines by the formation of their characteristic foul-smelling isocyanide products.

81. **(A)** For an isolated system, the change in internal energy is zero, meaning that the direction of any spontaneous change is determined solely by entropy. The second law of thermodynamics states that the total entropy of an isolated system must increase during any spontaneous process, making the condition $\Delta S > 0$.

82. **(C)** The oxidation of one mole of water to oxygen releases two moles of electrons ($H_2O \rightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$). Since each mole of electrons carries a charge of approximately 96,500 Coulombs (one Faraday), the total charge required for this electrochemical oxidation process is 193,000 Coulombs.

83. **(C)** The sequence begins with the Friedel-Crafts alkylation of benzene to toluene, followed by oxidation to benzoic acid. After conversion to benzoyl chloride using phosphorus pentachloride, the final Rosenmund reduction step specifically converts the acid chloride into benzaldehyde using hydrogen gas and a poisoned palladium catalyst.

84. **(D)** The chromium (III) ion is particularly stable in aqueous solutions because it has a half-filled t_{2g} subshell in an octahedral field. This stable electronic configuration (t_{2g}^3) provides high crystal field stabilization energy, making it more stable than other transition metal ions like Mn^{3+} or Ti^{3+} in similar environments.

85. **(C)** According to collision theory, a chemical reaction only occurs if the colliding molecules possess a minimum threshold of kinetic energy known as activation energy. Additionally, the molecules must collide with a specific geometric orientation that allows for the effective breaking of existing bonds and the formation of new chemical bonds.

86. **(A)** Density is calculated using the unit cell mass and volume. By determining the molar mass from the given number of atoms ($200g$ for 2.4×10^{24} atoms implies $M = 50g/mol$) and dividing the mass of four atoms by the volume of a cube with 200 pm sides, the density is 41.6.

87. **(C)** In coordination nomenclature, ligands are listed in alphabetical order: ammine comes first, followed by chlorido, and then methanamine. The oxidation state of the central platinum atom is denoted by a Roman numeral in parentheses (II), followed by the name of the counter-ion, which is chloride in this specific complex.

88. **(B)** Zinc dust reduces phenol to benzene, which then undergoes Friedel-Crafts alkylation to produce toluene. The final step involves the strong oxidation of the methyl side chain by potassium permanganate, which results in the formation of benzoic acid as the final major organic product in the reaction sequence.

89. **(B)** The activation energy is calculated using the logarithmic form of the Arrhenius equation by comparing rate constants at two different temperatures. Plugging the given values of rate constants and temperatures into the formula yields an activation energy of approximately 55.3 kilojoules per mole for the specific chemical reaction.

90. **(A)** Both xenon difluoride and the interhalogen ion IBr_2^- possess a central atom surrounded by two bonding pairs and three lone pairs. This electron distribution results in an identical linear molecular geometry and sp^3d hybridization for the central atom in both of these distinct chemical species.

91. **(A)** The spectrochemical series ranks ligands based on their ability to split the d-orbitals of a central metal ion. According to this experimentally derived order, thiocyanate is the weakest field ligand among the choices, followed by fluoride and oxalate, while the cyanide ion is the strongest field ligand.

92. **(C)** Molar conductivity for strong electrolytes decreases linearly with the square root of concentration due to interionic attractions, not sharply. The statement that the number of ions per unit volume increases with concentration is true, but it is not a correct explanation for the decrease in molar conductivity per unit of concentration.

93. **(A)** Many biological molecules contain essential metal ions as cofactors: vitamin B_{12} contains cobalt, chlorophyll features magnesium at its center for photosynthesis, hemoglobin uses iron to transport oxygen in the blood, and the enzyme carbonic anhydrase requires a zinc ion to function correctly in the human body.

94. **(C)** Adsorption is typically exothermic because it involves the formation of attractions, which releases energy. However, physical adsorption is generally non-specific and occurs via weak van der Waals forces, whereas chemical adsorption is highly specific because it involves the formation of actual chemical bonds between the adsorbent and adsorbate.

