# UPCATET Complete Sample Paper – 1

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

## Instructions

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

## Part A: Physics (Q1–Q50)

**Q1.** A car starts from rest and accelerates uniformly at $4$ m/s$^2$. What is the velocity of the car after travelling $50$ m?

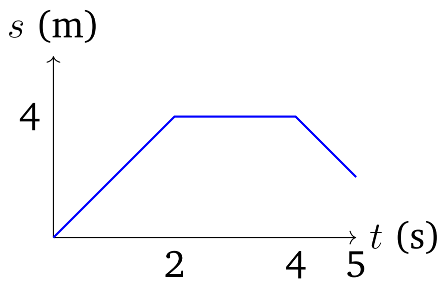
(A) $20$ m/s

(B) $10$ m/s

(C) $\sqrt{400}$ m/s

(D) $25$ m/s

**Q2.** The displacement-time graph of a body is shown below:




Which segment shows the body at rest?

(A) OA (0 to 2 s)

(B) AB (2 to 4 s)

(C) BC (4 to 5 s)

(D) The body is never at rest

**Q3.** A stone is dropped from the top of a tower of height $80$ m. Taking $g = 10$ m/s$^2$, the time taken to reach the ground is:

(A) $2$ s

(B) $6$ s

(C) $4$ s

(D) $8$ s

**Q4.** A body starts from rest with uniform acceleration $a$. The distance travelled in the $n^{\text{th}}$ second of its motion is given by:

(A) $s_n = an$

(B) $s_n = \frac{1}{2}an^2$

(C) $s_n = \frac{1}{2}a(2n-1)$

(D) $s_n = a\left(n - \frac{1}{2}\right)$

**Q5.** The velocity-time graph of a uniformly decelerating body is a straight line with a negative slope. The area under this $v$-$t$ graph gives the:

(A) Displacement of the body

(B) Acceleration of the body

(C) Speed of the body at any instant

(D) Force acting on the body

**Q6.** Two trains move in opposite directions. Train A has speed $72$ km/h and train B has speed $90$ km/h. Their relative velocity with respect to each other is:

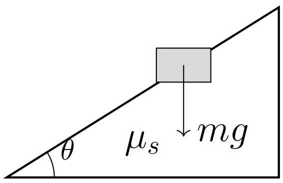
(A) $18$ km/h

(B) $162$ km/h

(C) $90$ km/h

(D) $72$ km/h

**Q7.** A block of mass $m$ rests on an inclined plane making angle $\theta$ with horizontal. The coefficient of static friction is $\mu_s$. The minimum force needed to hold the block from sliding down is:




(A) $mg\cos\theta$

(B) $mg\sin\theta + \mu_s mg\cos\theta$

(C) $mg(\sin\theta - \mu_s\cos\theta)$

(D) $\mu_s mg\cos\theta$

**Q8.** In an Atwood's machine, masses $m_1 = 3$ kg and $m_2 = 5$ kg are connected over a frictionless pulley. The acceleration of the system is (take $g = 10$ m/s$^2$):

(A) $1.5$ m/s$^2$

(B) $3.0$ m/s$^2$

(C) $5.0$ m/s$^2$

(D) $2.5\ \text{m/s}^2$

**Q9.** A person of mass $60$ kg stands on a weighing machine inside a lift that accelerates upward at $2\ \text{m/s}^2$. The reading of the machine (in kgf) is approximately (take $g = 10\ \text{m/s}^2$):

(A) $72$ kgf

(B) $60$ kgf

(C) $48$ kgf

(D) $80$ kgf

**Q10.** Which of the following statements about friction is **incorrect**?

(A) Static friction is a self-adjusting force up to a maximum value

(B) Kinetic friction is always greater than maximum static friction

(C) The coefficient of friction depends on the nature of surfaces in contact

(D) Friction acts parallel to the surface of contact

**Q11.** Three blocks $A$ ($3$ kg), $B$ ($4$ kg), and $C$ ($3$ kg) are connected in series on a frictionless surface. A force $F = 20$ N is applied to block $A$. The tension in the string between $B$ and $C$ is:

(A) $4$ N

(B) $8$ N

(C) $6$ N

(D) $10$ N

**Q12.** If the coefficient of static friction between a block and a horizontal surface is $\mu_s = \tan\lambda$, then $\lambda$ is called the:

(A) Critical angle

(B) Refraction angle

(C) Brewster's angle

(D) Angle of friction

**Q13.** A spring with spring constant $k = 200$ N/m is compressed by $0.1$ m. The elastic potential energy stored in the spring is:

(A) $1$ J

(B) $10$ J

(C) $20$ J

(D) $0.1$ J

**Q14.** A block of mass $2$ kg is moving at $5$ m/s. A constant force brings it to rest over $2$ m. The work done by this force is:

(A) $+25$ J

(B) $-25$ J

(C) $+10$ J

(D) $-10$ J

**Q15.** An engine exerts a force of $5000$ N on a vehicle moving at $72$ km/h. The power developed by the engine is:

(A) $36$ kW

(B) $72$ kW

(C) $100$ kW

(D) $50$ kW

**Q16.** In a perfectly elastic collision between two bodies of equal mass, one of which is initially at rest:

(A) Both bodies move together after collision

(B) The first body continues with the same velocity; the second remains at rest

(C) Both bodies come to rest

(D) The first body comes to rest and the second moves with the first body's initial velocity

**Q17.** Which of the following forces is **conservative**?

(A) Gravitational force

(B) Friction

(C) Air resistance

(D) Viscous drag

**Q18.** The moment of inertia of a uniform disc of mass $M$ and radius $R$ about an axis through its centre and perpendicular to its plane is:

(A) $MR^2$

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

(C) $\frac{2}{5}MR^2$

(D) $\frac{1}{4}MR^2$

**Q19.** The moment of inertia of a ring of mass $M$ and radius $R$ about a diameter is:

(A) $MR^2$

(B) $\frac{1}{4}MR^2$

(C) $\frac{1}{2}MR^2$

(D) $2MR^2$

**Q20.** A torque of $10$ N · m acts on a flywheel having a moment of inertia of $5$ kg · m$^2$. The angular acceleration produced is:

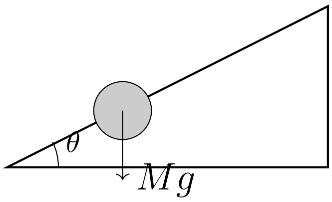
(A) $0.5$ rad/s$^2$

(B) $5$ rad/s$^2$

(C) $50$ rad/s$^2$

(D) $2$ rad/s$^2$

**Q21.** A solid sphere of mass $M$ and radius $R$ rolls without slipping down an inclined plane. The ratio of its translational kinetic energy to its total kinetic energy is:




(A) $\frac{5}{7}$

(B) $\frac{2}{7}$

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

(D) $\frac{7}{5}$

**Q22.** A student sits on a freely rotating stool holding weights in outstretched hands. When the student draws the weights inward, the moment of inertia decreases. What happens to angular velocity?

(A) Decreases

(B) Increases

(C) Remains the same

(D) Becomes zero

**Q23.** According to the first law of thermodynamics, which of the following is correct for a system undergoing a process?

(A) $Q = W$ (heat equals work in all processes)

(B) $\Delta U = 0$ always

(C) $Q = \Delta U + W$

(D) $W = \Delta U + Q$

**Q24.** For an ideal gas undergoing an isothermal expansion from volume $V_1$ to $V_2$ at temperature $T$, the work done by the gas is:

(A) $nR(V_2 - V_1)$

(B) $nCv(V_2 - V_1)$

(C) Zero

(D) $nRT \ln\left(\frac{V_2}{V_1}\right)$

**Q25.** For an ideal gas, the difference $C_p - C_v$ is equal to:

(A) $R$

(B) $2R$

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

(D) $\frac{5}{2}R$

**Q26.** The internal energy of an ideal gas at temperature $T$ depends on:

(A) Only the pressure of the gas

(B) Only the temperature of the gas

(C) Both temperature and volume

(D) Only the volume of the gas

**Q27.** In an adiabatic process, the quantity that remains constant is:

(A) Pressure

(B) Temperature

(C) Heat exchanged ($Q = 0$, no heat transfer occurs)

(D) Volume

**Q28.** Two point charges $q_1 = 2\ \mu$C and $q_2 = 8\ \mu$C are separated by $0.2$ m in air. The electrostatic force between them is (take $k = 9 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2$):

(A) $1.44$ N

(B) $0.36$ N

(C) $7.2$ N

(D) $3.6$ N

**Q29.** The electric field on the axial line of a short electric dipole of moment $p$ at a distance $r$ from its centre is:

(A) $\frac{2kp}{r^3}$

(B) $\frac{kp}{r^3}$

(C) $\frac{kp}{r^2}$

(D) $\frac{2kp}{r^2}$

**Q30.** A parallel plate capacitor of capacitance $C = 10\ \mu$F is charged to a potential $V = 100$ V. The energy stored in the capacitor is:

(A) $0.01$ J

(B) $0.05$ J

(C) $0.1$ J

(D) $0.5$ J

**Q31.** If the area of the plates of a parallel plate capacitor is doubled and the separation between the plates is also doubled, the new capacitance compared to original is:

(A) Doubled

(B) Halved

(C) Unchanged

(D) Quadrupled

**Q32.** Two charges $+q$ and $-q$ are placed at a separation $d$. The potential at the midpoint between them is:

(A) $\frac{kq}{d}$

(B) $\frac{2kq}{d}$

(C) $\frac{kq}{d^2}$

(D) Zero

**Q33.** A resistor of $10\,\Omega$ is connected across a battery of $5$ V. The current flowing through the resistor is:

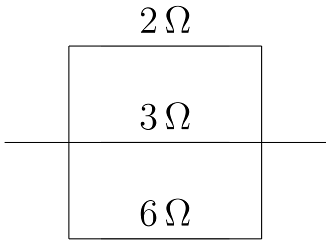
(A) $0.5$ A

(B) $2$ A

(C) $5$ A

(D) $50$ A

**Q34.** Three resistors of $2\ \Omega$, $3\ \Omega$, and $6\ \Omega$ are connected in parallel. The equivalent resistance of the combination is:




(A) $1.5\ \Omega$

(B) $1\ \Omega$

(C) $11\ \Omega$

(D) $0.5\ \Omega$

**Q35.** A current of $12$ A enters a junction where the wire splits into two branches of resistance $4\ \Omega$ and $8\ \Omega$. The current through the $8\ \Omega$ branch is:

(A) $8$ A

(B) $6$ A

(C) $4$ A

(D) $3$ A

**Q36.** At a junction in a circuit, currents of $3$ A, $5$ A, and $2$ A flow into the junction. If $4$ A and $3$ A flow out of the junction, the current flowing out of the remaining branch is:

(A) $2$ A

(B) $4$ A

(C) $1$ A

(D) $3$ A

**Q37.** In a Wheatstone bridge, $P = 10\ \Omega$, $Q = 30\ \Omega$, $R = 20\ \Omega$. For the bridge to be balanced, the value of $S$ must be:

(A) $60\ \Omega$

(B) $30\ \Omega$

(C) $10\ \Omega$

(D) $15\ \Omega$

**Q38.** A ray of light travels from glass ($\mu = 1.5$) into air. The critical angle for total internal reflection is approximately:

(A) $30$

(B) $42$

(C) $60$

(D) $90$

**Q39.** An object is placed $30$ cm in front of a convex lens of focal length $10$ cm. The image distance is:

(A) $-15$ cm

(B) $20$ cm

(C) $15$ cm

(D) $30$ cm

**Q40.** A concave lens of focal length $20$ cm produces a virtual, erect, and diminished image of an object placed anywhere in front of it. If the object is at $40$ cm, the image distance is:

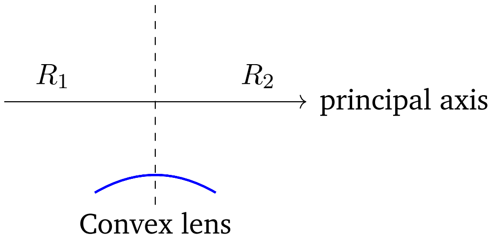
(A) $-40$ cm

(B) $-30$ cm

(C) $-10$ cm

(D) $-\frac{40}{3}$ cm

**Q41.** The lens maker's equation is:




(A) $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

(B) $\frac{1}{f} = \frac{\mu}{R_1 - R_2}$

(C) $\frac{1}{f} = \frac{1}{R_1} - \frac{1}{R_2}$

(D) $\frac{1}{f} = (\mu + 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

**Q42.** A convex lens of power $+5$ D is placed in contact with a concave lens of power $-3$ D. The power of the combination and the nature of the equivalent lens are:

(A) $-2$ D, concave

(B) $+2$ D, convex

(C) $+8$ D, convex

(D) $-8$ D, concave

**Q43.** The speed of a transverse wave on a string of linear mass density $\mu$ under tension $T$ is:

(A) $v = \sqrt{\mu T}$

(B) $v = \dfrac{T}{\mu}$

(C) $v = \sqrt{\dfrac{T}{\mu}}$

(D) $v = \dfrac{\mu}{T}$

**Q44.** In Young's double slit experiment, the path difference for the $n^{\text{th}}$ bright fringe is:

(A) $(2n-1)\dfrac{\lambda}{2}$

(B) $(2n+1)\dfrac{\lambda}{2}$

(C) $(n+1)\lambda$

(D) $n\lambda$

**Q45.** In a stationary wave, the distance between two consecutive nodes is:

(A) $\dfrac{\lambda}{2}$

(B) $\lambda$

(C) $\dfrac{\lambda}{4}$

(D) $2\lambda$

**Q46.** A closed organ pipe of length $L$ resonates in its fundamental mode. The wavelength of the standing wave is:

(A) $L$

(B) $4L$

(C) $2L$

(D) $\dfrac{L}{2}$

**Q47.** A source of sound emitting frequency $f$ moves towards a stationary observer with speed $v_s$. If the speed of sound is $v$, the apparent frequency heard by the observer is:

(A) $f\left(\dfrac{v-v_s}{v}\right)$

(B) $f\left(\dfrac{v}{v+v_s}\right)$

(C) $f\left(\dfrac{v}{v-v_s}\right)$

(D) $f\left(\dfrac{v+v_s}{v}\right)$

**Q48.** In the photoelectric effect, the stopping potential $V_0$ is related to the maximum kinetic energy $KE_{\text{max}}$ of ejected electrons by:

(A) $V_0 = \dfrac{KE_{\text{max}}}{2e}$

(B) $V_0 = \sqrt{KE_{\text{max}}/e}$

(C) $V_0 = e \cdot KE_{\text{max}}$

(D) $V_0 = \dfrac{KE_{\text{max}}}{e}$

**Q49.** The threshold wavelength for photoelectric emission from a metal of work function $\phi$ is:

(A) $\lambda_0 = \dfrac{hc}{\phi}$

(B) $\lambda_0 = \dfrac{\phi}{hc}$

(C) $\lambda_0 = \dfrac{h\phi}{c}$

(D) $\lambda_0 = \dfrac{c}{h\phi}$

**Q50.** An electron is accelerated through a potential difference of $V$ volts. Its de Broglie wavelength is (in SI units):

(A) $\lambda = \dfrac{h}{\sqrt{meV}}$

(B) $\lambda = \dfrac{h}{\sqrt{2meV}}$

(C) $\lambda = \dfrac{h}{meV}$

(D) $\lambda = \dfrac{h}{\sqrt{meV/2}}$

## Part B: Chemistry (Q51–Q100)

**Q51.** The molar mass of glucose ($C_6H_{12}O_6$) is:

(A) 160 g/mol

(B) 172 g/mol

(C) 180 g/mol

(D) 192 g/mol

**Q52.** How many molecules are present in $0.5$ moles of $CO_2$ (take $N_A = 6.022 \times 10^{23}$)?

(A) $6.022 \times 10^{23}$

(B) $1.2 \times 10^{24}$

(C) $6.022 \times 10^{22}$

(D) $3.011 \times 10^{23}$

**Q53.** In the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, if 2 moles of $N_2$ and 3 moles of $H_2$ are mixed, the limiting reagent is:

(A) $H_2$

(B) $N_2$

(C) $NH_3$

(D) None; both are consumed equally

**Q54.** The percentage by mass of nitrogen in urea ($NH_2CONH_2$, molar mass $= 60$ g/mol) is:

(A) $23.3\%$

(B) $46.7\%$

(C) $33.3\%$

(D) $53.3\%$

**Q55.** A compound contains $40\%$ C, $6.67\%$ H, and $53.33\%$ O by mass. Its empirical formula is:

(A) $CH_2O_2$

(B) $C_2H_4O_2$

(C) $CH_2O$

(D) $C_2H_2O$

**Q56.** The energy of the electron in the $n^{\text{th}}$ orbit of hydrogen atom according to Bohr's model is:

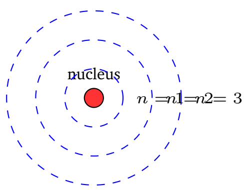
(A) $E_n = +13.6\,n^2$ eV

(B) $E_n = \dfrac{-13.6}{n}$ eV

(C) $E_n = -13.6\,n^2$ eV

(D) $E_n = \dfrac{-13.6}{n^2}$ eV

**Q57.** According to Bohr's model, the radius of the $n^{\text{th}}$ orbit of hydrogen is proportional to:




(A) $n^2$

(B) $n$

(C) $\dfrac{1}{n^2}$

(D) $\dfrac{1}{n}$

**Q58.** The correct electronic configuration of Fe (atomic number 26) is:

(A) $[\text{Ar}]\,3d^6\,4s^0$

(B) $[\text{Ar}]\,3d^6\,4s^2$

(C) $[\text{Ar}]\,3d^8\,4s^0$

(D) $[\text{Ar}]\,3d^5\,4s^1$

**Q59.** Which set of quantum numbers is **not allowed** for an electron?

(A) $n = 2,\ l = 1,\ m_l = 0,\ m_s = +\frac{1}{2}$

(B) $n = 3,\ l = 2,\ m_l = -1,\ m_s = -\frac{1}{2}$

(C) $n = 2,\ l = 2,\ m_l = 0,\ m_s = +\frac{1}{2}$

(D) $n = 4,\ l = 3,\ m_l = +3,\ m_s = -\frac{1}{2}$

**Q60.** According to de Broglie's concept applied to Bohr orbits, an electron in the $n^{\text{th}}$ orbit satisfies:

(A) $2\pi r_n = \dfrac{nh}{mv}$

(B) $mvr_n = \dfrac{nh}{4\pi}$

(C) $r_n = \dfrac{nh}{2\pi mv}$

(D) $2\pi r_n = n\lambda$

**Q61.** Which of the following compounds has the **highest** ionic character?

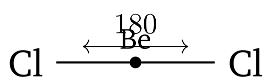
(A) NaF

(B) HCl

(C) $CCl_4$

(D) $SO_2$

**Q62.** According to VSEPR theory, the shape of $BeCl_2$ molecule is:



(A) Bent (V-shaped)

(B) Linear

(C) Trigonal planar

(D) Tetrahedral

**Q63.** $NH_3$ has a lone pair on nitrogen. Its molecular geometry according to VSEPR is:

(A) Trigonal planar

(B) T-shaped

(C) Trigonal pyramidal

(D) Tetrahedral

**Q64.** The hybridization of sulfur in $SF_6$ is:

(A) $sp^2$

(B) $sp^3$

(C) $sp^3d$

(D) $sp^3d^2$

**Q65.** Among the following, the molecule with zero dipole moment is:

(A) $CCl_4$

(B) $CHCl_3$

(C) $H_2O$

(D) $NH_3$

**Q66.** Given: C (graphite) + $O_2 \to CO_2$; $\Delta H = -394$ kJ/mol and $H_2 + \frac{1}{2}O_2 \to H_2O$; $\Delta H = -286$ kJ/mol. Using Hess's law, $\Delta H$ of formation of $H_2O_2$ (from its elements in their standard states) given that $H_2O_2 \to H_2O + \frac{1}{2}O_2$; $\Delta H = -98$ kJ/mol, is:

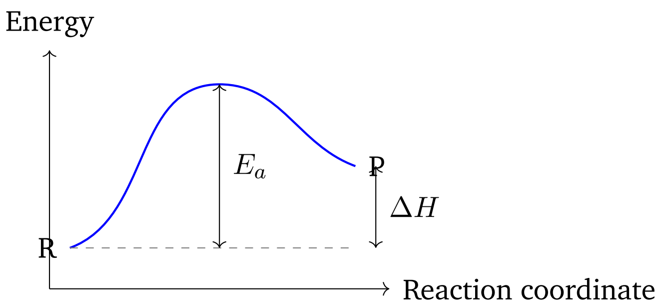
(A) $-394$ kJ/mol

(B) $-188$ kJ/mol

(C) $-286$ kJ/mol

(D) $+188$ kJ/mol

**Q67.** An energy profile diagram for a reaction is shown below:




The reaction is:

(A) Exothermic with no activation energy

(B) Exothermic with high activation energy

(C) Endothermic ($\Delta H > 0$)

(D) Thermoneutral

**Q68.** Using bond enthalpies: $E$(H–H) $= 436$ kJ/mol, $E$(Cl–Cl) $= 242$ kJ/mol, $E$(H–Cl) $= 431$ kJ/mol, the $\Delta H$ for $H_2 + Cl_2 \rightarrow 2HCl$ is:

(A) $+678$ kJ

(B) $+184$ kJ

(C) $-678$ kJ

(D) $-184$ kJ

**Q69.** The standard enthalpy of formation ($\Delta H_f^\circ$) of an element in its most stable form at $298$ K and 1 atm is:

(A) Zero

(B) $-RT \ln K$

(C) Positive

(D) Negative

**Q70.** A reaction is spontaneous at all temperatures if:

(A) $\Delta H > 0$ and $\Delta S < 0$

(B) $\Delta H < 0$ and $\Delta S > 0$

(C) $\Delta H < 0$ and $\Delta S < 0$

(D) $\Delta H > 0$ and $\Delta S > 0$

**Q71.** For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the expression for $K_c$ is:

(A) $K_c = \dfrac{[N_2][H_2]^3}{[NH_3]^2}$

(B) $K_c = \dfrac{[NH_3]}{[N_2][H_2]^3}$

(C) $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$

(D) $K_c = \dfrac{[NH_3]^3}{[N_2][H_2]^2}$

**Q72.** For the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, the relation between $K_p$ and $K_c$ is:

(A) $K_p = K_c/(RT)$

(B) $K_p = K_c$

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

(D) $K_p = K_c \cdot RT$

**Q73.** For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$, increasing the pressure at constant temperature will:

(A) Shift equilibrium to the right (towards $NH_3$)

(B) Shift equilibrium to the left

(C) Have no effect on equilibrium

(D) Decrease the value of $K_c$

**Q74.** The formation of $SO_3$ from $SO_2$ and $O_2$ is exothermic. Increasing the temperature will:

(A) Increase the yield of $SO_3$

(B) Decrease the yield of $SO_3$

(C) Have no effect on yield

(D) Increase $K_c$

**Q75.** If $\alpha$ is the degree of dissociation of $PCl_5$ into $PCl_3$ and $Cl_2$, and the initial moles of $PCl_5$ are 1, the total moles at equilibrium are:

(A) $1 - \alpha$

(B) $\alpha$

(C) $1 + \alpha$

(D) $2\alpha$

**Q76.** What is the pH of a $0.01$ M solution of HCl (a strong acid, fully dissociated)?

(A) 1

(B) 7

(C) 0

(D) 2

**Q77.** The Henderson-Hasselbalch equation for a buffer made of a weak acid HA and its conjugate base $A^-$ is:

(A) $\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$

(B) $\text{pH} = \text{p}K_a - \log \frac{[\text{A}^-]}{[\text{HA}]}$

(C) $\text{pH} = \text{p}K_b + \log \frac{[\text{HA}]}{[\text{A}^-]}$

(D) $\text{pH} = -\log[\text{HA}]$

**Q78.** A buffer solution resists changes in pH when small amounts of acid or base are added because:

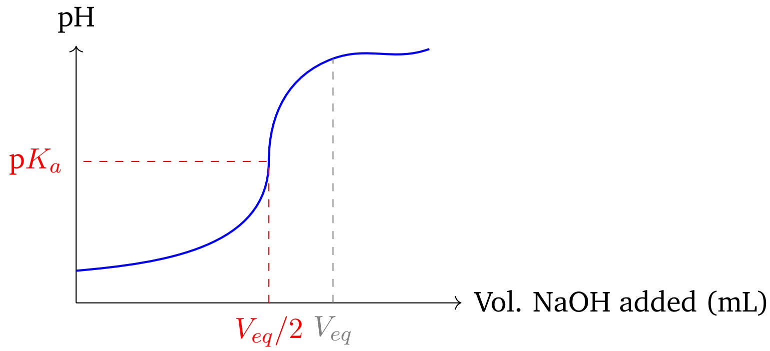
(A) It has a very high pH

(B) The weak acid or base component neutralises the added acid or base

(C) It contains a strong acid-strong base pair

(D) It has infinite capacity to absorb acids

**Q79.** In the titration curve of a weak acid with a strong base shown below, the half-equivalence point corresponds to:




(A) pH = 7

(B) pH = pOH

(C) pH = p$K_a$

(D) pH = 14

**Q80.** A salt formed from a strong acid and weak base undergoes hydrolysis. Its aqueous solution is:

(A) Basic (pH $>$ 7)

(B) Neutral (pH $=$ 7)

(C) Strongly basic

(D) Acidic (pH $<$ 7)

**Q81.** The IUPAC name of the compound $CH_3$-$CH(CH_3)$-$CH_2$-$CH_3$ is:

(A) 2-methylbutane

(B) 3-methylbutane

(C) Isopentane

(D) 2-methylpropane

**Q82.** The number of structural isomers of butane ($C_4H_{10}$) is:

(A) 1

(B) 2

(C) 3

(D) 4

**Q83.** Which functional group is present in acetic acid ($CH_3COOH$)?

(A) Ketone ($-$CO$-$)

(B) Ester ($-$COO$-$)

(C) Carboxyl ($-$COOH)

(D) Aldehyde ($-$CHO)

**Q84.** The IUPAC name of HC$\equiv$C-$CH_2$-$CH_3$ is:

(A) but-2-yne

(B) but-3-yne

(C) prop-1-yne

(D) but-1-yne

**Q85.** The degree of unsaturation (index of hydrogen deficiency) of benzene ($C_6H_6$) is:

(A) 4

(B) 2

(C) 3

(D) 6

**Q86.** When HBr is added to propene ($CH_3$-CH=$CH_2$) according to Markovnikov's rule, the major product is:

(A) 1-bromopropane

(B) 2-bromopropane

(C) 1,2-dibromopropane

(D) Propanal

**Q87.** Ozonolysis of 2-butene ($CH_3$-CH=CH-$CH_3$) followed by reductive workup gives:

(A) Formaldehyde and acetaldehyde

(B) Only formaldehyde

(C) Two molecules of acetaldehyde ($CH_3CHO$)

(D) Acetone and formaldehyde

**Q88.** Hydration of propyne ($CH_3$-C≡CH) in the presence of $H_2SO_4$/$HgSO_4$ gives the major product:

(A) Propanal

(B) Propan-1-ol

(C) Prop-2-en-1-ol

(D) Propan-2-one (acetone)

**Q89.** Bromine water is decolorised by an alkene due to:

(A) Electrophilic addition (addition of $Br_2$ across the double bond)

(B) Nucleophilic substitution

(C) Free radical reaction

(D) Elimination reaction

**Q90.** The order of stability of carbocations is:

(A) Primary $>$ Secondary $>$ Tertiary

(B) Tertiary $>$ Secondary $>$ Primary

(C) Secondary $>$ Tertiary $>$ Primary

(D) Primary $>$ Tertiary $>$ Secondary

**Q91.** Which of the following is a valid oxidation state of manganese (Mn)?

(A) $+1$

(B) $+3$ only

(C) $+7$ (as in $KMnO_4$)

(D) $+6$ only

**Q92.** Transition metal compounds are often colored because:

(A) They have high atomic masses

(B) They form ionic compounds

(C) They have high melting points

(D) Partially filled $d$-orbitals allow $d$-$d$ electronic transitions

**Q93.** Which of the following ions is **paramagnetic**?

(A) $Cu^{2+}$

(B) $Zn^{2+}$

(C) $Cu^{+}$

(D) $Sc^{3+}$

**Q94.** In potassium dichromate ($K_2Cr_2O_7$), the oxidation state of chromium is:

(A) $+3$

(B) $+6$

(C) $+4$

(D) $+7$

**Q95.** Transition metals and their compounds act as good catalysts mainly because of their:

(A) High density and high melting points

(B) Ability to form ionic bonds

(C) Variable oxidation states and ability to form complexes

(D) Low reactivity with oxygen

**Q96.** Carbon monoxide (CO) emitted directly from vehicle exhaust is an example of a:

(A) Secondary pollutant

(B) Tertiary pollutant

(C) Non-pollutant (natural gas)

(D) Primary pollutant

**Q97.** Biochemical Oxygen Demand (BOD) is used as a measure of:

(A) The degree of water pollution by organic matter

(B) The level of dissolved oxygen in clean water

(C) Air quality index

(D) Soil fertility

**Q98.** Chlorofluorocarbons (CFCs) deplete the ozone layer by releasing chlorine radicals. The reaction that destroys ozone is:

(A) $Cl + O_2 \rightarrow ClO_2$

(B) $Cl\cdot + O_3 \rightarrow ClO\cdot + O_2$

(C) $CF_2Cl_2 + O_3 \rightarrow CO_2 + Cl_2 + F_2$

(D) $O_3 \rightarrow 3O$ (spontaneous)

**Q99.** Which of the following is NOT a greenhouse gas?

(A) $CO_2$

(B) $CH_4$

(C) $N_2O$ (nitrous oxide)

(D) $N_2$ (dinitrogen)

**Q100.** Acid rain is caused primarily by emissions of:

(A) $CO_2$ and $CH_4$

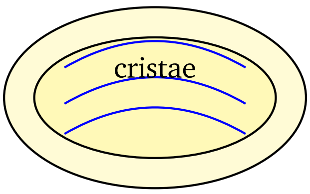
(B) $O_3$ and CO

(C) CO and HCl

(D) $SO_2$ and $NO_x$

## Part C: Biology (Q101–Q180)

**Q101.** The inner membrane of the mitochondrion is folded into structures called:




Mitochondria cross-section

(A) Cristae

(B) Thylakoids

(C) Grana

(D) Cisternae

**Q102.** In the chloroplast, the dark reactions (Calvin cycle) take place in the:

(A) Thylakoid membrane

(B) Stroma

(C) Grana

(D) Outer membrane

**Q103.** Prokaryotic ribosomes are:

(A) 80S (60S + 40S)

(B) 60S only

(C) 70S (50S + 30S)

(D) 50S only

**Q104.** Lysosomes are organelles that:

(A) Produce ATP by oxidative phosphorylation

(B) Synthesise proteins

(C) Perform photosynthesis

(D) Digest damaged organelles and macromolecules (autolysis)

**Q105.** The Golgi apparatus is primarily involved in:

(A) Processing, packaging, and secretion of proteins

(B) ATP synthesis

(C) DNA replication

(D) Lipid breakdown

**Q106.** Which of the following events occurs during prophase of mitosis?

(A) Nuclear envelope reforms

(B) Chromatin condenses into visible chromosomes

(C) Sister chromatids separate at centromeres

(D) Chromosomes align at the metaphase plate

**Q107.** During metaphase of mitosis, chromosomes:

(A) Decondense into chromatin

(B) Begin replicating their DNA

(C) Align along the equatorial plate (metaphase plate)

(D) Move toward the poles

**Q108.** During anaphase of mitosis, the event that ensures each daughter cell receives the correct chromosome number is:

(A) Formation of the spindle apparatus

(B) Condensation of chromosomes

(C) Alignment of chromosomes at the equatorial plate

(D) Separation of sister chromatids at the centromeres

**Q109.** The biological significance of mitosis is:

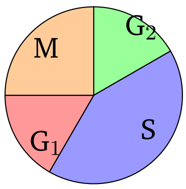
(A) Growth, repair, and asexual reproduction with maintenance of chromosome number

(B) Reduction of chromosome number to half

(C) Genetic recombination between homologues

(D) Production of gametes

**Q110.** The cell cycle is shown as a pie chart below. The S phase (DNA synthesis) occurs during:




(A) $G_1$ phase

(B) Interphase (specifically the S phase)

(C) M phase

(D) $G_2$ phase

**Q111.** Mendel's Law of Segregation states that:

(A) Traits blend in offspring

(B) Alleles of different genes assort independently

(C) Dominant allele always suppresses recessive

(D) Two alleles for each trait separate during gamete formation

**Q112.** In a dihybrid cross between AaBb × AaBb, the expected phenotypic ratio in the offspring is:

(A) $3:1$

(B) $1:2:1$

(C) $1:1:1:1$

(D) $9:3:3:1$

**Q113.** A test cross is a cross between an individual showing a dominant phenotype and:

(A) A homozygous recessive individual

(B) A homozygous dominant individual

(C) A heterozygous individual

(D) An individual of unknown genotype

**Q114.** In snapdragons, a cross between a red-flowered plant (RR) and a white-flowered plant (WW) gives all pink-flowered offspring (RW). This is an example of:

(A) Complete dominance

(B) Incomplete dominance

(C) Codominance

(D) Epistasis

**Q115.** In a monohybrid cross Tt × Tt, the genotypic ratio of the offspring is:

(A) $1:1$

(B) $3:1$

(C) $1 : 2 : 1$

(D) $2 : 1 : 1$

**Q116.** The semiconservative nature of DNA replication was experimentally proved by:

(A) Watson and Crick (1953)

(B) Griffith (1928)

(C) Hershey and Chase (1952)

(D) Meselson and Stahl (1958)

**Q117.** In DNA replication, primase synthesises a short RNA primer. The purpose of this primer is to:

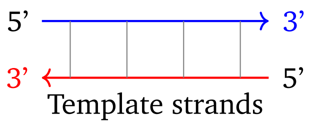
(A) Provide a free 3'-OH end for DNA polymerase to begin synthesis

(B) Unwind the double helix

(C) Join Okazaki fragments

(D) Proofread newly synthesised DNA

**Q118.** DNA polymerase III synthesises new DNA strands:




(A) In both 5'→3' and 3'→5' directions simultaneously

(B) Only in the 5'→3' direction

(C) Only in the 3'→5' direction

(D) Bidirectionally with equal efficiency

**Q119.** Okazaki fragments are formed on the:

(A) Leading strand in a continuous manner

(B) Both leading and lagging strands

(C) Lagging strand in a discontinuous manner

(D) mRNA during transcription

**Q120.** DNA ligase in DNA replication is responsible for:

(A) Unwinding the double helix ahead of the replication fork

(B) Synthesising new nucleotides

(C) Proofreading for base pair errors

(D) Joining Okazaki fragments on the lagging strand

**Q121.** Spirogyra, commonly known as "pond silk," belongs to which division of the plant kingdom?

(A) Chlorophyta (green algae)

(B) Phaeophyta (brown algae)

(C) Rhodophyta (red algae)

(D) Cyanobacteria

**Q122.** Funaria (common moss) is a bryophyte. Which of the following is true about bryophytes?

(A) They have true vascular tissue (xylem and phloem)

(B) They require water for fertilization (flagellated sperms)

(C) They produce seeds for reproduction

(D) They are the most advanced plant group

**Q123.** Selaginella is a heterosporous pteridophyte. Heterospory means it produces:

(A) Only one type of spore (homospory)

(B) Seeds instead of spores

(C) Two types of spores: microspores and megaspores

(D) Spores only in water

**Q124.** Gymnosperms differ from angiosperms in that:

(A) Gymnosperms have flowers

(B) Gymnosperms produce fruits enclosing the seeds

(C) Gymnosperms lack a vascular system

(D) Gymnosperm seeds are naked (not enclosed in a fruit)

**Q125.** The characteristic feature that distinguishes angiosperms from all other plant groups is:

(A) Seeds enclosed within a fruit (carpel-enclosed ovules)

(B) Presence of vascular tissue

(C) Production of spores

(D) Absence of roots

**Q126.** In Porifera (sponges), the water canal system responsible for circulating water and nutrients is called the:

(A) Coelom

(B) Canal system (ascon/sycon/leucon types)

(C) Gastrovascular cavity

(D) Pseudocoelom

**Q127.** The stinging cells found in Coelenterata (cnidarians) used for capturing prey are called:

(A) Flame cells

(B) Setae

(C) Cnidoblasts (nematocysts)

(D) Choanocytes

**Q128.** Flame cells in Platyhelminthes (flatworms) function as:

(A) Digestive cells

(B) Reproductive cells

(C) Locomotory structures

(D) Excretory structures for osmoregulation

**Q129.** In annelids (earthworms), the small hair-like structures on each segment that aid in locomotion are called:

(A) Setae

(B) Parapodia

(C) Cilia

(D) Pseudopods

**Q130.** The phylum Arthropoda is the largest animal phylum. Its key distinguishing feature is:

(A) A notochord

(B) Jointed appendages and an exoskeleton of chitin

(C) Water vascular system

(D) Radial symmetry

**Q131.** In the light reactions of photosynthesis, the reaction centre of Photosystem II absorbs light at:

(A) 700 nm

(B) 620 nm

(C) 680 nm

(D) 750 nm

**Q132.** The photolysis of water in the light reactions occurs in Photosystem II. The products are:

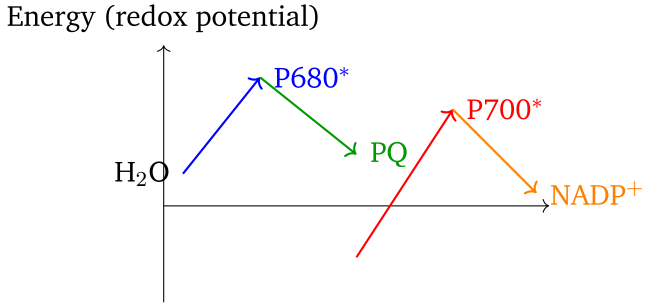
(A) $O_2$, NADPH, and ATP

(B) $CO_2$ and $H_2O$

(C) Glucose and $O_2$

(D) $O_2$, $H^+$ ions, and electrons

**Q133.** In the Z-scheme of photosynthesis, the overall electron flow is:




(A) $H_2O \rightarrow$ PS-II $\rightarrow$ PS-I $\rightarrow$ $NADP^+$

(B) $NADP^+ \rightarrow$ PS-I $\rightarrow$ PS-II $\rightarrow$ $H_2O$

(C) PS-I $\rightarrow$ PS-II $\rightarrow$ $NADP^+ \rightarrow H_2O$

(D) $H_2O \rightarrow$ PS-I $\rightarrow$ PS-II $\rightarrow$ $NADP^+$

**Q134.** Cyclic photophosphorylation involves:

(A) Both PS-I and PS-II, producing ATP and NADPH

(B) Only PS-I, producing only ATP (no NADPH, no $O_2$)

(C) Only PS-II, producing only NADPH

(D) Splitting of water to generate $O_2$

**Q135.** The light reactions of photosynthesis produce which combination of products used in the Calvin cycle?

(A) Glucose and $CO_2$

(B) $CO_2$ and $H_2O$

(C) ATP and NADPH

(D) $O_2$ and $H_2O$

**Q136.** Glycolysis converts one molecule of glucose (6C) into two molecules of pyruvate (3C). The net ATP produced in glycolysis is:

(A) 4 ATP

(B) 8 ATP

(C) 0 ATP

(D) 2 ATP

**Q137.** The molecule that enters the Krebs cycle (citric acid cycle) from pyruvate (after decarboxylation) is:

(A) Acetyl-CoA (2C)

(B) Oxaloacetate (4C)

(C) Citrate (6C)

(D) Pyruvate (3C) directly

**Q138.** Approximately how many ATP molecules are produced per glucose molecule via the electron transport chain (oxidative phosphorylation)?