95. **(C)** The freezing point depression is the product of the molality and the cryoscopic constant of water. For a 0.05 molal non-electrolyte solution, the depression is $1.86 \times 0.05 = 0.093$ degrees, which means the actual freezing point of the solution is negative 0.093 degrees Celsius.

96. **(B)** In the final stage of copper smelting, a process known as auto-reduction occurs where cuprous oxide reacts directly with the remaining cuprous sulfide. This reaction produces pure metallic copper and releases sulfur dioxide gas, eliminating the need for an external reducing agent like carbon or carbon monoxide.

97. **(C)** Propanone is a ketone that reacts with 2,4-DNP to form a brightly colored orange-red hydrazone precipitate. Unlike propanal, it is resistant to mild oxidation, and unlike propan-2-ol, it already contains the carbonyl group required for a positive reaction with the dinitrophenylhydrazine reagent used for detection.

98. **(A)** According to the Henderson-Hasselbalch equation, the pH of a buffer depends on the pK_a and the log of the salt-to-acid ratio. Since the provided mixture contains equal amounts of acetic acid and sodium acetate, the log term becomes zero, and the final pH of the buffer equals the pK_a.

99. **(B)** The iron (II) ion has four unpaired electrons in its 3d subshell. Using the spin-only formula, the magnetic moment is calculated as the square root of the product of the number of unpaired electrons (4) and that number plus two (6), resulting in a value of approximately 4.90 Bohr magnetons.

100. **(C)** Nylon 6,6 is a synthetic polymer classified as a polyamide because its repeating units are joined by amide linkages. These bonds are formed through a condensation reaction between a dicarboxylic acid and a diamine, similar to the peptide bonds that link amino acids together in biological proteins.

101. **(A)** The taxonomic hierarchy follows a specific descending order from the most inclusive to the most specific group. This sequence starts with Kingdom, followed by Phylum (or Division for plants), Class, Order, Family, Genus, and finally the species which is the basic unit of biological classification.

102. **(A)** Both statements are accurate as per Whittaker's 1969 classification system. His criteria included cell structure and body organization, and he placed unicellular eukaryotes like Chlamydomonas and Chlorella into the Kingdom Protista to solve earlier taxonomic inconsistencies where they were treated as plants.

103. **(B)** Red algae, members of the Rhodophyceae such as Porphyra, possess chlorophyll a and d along with the accessory pigment r-phycoerythrin. This specific pigment combination allows them to absorb blue light efficiently and survive at much greater ocean depths than other types of algae.

104. **(A)** Valvate aestivation is characterized by sepals or petals meeting at their edges without overlapping each other. This specific arrangement is observed in Calotropis, while other options like China rose or Gulmohur exhibit twisted, imbricate, or vexillary aestivation respectively in their floral buds.

105. **(B)** In dicot roots, the vascular bundles are arranged radially, meaning xylem and phloem are located on alternating radii. The xylem is described as exarch because the smaller protoxylem elements are formed toward the periphery and the larger metaxylem elements are positioned toward the center.

106. **(A)** The cell cycle consists of distinct metabolic phases where the S phase is dedicated to DNA replication and the G2 phase involves protein synthesis for mitosis. G1 serves as the interval between mitosis and replication, while G0 represents a non-dividing, quiescent state for stable cells.

107. **(A)** Water moves unidirectionally through the xylem because it is pulled upward by the negative pressure generated by transpiration at the leaf surface. Root pressure also contributes at the base, and these forces together ensure the continuous upward stream of water and minerals through the plant.

108. **(B)** In the Z-scheme of light-dependent reactions, electrons energized in PS-II move through an electron transport chain consisting of plastoquinone and the cytochrome b6f complex. These carriers facilitate the transfer of electrons to PS-I, providing the energy needed for the production of ATP and NADPH.

109. **(C)** The complete aerobic oxidation of one glucose molecule through glycolysis, the Krebs cycle, and oxidative phosphorylation typically yields a net gain of 36 or 38 ATP. The variation depends on the specific shuttle mechanism used to transport electrons from cytoplasmic NADH into the mitochondrial matrix.