(A) 2

(B) 34

(C) 8

(D) 38 (exact, no losses)

**Q139.** In anaerobic respiration in yeast, glucose is converted to:

(A) Lactic acid + $CO_2$

(B) Lactic acid only

(C) Ethanol + $CO_2$

(D) Acetic acid + $H_2O$

**Q140.** The Respiratory Quotient (RQ) for carbohydrates (e.g., glucose) during aerobic respiration is:

(A) Less than 1

(B) More than 1

(C) Zero

(D) Equal to 1

**Q141.** Salivary amylase (ptyalin) acts on starch and converts it to:

(A) Maltose

(B) Glucose

(C) Sucrose

(D) Fructose

**Q142.** Hydrochloric acid (HCl) secreted by the gastric glands of the stomach:

(A) Digests carbohydrates directly

(B) Activates pepsinogen to pepsin and creates an acidic medium for digestion

(C) Absorbs fat-soluble vitamins

(D) Emulsifies fats

**Q143.** Bile salts secreted by the liver and stored in the gall bladder help in:

(A) Protein digestion

(B) Carbohydrate absorption

(C) Emulsification of fats

(D) Activating lipase in the stomach

**Q144.** Villi and microvilli in the small intestine increase the:

(A) Rate of peristalsis

(B) Secretion of digestive enzymes

(C) Volume of the intestinal lumen

(D) Surface area for absorption of digested nutrients

**Q145.** The primary function of the large intestine is:

(A) Absorption of water and formation of faeces

(B) Digestion of proteins

(C) Secretion of bile

(D) Absorption of glucose

**Q146.** The human heart has four chambers. Which chamber pumps oxygenated blood to the body (systemic circulation)?

(A) Right atrium

(B) Left ventricle

(C) Left atrium

(D) Right ventricle

**Q147.** The sinoatrial (SA) node is called the 'pacemaker' of the heart because:

(A) It is the largest structure in the heart

(B) It pumps blood directly into the aorta

(C) It generates spontaneous electrical impulses that set the rhythm of heartbeat

(D) It controls the pressure of blood in the aorta

**Q148.** Normal human blood pressure is approximately $120/80$ mmHg. The numerator $120$ represents:

(A) Diastolic pressure (heart at rest)

(B) Mean arterial pressure

(C) Pulse pressure

(D) Systolic pressure (heart contracting)

**Q149.** Cardiac output is calculated as:

(A) Stroke volume $\times$ Heart rate

(B) Blood pressure $\div$ Heart rate

(C) Heart rate ÷ Stroke volume

(D) $\dfrac{\text{Blood pressure}}{\text{Peripheral resistance}}$

**Q150.** The valve located between the left atrium and the left ventricle is the:

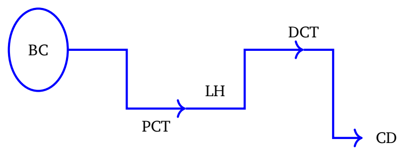
(A) Tricuspid valve

(B) Bicuspid (mitral) valve

(C) Pulmonary valve

(D) Aortic valve

**Q151.** The correct sequence of filtrate flow through the nephron is:




(A) PCT → Bowman's capsule → Loop of Henle → DCT → CD

(B) Bowman's capsule → DCT → PCT → Loop of Henle → CD

(C) Bowman's capsule → PCT → Loop of Henle → DCT → CD

(D) Loop of Henle → PCT → Bowman's capsule → DCT → CD

**Q152.** Glomerular filtration in the Bowman's capsule results in the formation of:

(A) Final urine

(B) Concentrated urine

(C) Hypertonic filtrate

(D) Ultrafiltrate (primary urine) — similar to blood plasma without large proteins

**Q153.** Antidiuretic hormone (ADH / vasopressin) acts on the:

(A) Collecting duct and distal convoluted tubule to increase water reabsorption

(B) Loop of Henle to decrease salt reabsorption

(C) Glomerulus to increase filtration rate

(D) Proximal convoluted tubule to secrete $H^+$ ions

**Q154.** Urea, the main nitrogenous waste product in humans, is synthesised in the:

(A) Kidney

(B) Liver (via the ornithine cycle / urea cycle)

(C) Spleen

(D) Lungs

**Q155.** Aldosterone, secreted by the adrenal cortex, acts on the distal convoluted tubule to:

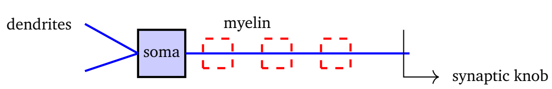
(A) Decrease $Na^+$ reabsorption

(B) Increase $K^+$ reabsorption

(C) Increase $Na^+$ reabsorption and $K^+$ secretion

(D) Decrease water reabsorption

**Q156.** In a neuron, the myelin sheath surrounding the axon:




(A) Generates action potentials

(B) Provides nutrients to the axon

(C) Conducts nerve impulses along its surface

(D) Provides electrical insulation and speeds up impulse conduction via saltatory conduction

**Q157.** The resting membrane potential of a typical neuron is approximately:

(A) $-70$ mV (inside negative relative to outside)

(B) $+70$ mV

(C) $0$ mV

(D) $-40$ mV

**Q158.** During the propagation of an action potential (nerve impulse), depolarisation occurs due to:

(A) Outflow of $Na^+$ ions from the neuron

(B) Inflow of $Na^+$ ions into the neuron

(C) Inflow of $K^+$ ions

(D) Outflow of $Cl^-$ ions

**Q159.** At a chemical synapse, the transmission of the nerve impulse from pre-synaptic neuron to post-synaptic neuron occurs through:

(A) Direct electrical conduction across the gap

(B) $Na^+$ ions flowing between the neurons

(C) Release of neurotransmitters into the synaptic cleft

(D) Reverse flow of the action potential

**Q160.** The spinal cord is responsible for:

(A) Higher cognitive functions like thinking and memory

(B) Production of hormones

(C) Visual processing

(D) Reflex actions and relaying impulses between the brain and body

**Q161.** Which of the following is a biotic component of an ecosystem?

(A) Decomposers (bacteria and fungi)

(B) Temperature

(C) Light intensity

(D) Soil pH

**Q162.** A food chain is correctly represented as:

(A) Carnivore → Herbivore → Producer

(B) Producer → Primary consumer → Secondary consumer → Tertiary consumer

(C) Decomposer → Producer → Herbivore

(D) Secondary consumer → Primary consumer → Producer

**Q163.** Lindeman's 10% law in ecology states that only about 10% of the energy at one trophic level is:

(A) Lost as heat to the environment

(B) Stored in producers

(C) Transferred to the next trophic level

(D) Used for decomposition

**Q164.** An energy pyramid in an ecosystem is always:

(A) Inverted (top-heavy)

(B) Irregular in shape

(C) Spindle-shaped

(D) Upright (broad base, narrow top)

**Q165.** A food web differs from a food chain in that:

$$\begin{tikzcd}
\text{Fox} & \text{Eagle} & \\
\text{Rabbit} \arrow[u] \arrow[ur] & \text{Deer} \arrow[u] & \text{Insects} \arrow[ul] \\
& \text{Grass} \arrow[ul] \arrow[u] \arrow[ur] &
\end{tikzcd}$$

(A) A food web shows multiple interconnected food chains

(B) A food web has only one producer

(C) A food web is a single straight chain of organisms

(D) A food web only involves decomposers

**Q166.** Alpha diversity refers to:

(A) Diversity between different habitats or ecosystems

(B) Species diversity within a single local habitat or community

(C) Total diversity across a large geographic region

(D) Genetic diversity within a single species

**Q167.** Which of the following is NOT one of India's four biodiversity hotspots?

(A) Western Ghats and Sri Lanka

(B) Himalayas (Eastern Himalaya hotspot)

(C) Deccan Plateau (central India)

(D) Indo-Burma region

**Q168.** According to IUCN Red List categories, a species facing a very high risk of extinction in the wild is categorised as:

(A) Vulnerable (VU)

(B) Near Threatened (NT)

(C) Least Concern (LC)

(D) Critically Endangered (CR)

**Q169.** Ex situ conservation of biodiversity refers to:

(A) Conservation outside the natural habitat (e.g., zoos, seed banks, botanical gardens)

(B) Conservation within the natural habitat (e.g., national parks, wildlife sanctuaries)

(C) Conservation of only plant species

(D) Conservation in international territories

**Q170.** As one moves from the poles toward the equator, species richness generally:

(A) Decreases

(B) Increases

(C) Remains the same

(D) First increases then decreases

**Q171.** When pollen from a flower is transferred to the stigma of a different plant of the same species, it is called:

(A) Autogamy (self-pollination)

(B) Geitonogamy

(C) Cross-pollination (xenogamy / allogamy)

(D) Cleistogamy

**Q172.** In angiosperms, double fertilisation results in:

(A) Two embryos in each seed

(B) A haploid embryo and a haploid endosperm

(C) A diploid endosperm and a haploid embryo

(D) A diploid embryo (2n) and a triploid endosperm (3n)

**Q173.** The endosperm in angiosperm seeds provides:

(A) Nutrition to the developing embryo

(B) Protection of the seed

(C) Water transport

(D) Germination signals

**Q174.** After fertilisation in angiosperms, the ovary develops into:

(A) The seed

(B) The fruit

(C) The flower

(D) The endosperm

**Q175.** The three basic conditions required for seed germination are:

(A) Light, nutrients, and soil

(B) $CO_2$, light, and warmth

(C) Water, oxygen, and appropriate temperature

(D) Soil, water, and fertiliser

**Q176.** The restriction endonuclease EcoRI recognises and cuts DNA at the sequence:

(A) 5'-AAGCTT-3'

(B) 5'-GGATCC-3'

(C) 5'-CCCGGG-3'

(D) 5'-GAATTC-3'

**Q177.** In recombinant DNA technology, DNA ligase is used to:

(A) Join the foreign DNA insert with the vector DNA (seal the phosphodiester bonds)

(B) Cut DNA at specific sequences

(C) Amplify DNA in PCR

(D) Separate DNA fragments by size

**Q178.** A plasmid used as a cloning vector in recombinant DNA technology must have:

(A) An antibiotic resistance gene only

(B) An origin of replication (ori), a selectable marker, and restriction sites

(C) Only restriction enzyme recognition sites

(D) A promoter gene only

**Q179.** In Polymerase Chain Reaction (PCR), the step that separates the two DNA strands is called:

(A) Annealing

(B) Extension

(C) Denaturation (at $\approx 94–96$C)

(D) Hybridisation

**Q180.** Bt cotton is a transgenic crop that contains a gene from:

(A) A fungus (*Aspergillus*)

(B) A virus (mosaic virus)

(C) Another plant (*Arabidopsis*)

(D) *Bacillus thuringiensis* (a bacterium) that produces insecticidal Cry proteins

## Part D: General Studies (Q181–Q200)

**Q181.** The National Agricultural Policy 2024 (India) primarily aims at:

(A) Doubling farmers' income through sustainable intensification and better market linkages

(B) Completely replacing traditional farming with hydroponics

(C) Banning use of chemical fertilisers

(D) Privatisation of all agricultural land

**Q182.** The PM-KISAN Samman Nidhi scheme provides direct income support of Rs. 6,000 per year to eligible farming families in three installments. The 18th installment was released in:

(A) 2023

(B) 2024

(C) 2022

(D) 2025

**Q183.** India achieved a record foodgrain production of approximately how many million tonnes in 2023–24?

(A) 200 million tonnes

(B) 250 million tonnes

(C) 321 million tonnes

(D) 400 million tonnes

**Q184.** SVPUAT stands for:

(A) Sardar Vallabhbhai Patel University of Agriculture and Technology

(B) Swami Vivekananda Polytechnic University of Agriculture and Technology

(C) Sardar Venkaiah Patel University of Agriculture and Technology

(D) Sardar Vallabhbhai Patel University of Agriculture and Technology (Meerut, UP), which conducts UPCATET

**Q185.** The UPCATET entrance examination is conducted for admission to agricultural universities in Uttar Pradesh. Which of the following universities is NOT covered under UPCATET?

(A) Indian Agricultural Research Institute (IARI), New Delhi

(B) SVPUAT, Meerut

(C) CSAUA&T, Kanpur

(D) ANDUAT, Faizabad

**Q186.** Which river marks the eastern boundary of Uttar Pradesh with Bihar?

(A) Yamuna

(B) Karmanasa / Ganga (boundary area)

(C) Ghaghra

(D) Saryu

**Q187.** The most dominant soil type found in the Indo-Gangetic plains of Uttar Pradesh is:

(A) Black soil (regur)

(B) Red laterite soil

(C) Alluvial soil (transported sediment from rivers)

(D) Desert sandy soil

**Q188.** The river Saryu (Ghaghra) is a tributary of which major river?

(A) Yamuna

(B) Chambal

(C) Gomti

(D) Ganga

**Q189.** The Preamble to the Indian Constitution describes India as a:

(A) Sovereign, Socialist, Secular, Democratic Republic

(B) Federal, Democratic, Theocratic Republic

(C) Sovereign, Capitalist, Secular, Democratic Republic

(D) Unitary, Socialist, Secular, Democratic Republic

**Q190.** Article 21 of the Indian Constitution guarantees:

(A) Right to equality

(B) Protection of life and personal liberty

(C) Right to freedom of speech

(D) Right against exploitation

**Q191.** Article 21A of the Indian Constitution (inserted by the 86th Amendment, 2002) provides:

(A) Right to vote for all citizens

(B) Right to work

(C) Right to free and compulsory education for children aged 6–14 years

(D) Right to information

**Q192.** Norman Borlaug, who is regarded as the father of the Green Revolution, received the Nobel Peace Prize in:

(A) 1955

(B) 1963

(C) 1968

(D) 1970

**Q193.** IR-8, the high-yielding semi-dwarf rice variety that transformed rice production in Asia during the Green Revolution, was developed by:

(A) IRRI (International Rice Research Institute, Philippines)

(B) IARI (India)

(C) CIMMYT (Mexico)

(D) FAO (Rome)

**Q194.** Sonalika is a high-yielding wheat variety introduced during India's Green Revolution. It is a variety of:

(A) Hybrid rice

(B) Bread wheat (*Triticum aestivum*)

(C) Bajra (pearl millet)

(D) Maize

**Q195.** The Green Revolution in India had the greatest initial impact in the states of:

(A) Maharashtra and Andhra Pradesh

(B) West Bengal and Odisha

(C) Punjab, Haryana, and western Uttar Pradesh

(D) Rajasthan and Gujarat

**Q196.** Sir C.V. Raman was awarded the Nobel Prize in Physics in 1930 for the discovery of:

(A) X-ray crystallography

(B) Radioactivity in heavy elements

(C) Neutron

(D) The Raman effect (inelastic scattering of light)

**Q197.** Dr. Homi J. Bhabha is known as the father of India's nuclear programme. He established the:

(A) Tata Institute of Fundamental Research (TIFR) and the Atomic Energy Commission

(B) Indian Space Research Organisation (ISRO)

(C) Defence Research and Development Organisation (DRDO)

(D) Indian Agricultural Research Institute (IARI)

**Q198.** Dr. Vikram Sarabhai, the founder of ISRO, established India's first rocket launching station at:

(A) Sriharikota, Andhra Pradesh

(B) Thumba, Thiruvananthapuram (Kerala)

(C) Chandipur, Odisha

(D) Bangalore, Karnataka

**Q199.** ISRO's Chandrayaan-3 mission successfully soft-landed on the Moon's south polar region in:

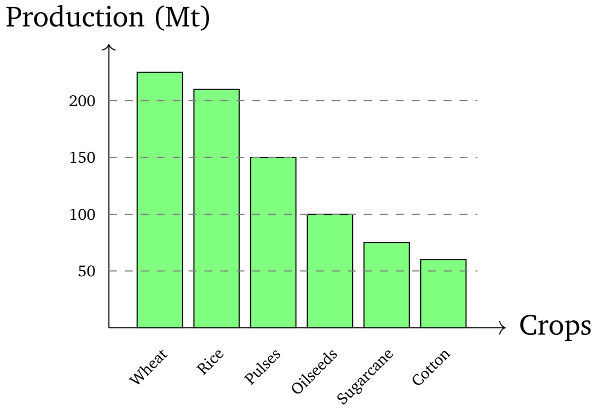
(A) June 2023

(B) September 2023

(C) August 2023

(D) October 2023

**Q200.** A bar chart of India's major crop production (2023–24) is shown below. Which crop recorded the highest production?