110. **(C)** Abscisic acid (ABA) functions as a primary stress hormone that inhibits growth and promotes seed dormancy to ensure survival during harsh conditions. It also regulates stomatal closure to conserve water by responding to dehydration and osmotic stress in the plant tissues during drought.

111. **(B)** In most flowering plants, the functional megaspore undergoes three sequential mitotic divisions without immediate cytokinesis to form an eight-nucleate cell. This cell then differentiates into the female gametophyte, commonly known as the embryo sac, which contains the egg, synergids, antipodals, and polar nuclei.

112. **(B)** To produce 100 seeds, a plant needs 100 zygotes resulting from the fusion of 100 eggs and 100 male gametes. This requires 100 meiotic divisions in megaspore mother cells (one egg per meiosis) and 25 divisions in microspore mother cells (which produce four pollen grains per meiosis).

113. **(A)** In a Mendelian dihybrid cross between two heterozygous parents, the total number of possible genotypic combinations in the Punnett square is 16. The specific genotype $rrYY$, representing homozygous recessive for one trait and homozygous dominant for another, appears exactly once in the resulting 16-cell grid.

114. **(B)** DNA strands are antiparallel, so the complementary strand runs from 3' to 5' relative to the 5' to 3' template. By pairing bases and then reversing the sequence to the standard 5' to 3' notation, the resulting sequence for the template ATGCATGC is found to be TACGTACG.

115. **(B)** This specific enzyme is responsible for the critical "charging" step of translation, where it covalently links a specific amino acid to its corresponding tRNA molecule. This ensures that the correct amino acids are brought to the ribosome in the order specified by the genetic code on mRNA.

116. **(B)** The repressor protein produced by the i-gene has a high affinity for the operator region of the lac operon. When the repressor binds to the operator, it physically blocks RNA polymerase from transcribing the structural genes, effectively shutting down the metabolic pathway for lactose digestion.

117. **(B)** In a grazing food chain, primary consumers are herbivores that feed directly on producers like green plants. A rabbit serves as a primary consumer because it derives its energy by consuming grass, making it the second link in the trophic hierarchy above the photosynthetic producers.

118. **(A)** The United Nations Conference on Environment and Development, also known as the Earth Summit, was a historic meeting held in Rio de Janeiro in 1992. It resulted in the Convention on Biological Diversity, which aimed to promote global conservation and sustainable development of resources.

119. **(B)** Monocot stems are characterized by an atactostele arrangement, where numerous vascular bundles are scattered throughout a large mass of parenchymatous ground tissue. Unlike dicot stems, they lack a distinct cortex and pith and do not typically undergo secondary growth via a vascular cambium.

120. **(C)** In C4 plants, the first stable product formed after carbon dioxide fixation is oxaloacetic acid, a four-carbon compound, which occurs in the mesophyll cells. 3-phosphoglyceric acid (PGA) is the first stable product in C3 plants, which lack the specialized anatomical adaptations of the C4 pathway.

121. **(C)** Crossing over is a genetic process that occurs during the pachytene stage of prophase I in meiosis. It involves the physical exchange of genetic segments between non-sister chromatids of a pair of homologous chromosomes, resulting in recombinant gametes and significantly increased genetic variation.

122. **(C)** Agave reproduces vegetatively through bulbils, which are specialized fleshy buds that develop on the floral axis. Aquatic plants like Pistia and Eichhornia (water hyacinth) are well-known for using offsets, which are short, horizontal branches that produce new plantlets at their tips rapidly.

123. **(B)** The total amount of ozone in a vertical column of the atmosphere is measured in Dobson Units (DU). One DU represents the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at standard temperature and pressure.

124. **(A)** Morphine is classified as an alkaloid, curcumin is a drug extracted from turmeric, concanavalin A is a lectin, and lemon grass oil is an essential oil. These compounds are secondary metabolites because they are not directly involved in the basic growth or reproductive development of the plant.

125. **(B)** Calcium is a vital mineral element required for the synthesis of the middle lamella, where it exists primarily as calcium pectate. This layer acts as a cementing material that holds the primary cell walls of adjacent plant cells together, providing essential structural integrity to tissues.

126. **(B)** According to Chargaff's rule, Adenine equals Thymine (20

127. **(C)** During the discontinuous synthesis of the lagging DNA strand, short segments called Okazaki fragments are produced. The enzyme DNA ligase is responsible for catalyzes the formation of phosphodiester bonds to join these fragments together, creating a continuous and functional sugar-phosphate backbone for the DNA strand.

128. **(D)** Cleistogamous flowers are specialized for mandatory self-pollination because they never open, ensuring that pollen from the same flower reaches its stigma. This is the opposite of an outbreeding device, which is an evolutionary mechanism designed by plants to promote cross-pollination and genetic diversity.

129. **(A)** Rudolf Virchow was the scientist who first proposed the fundamental biological principle "Omnis cellula-e cellula" in 1855. This statement expanded the cell theory by asserting that all new living cells can only arise from the division of pre-existing living cells through the process of cell division.

130. **(B)** A peptide bond is formed through a chemical reaction between the carboxyl group of one amino acid and the amino group of another. This process, known as dehydration synthesis, results in the covalent linkage of amino acids and the simultaneous elimination of a water molecule.

131. **(C)** In the cyclic photophosphorylation pathway, energized electrons are ejected from the reaction center of Photosystem I (P700). After passing through a series of electron carriers and generating ATP, the electrons eventually return to the same P700 reaction center to be re-excited for the next cycle.

132. **(D)** Double fertilization is a unique and defining feature of angiosperms, or flowering plants. It involves one male gamete fusing with the egg to form a zygote, while a second male gamete fuses with the two polar nuclei to produce the triploid endosperm nutritive tissue.

133. **(C)** The enzyme nitrogenase, which catalyzes the conversion of atmospheric nitrogen into ammonia, is highly sensitive to molecular oxygen. Oxygen irreversibly inactivates the enzyme, which is why nitrogen-fixing organisms use mechanisms like leghemoglobin to maintain an anaerobic environment within the root nodules for the process.

134. **(C)** The pyramid of energy is always upright in any stable ecosystem because energy is lost as heat at every trophic level during transfer. This follows the 10

135. **(B)** Mendel's law of independent assortment describes how different pairs of alleles segregate into gametes independently of one another. This principle was established based on his observations of dihybrid crosses, where he followed the inheritance patterns of two distinct traits, like seed color and shape, simultaneously.

136. **(C)** In C4 plants, initial CO2 fixation occurs in mesophyll cells via PEPcase, forming malic acid. This acid is then moved to bundle sheath cells, where it is decarboxylated and the resulting CO2 is finally fixed by RuBisCO, illustrating the spatial separation of these two distinct processes.

137. **(B)** The Krebs cycle does not begin by condensing acetyl groups with pyruvic acid; instead, pyruvic acid is first converted to Acetyl-CoA. This Acetyl-CoA then condenses with the four-carbon compound oxaloacetic acid to form citric acid, which is the actual starting point of the metabolic cycle.

138. **(B)** In plant tissue culture techniques, the relative concentration of hormones determines the type of organogenesis. A high ratio of cytokinin to auxin in the growth medium promotes the differentiation and development of shoots, while a high auxin to cytokinin ratio favors the formation of roots.

139. **(A)** Both statements are correct because perisperm is defined as the persistent diploid nucellar tissue found in certain mature seeds. In plants like black pepper

and beet, the nucellus is not entirely consumed during development and remains as a nutritive layer for the embryo inside the seed.

140. **(C)** Gene mapping is based on recombination frequencies where distances are additive on a linear chromosome. Since the distance between B and C (25 cM) is the sum of the distances from B to A (10 cM) and A to C (15 cM), the gene A must be located between genes B and C.

141. **(D)** Modern DNA fingerprinting techniques are highly sensitive because they utilize the Polymerase Chain Reaction (PCR) to amplify very small amounts of DNA. This allows scientists to analyze even minute biological samples by focusing on polymorphic regions of satellite DNA called variable number tandem repeats.

142. **(B)** According to the species-area relationship $S = CA^Z$, if the area A is increased by a factor of 100 and the slope Z is 0.5, the species richness S increases by $100^{0.5}$. This calculation results in an increase of species richness by a factor of exactly ten from its original value.

143. **(A)** Liverworts are represented by Marchantia, mosses by Sphagnum, pteridophytes include heterosporous forms like Selaginella, and gymnosperms include large trees like Cedrus. These examples represent the broad diversity and characteristic life cycles found within the various groups of the plant kingdom in NCERT classifications.

144. **(B)** The family Solanaceae is characterized by actinomorphic flowers with five fused sepals, five fused petals, and five epipetalous stamens. Its floral formula shows a superior, bicarpellary, syncarpous ovary with axile placentation, which distinguishes it from the fabaceous or liliaceous families in terms of reproductive structure.

145. **(A)** Secondary xylem in older trees is differentiated into two zones: the central, non-functional heartwood and the peripheral, functional sapwood. Furthermore, spring wood (early wood) is formed during high cambial activity in spring, and autumn wood (late wood) is formed during slower growth in winter conditions.

146. **(B)** Lichens are extremely sensitive to air pollution, particularly sulfur dioxide, because they lack a protective cuticle and absorb minerals directly from rainwater. Their inability to grow in polluted urban areas makes them excellent bio-indicators for monitoring atmospheric health and long-term environmental quality in an area.

147. **(C)** A cell enters meiosis after DNA replication, so it has a 4C amount of DNA. After the first meiotic division, the DNA is reduced to 2C in each cell. Following the second meiotic division (Meiosis II), the DNA content is halved again, resulting in daughter cells with 1C.

148. **(A)** Both statements are true as plasmolysis involves the shrinkage of the protoplast away from the cell wall in a hypertonic solution. Water is lost by osmosis, exiting the cytoplasm first and then the vacuole, leading to the characteristic collapse of the living cell contents away from its boundary.

149. **(A)** Rhizobium is a symbiotic nitrogen fixer in legumes, while Azotobacter fixes nitrogen freely in the soil. Anabaena is a cyanobacterium that can fix nitrogen in

association with the water fern Azolla, and Nitrosomonas is a nitrifying bacterium that converts ammonia into nitrite during the nitrogen cycle.

150. **(B)** Somatic hybridization is a technique where the cell walls of two different plant varieties are digested with enzymes to produce naked protoplasts. These protoplasts are then fused using chemical or electrical methods to create a hybrid cell, which can be regenerated into a whole new plant.

151. **(C)** Monkeys, chimpanzees, and humans are grouped together because they all belong to the mammalian order Primates. These species share complex evolutionary traits, including highly developed cerebral hemispheres, opposable thumbs, and intricate social behaviors, which distinguish them from members of the other taxonomic groups listed.

152. **(A)** Animal phyla possess unique diagnostic features: sponges are characterized by flagellated cells called choanocytes; aschelminthes are pseudocoelomates; annelids exhibit true metameric segmentation; and coelenterates are defined by specialized stinging cells known as cnidoblasts, which are used for capturing prey and providing defense.

153. **(C)** In the biting and chewing mouthparts of a cockroach, the hypopharynx is a small, median, lobe-like structure that acts as a tongue. It is located within the cavity enclosed by the mouthparts and helps in the manipulation of food particles during the process of mechanical digestion.

154. **(D)** The human cardiac conduction system includes specialized auto-excitable nodal tissues like the SAN and AVN. However, Purkinje fibers are not found in the atria; they are specialized conductive fibers that branch throughout the ventricular musculature to ensure rapid and coordinated contraction of the lower heart chambers.

155. **(C)** Emphysema is a chronic respiratory condition most commonly caused by long-term cigarette smoking. It involves the progressive and irreversible damage of the alveolar walls, which significantly reduces the total surface area available for gas exchange, making it increasingly difficult for the body to obtain sufficient oxygen.

156. **(C)** The rate at which gases diffuse across the respiratory membrane is heavily influenced by their solubility in blood plasma. Carbon dioxide is approximately 20 to 25 times more soluble than oxygen, allowing it to diffuse rapidly out of the blood even with a relatively small pressure gradient.

157. **(A)** Musculoskeletal disorders have distinct characteristics: gout is caused by the accumulation of uric acid crystals in joints; myasthenia gravis is an autoimmune disease affecting the neuromuscular junction; muscular dystrophy involves progressive genetic muscle degeneration; and tetany consists of muscle spasms due to low calcium levels.

158. **(C)** The Juxtaglomerular Apparatus (JGA) is a critical regulatory structure within the kidney that monitors blood pressure. it is formed at a specialized point of contact between the afferent arteriole and the distal convoluted tubule (DCT), where modified cells coordinate the release of the hormone renin.

159. **(C)** Hormones are categorized by their chemical nature: while epinephrine is an amino acid derivative and glucagon is a polypeptide, cortisol is a steroid hormone. It is produced by the adrenal cortex from cholesterol and is lipid-soluble, allowing it to act on intracellular receptors to regulate metabolism.

160. **(B)** The "Fight or Flight" response is a rapid physiological reaction to acute stress mediated by the sympathetic nervous system. This system triggers the adrenal medulla to release catecholamines, specifically adrenaline and noradrenaline, into the bloodstream to increase alertness, heart rate, and the availability of energy.

161. **(A)** Blood group AB individuals are universal recipients because their red blood cells possess both A and B antigens, and their plasma lacks both anti-A and anti-B antibodies. This absence of antibodies prevents their immune system from attacking donor red blood cells from any of the ABO groups.

162. **(B)** Both statements regarding male fertility are factually correct; a normal ejaculate contains several hundred million sperm, and specific percentages must meet motility and shape standards for successful fertilization. However, the requirement for motility does not explain the biological reason for the large total volume of sperm produced.

163. **(C)** The human fallopian tube consists of several regions: the infundibulum is the funnel-shaped part located closest to the ovary. It features finger-like projections called fimbriae that are responsible for picking up the secondary oocyte from the abdominal cavity immediately after it is released during the process of ovulation.

164. **(A)** Intrauterine devices are effective contraceptives placed inside the uterus. While Multiload 375 and CuT release copper ions and LNG-20 releases hormones, the Lippes loop is a non-medicated IUD. It works by triggering a local inflammatory response in the uterus that inhibits sperm motility and prevents implantation.

165. **(B)** GIFT, or Gamete Intra-Fallopian Transfer, is an assisted reproductive technique where an egg collected from a donor or the patient is placed directly into the fallopian tube along with sperm. This method is used when the female environment can support fertilization but the natural production of eggs is compromised.

166. **(B)** Phenylketonuria is an autosomal recessive metabolic disorder where the patient lacks the hepatic enzyme phenylalanine hydroxylase. Without this enzyme, the body cannot convert the amino acid phenylalanine into tyrosine, leading to an accumulation of phenylalanine that can cause severe mental retardation and other neurological issues if untreated.

167. **(C)** The genetic code is a set of rules used by living cells to translate genetic information. While it is universal, degenerate, and unambiguous, it is strictly non-overlapping. This means that each nucleotide in a DNA or RNA sequence is part of only one codon and is not shared with others.

168. **(B)** Charles Darwin developed his theory of natural selection primarily after his historic voyage on the HMS Beagle. His observations of the unique and diverse finches and tortoises on the Galapagos Islands were particularly instrumental in his understanding of how organisms adapt to specific environmental niches over time.

169. **(C)** Evolution results in different anatomical relationships: homologous organs share a common ancestry but may have different functions (divergent evolution), while analogous organs have different ancestries but similar functions because they evolved to solve similar environmental challenges in unrelated species through the process of convergent evolution.

170. **(C)** While diseases like ringworm are fungal and ascariasis is caused by a helminth, amoebiasis is a protozoan infection. It is caused by the parasite Entamoeba histolytica, which typically infects the large intestine and is spread through the ingestion of cysts in contaminated food or water in areas with poor sanitation.

171. **(B)** Immunity can be categorized as active or passive. Active immunity is developed when the body produces its own antibodies in response to an antigen. Passive immunity, however, involves the immediate transfer of pre-formed antibodies into the body, providing instant but temporary protection against specific pathogens or toxins.

172. **(C)** Biopiracy is the unethical practice where multinational companies or organizations use biological resources and traditional knowledge from indigenous communities without obtaining proper authorization or providing fair compensation. This often involves patenting natural products that have been used by local people for generations without their knowledge or consent.

173. **(C)** Restriction endonucleases are essential tools in biotechnology known as molecular scissors. These enzymes recognize specific, often palindromic, sequences of DNA and cut the double helix at precise locations, allowing scientists to isolate, manipulate, and combine specific genes from different organisms for various genetic engineering applications.

174. **(C)** Adenosine deaminase (ADA) deficiency is a severe genetic disorder that cripples the immune system. While bone marrow transplants or enzyme replacements can help, gene therapy is a more permanent solution. It involves inserting a functional copy of the ADA gene into the patient's cells to restore normal enzyme production.

175. **(B)** The intrinsic rate of natural increase, represented by 'r', describes the growth potential of a population. It is calculated by subtracting the specific death rate from the specific birth rate. In this scenario, a birth rate of 0.15 minus a death rate of 0.05 results in an 'r' value of 0.10.

176. **(C)** Ecological interactions are defined by how they affect the participating species. Commensalism is a relationship where one organism benefits (+) from the interaction, while the other organism (0) remains completely unaffected, deriving neither benefit nor harm from the presence or the activities of the other participating species.

177. **(C)** While factors like pollution and over-exploitation are significant, habitat loss and fragmentation remain the most critical drivers of biodiversity loss today. As human activities destroy natural ecosystems, many species lose the large, contiguous areas they need to find sufficient food, maintain territory, and reproduce successfully in the wild.

178. **(B)** The Montreal Protocol is an international environmental treaty signed in 1987. Its primary goal was to protect the Earth's ozone layer by mandating the phase-out of the production and consumption of ozone-depleting substances, such as chlorofluorocarbons (CFCs), which were widely used in refrigeration and aerosol sprays.

179. **(C)** During oogenesis, a primary oocyte remains arrested in its first meiotic division for many years. It finally completes meiosis I just before ovulation occurs, typically within the environment of a large, fluid-filled tertiary follicle (Graafian follicle), resulting in a secondary oocyte and a small first polar body.

180. **(B)** The earliest life forms on Earth originated in an environment that lacked free atmospheric oxygen. These organisms were likely anaerobic chemoheterotrophs, which obtained their energy and carbon by breaking down complex organic molecules that had formed spontaneously through chemical reactions in the "primordial soup" of the early oceans.

181. **(A)** The innate immune system utilizes several protective barriers: skin acts as a physical barrier; stomach acid provides a physiological barrier; phagocytic cells like monocytes serve as a cellular barrier; and interferons are signaling proteins released by virus-infected cells to provide a cytokine barrier for neighboring cells.

182. **(B)** Many enzymes require non-protein components called cofactors to function. A prosthetic group is a specific type of cofactor that is permanently and very tightly bound to the protein part of the enzyme (the apoenzyme), unlike co-enzymes which are only transiently associated with the enzyme during the catalytic reaction.

183. **(B)** Secondary metabolites are chemical compounds produced by plants that are not essential for basic growth. Vinblastin, extracted from the periwinkle plant, is a potent anti-cancer drug, and curcumin, found in turmeric, is valued for its medicinal properties, making both compounds highly important in the field of pharmaceuticals.

184. **(D)** Protein hormones cannot cross the cell membrane and instead bind to receptors on the cell surface. This binding triggers the release of intracellular "second messengers" such as cyclic AMP (cAMP), inositol triphosphate (IP3), or calcium ions, which then relay the hormonal signal to the cell's internal machinery.

185. **(B)** After ovulation, the ruptured Graafian follicle undergoes a structural transformation to become a temporary endocrine structure called the corpus luteum, or "yellow body." This structure is responsible for secreting high levels of progesterone, which is essential for maintaining the uterine lining for a potential pregnancy.

186. **(C)** The mid-cycle surge of Luteinizing Hormone (LH) triggers ovulation and the subsequent development of the corpus luteum from the ruptured follicle. The corpus albicans is a white, fibrous scar that only forms later if fertilization does not occur, marking the final degeneration of the once-active corpus luteum.

187. **(C)** In the pBR322 vector, the BamHI restriction site is located within the tetracycline resistance gene. If a foreign DNA segment is inserted at this site, the gene is disrupted and the cell loses its tetracycline resistance. However, it still grows on ampicillin because that resistance gene remains functional and undisturbed.

188. **(C)** Allele frequency in a population can be calculated using the Hardy-Weinberg principle. If there are 360 AA and 480 Aa individuals in a population of 1000, the frequency of allele 'A' is found by adding the homozygous frequency (0.36) to half of the heterozygous frequency (0.24), resulting in a total of 0.6.

189. **(C)** Fish groups have distinct features: bony fishes like Labeo possess an operculum covering their gills and an air bladder for buoyancy. In contrast, cartilaginous fishes like Pristis and Carcharodon lack these features, possess persistent notochords throughout their lives, and are covered by characteristic tooth-like placoid scales.

190. **(B)** Allergic reactions are hypersensitive immune responses mediated by IgE antibodies. When these antibodies encounter an allergen, they bind to the surface of mast cells and basophils, triggering them to release inflammatory chemicals like histamine and serotonin, which cause the classic symptoms associated with an allergy or hay fever.

191. **(C)** Gap junctions are specialized intercellular connections found in animal tissues. They consist of protein channels called connexons that bridge the space between adjacent cells, allowing for the direct and rapid exchange of ions, small molecules, and electrical signals, which is essential for coordinating the activities of a tissue.

192. **(A)** Fat digestion begins with emulsification by bile salts to increase the surface area. The resulting lipids form micelles to be absorbed into intestinal cells, where they are repackaged into protein-coated chylomicrons. These chylomicrons are finally released into the specialized lymph vessels of the small intestine known as lacteals.

193. **(B)** Rhodopsin, also known as visual purple, is a light-sensitive protein found in the rod cells of the human eye. It is essential for vision in low-light conditions and is composed of a protein called opsin and retinal, which is a derivative of Vitamin A, emphasizing the link between nutrition and vision.

194. **(C)** Unlike protein-based hormones that require second messengers to relay signals from the cell surface, steroid hormones like estrogen are lipid-soluble. This allows them to pass directly through the cell membrane and bind to intracellular or nuclear receptors, where they can directly influence the transcription of specific target genes.

195. **(A)** Muscle contraction involves the interaction between thick and thin filaments. The globular head of the myosin molecule (thick filament) functions as an active ATPase enzyme, using the energy from ATP hydrolysis to bind to active sites on the actin filament (thin filament) and perform the necessary mechanical power stroke.

196. **(D)** The counter-current mechanism in the mammalian kidney is essential for concentrating urine and conserving water. It relies on the specific anatomical arrangement and opposing flow of fluid in the descending and ascending limbs of the Loop of Henle, as well as the closely associated vasa recta blood vessels in the medulla.

197. **(A)** Competitive inhibition occurs when a molecule similar in structure to the substrate competes for the same active site on an enzyme. This type of inhibition is reversible; therefore, it can be effectively overcome by significantly increasing the concentration of the actual substrate relative to the concentration of the inhibitor molecule.

198. **(B)** Saheli is a unique oral contraceptive developed by the Central Drug Research Institute (CDRI) in Lucknow, India. Unlike traditional daily pills that contain steroid hormones, Saheli is a non-steroidal selective estrogen receptor modulator that is highly effective and only needs to be taken once a week by the user.

199. **(B)** In the logistic growth model, population growth is limited by environmental resources. As the population size (N) increases and eventually reaches the carrying capacity (K) of the environment, the growth rate (dN/dt) slows down and ultimately becomes zero, indicating that the population has reached a stable equilibrium within its habitat.

200. **(A)** The Human Genome Project was a massive scientific endeavor that successfully mapped the entire sequence of human DNA. One of the project's most significant findings was that despite the vast size of the human genome, less than 2