(A) Rice

(B) Pulses

(C) Oilseeds

(D) Wheat

# Detailed Solutions

## Q1.

**Solution**

**Concept — Kinematics (Equations of Motion):** Using $v^2 = u^2 + 2as$ with $u = 0$, $a = 4$ m/s$^2$, $s = 50$ m.

**Calculation:** $v^2 = 0 + 2(4)(50) = 400$, so $v = 20$ m/s.

**Why other options are wrong:**

- Option B: 10 m/s gives $v^2 = 100$, requiring $s = 12.5$ m.
- Option C: $\sqrt{400} = 20$ m/s — this is the same as option A, so A is the clean numerical answer.
- Option D: 25 m/s gives $v^2 = 625$, requiring $s = 78$ m.

**Final Answer:** $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q1

## Q2.

**Solution**

**Concept — Displacement-time graph:** The slope of a $s$-$t$ graph gives velocity. A horizontal segment (zero slope) indicates the body is at rest.

**Identifying segments:** OA (0 to 2 s) has positive slope $\Rightarrow$ moving. AB (2 to 4 s) is horizontal (slope = 0) $\Rightarrow$ at rest. BC (4 to 5 s) has a negative slope $\Rightarrow$ moving backward.

**Final Answer:** Segment AB (2 to 4 s) $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q2

## Q3.

**Solution**

**Concept — Free fall:** Using $s = ut + \frac{1}{2}gt^2$ with $u = 0$, $g = 10$ m/s$^2$, $s = 80$ m.

**Calculation:** $80 = \frac{1}{2}(10)t^2 = 5t^2 \Rightarrow t^2 = 16 \Rightarrow t = 4$ s.

**Final Answer:** $t = 4$ s $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q3

## Q4.

**Solution**

**Concept — Distance in $n^{\text{th}}$ second:** $s_n = u + \frac{a}{2}(2n-1)$. For $u = 0$: $s_n = \frac{a}{2}(2n-1) = a(n - \frac{1}{2})$.

Both options C and D are equivalent: $\frac{1}{2}a(2n-1) = a(n-\frac{1}{2})$. Option D expresses this most directly in a single term $a(n-\frac{1}{2})$.

**Final Answer:** $s_n = a\left(n - \dfrac{1}{2}\right) \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

## Q5.

**Solution**

**Concept — Area under $v$-$t$ graph:** $\int v\,dt = s$ (displacement). This is a fundamental result of calculus applied to kinematics.

**Why other options are wrong:** Slope of $v$-$t$ gives acceleration (not area). Area has nothing to do with instantaneous speed or force.

**Final Answer:** Displacement $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

## Q6.

**Solution**

**Concept — Relative Velocity (opposite directions):** When two objects move in opposite directions, their relative speed = sum of speeds.

**Calculation:** $v_{rel} = 72 + 90 = 162$ km/h.

**Final Answer:** 162 km/h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

## Q7.

**Solution**

**Concept — Friction on Inclined Plane:** Forces along the plane: gravitational component down $= mg\sin\theta$; maximum static friction up $= \mu_s mg\cos\theta$.

**Net force tending to slide:** For the block to be on the verge of sliding down, applied force $F_{min} = mg\sin\theta - \mu_s mg\cos\theta$ (since friction acts up the plane). But the question asks for the minimum holding force from sliding down, which equals $mg(\sin\theta - \mu_s\cos\theta)$ when friction alone is insufficient.

**Final Answer:** $mg(\sin\theta - \mu_s\cos\theta) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

## Q8.

**Solution**

**Concept — Atwood's Machine:** Acceleration $a = \dfrac{(m_2 - m_1)g}{m_1 + m_2}$.

**Calculation:** $a = \dfrac{(5-3)\times 10}{5+3} = \dfrac{20}{8} = 2.5\ \text{m/s}^2$.

**Final Answer:** $2.5\ \text{m/s}^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

## Q9.

**Solution**

**Concept — Apparent Weight in Lift (accelerating up):** Apparent weight $N = m(g + a)$.

**Calculation:** $N = 60 \times (10 + 2) = 60 \times 12 = 720\ \text{N} = 72\ \text{kgf}$.

**Final Answer:** $72\ \text{kgf} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

## Q10.

**Solution**

**Concept — Laws of Friction:** The maximum static friction is always *greater than or equal to* kinetic friction — not the other way around.

**Incorrect statement:** Option B says kinetic friction is always greater than maximum static friction, which is FALSE. Kinetic friction $< f_{s,\text{max}}$.

**Final Answer:** Option B is incorrect $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

## Q11.

**Solution**

**Concept — Connected Bodies (no friction):** Total mass $= 3 + 4 + 3 = 10$ kg. Acceleration $a = F/M = 20/10 = 2$ m/s$^2$.

**Tension between B and C:** Only block C is pulled by this tension: $T_{BC} = m_C \times a = 3 \times 2 = 6$ N.

**Final Answer:** $6$ N $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

## Q12.

**Solution**

**Concept — Angle of Friction:** When $\mu_s = \tan\lambda$, the angle $\lambda$ is defined as the *angle of friction* (or limiting angle of friction). It is the angle that the resultant of normal reaction and maximum static friction makes with the normal.

**Final Answer:** Angle of friction $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

## Q13.

**Solution**

**Concept — Elastic Potential Energy of Spring:** $U = \frac{1}{2}kx^2$.

**Calculation:** $U = \frac{1}{2} \times 200 \times (0.1)^2 = 100 \times 0.01 = 1$ J.

**Final Answer:** 1 J $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

## Q14.

**Solution**

**Concept — Work-Energy Theorem:** Work done = change in KE = $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = 0 - \frac{1}{2}(2)(5)^2 = -25$ J.

The negative sign indicates the force opposes the motion.

**Final Answer:** $-25$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

## Q15.

**Solution**

**Concept — Power:** $P = F \times v$. Convert speed: 72 km/h = 20 m/s.

**Calculation:** $P = 5000 \times 20 = 100{,}000$ W $= 100$ kW.

**Final Answer:** 100 kW $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

## Q16.

**Solution**

**Concept — Elastic Collision (equal masses):** In a perfectly elastic collision between equal masses where one is at rest, the moving body comes to rest and the stationary body moves with the initial velocity of the first.

**Final Answer:** $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

## Q17.

**Solution**

**Concept — Conservative Forces:** A force is conservative if the work done by it is path-independent (depends only on initial and final positions). Gravity is conservative; friction, air resistance, and viscous drag are non-conservative (dissipative).

**Final Answer:** Gravitational force $\Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q17

## Q18.

**Solution**

**Concept — Moment of Inertia of Disc:** For a uniform disc about its central perpendicular axis, $I = \frac{1}{2}MR^2$.

**Standard results:** Ring $= MR^2$; Disc $= \frac{1}{2}MR^2$; Solid sphere $= \frac{2}{5}MR^2$.

**Final Answer:** $\frac{1}{2}MR^2 \Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q18

## Q19.

**Solution**

**Concept — MI of Ring about Diameter:** Using the perpendicular axis theorem: $I_z = I_x + I_y$. For a ring $I_z = MR^2$ and by symmetry $I_x = I_y$. Thus $I_{diameter} = \frac{1}{2}MR^2$.

**Final Answer:** $\frac{1}{2}MR^2 \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q19

## Q20.

**Solution**

**Concept — Newton's Second Law for Rotation:** $\tau = I\alpha \Rightarrow \alpha = \tau/I$.

**Calculation:** $\alpha = 10/5 = 2$ rad/s$^2$.

**Final Answer:** $2$ rad/s$^2$ $\Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q20

## Q21.

**Solution**

**Concept — Rolling Motion:** For a solid sphere: $I = \frac{2}{5}MR^2$. Total KE $= \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}Mv^2(1+\frac{2}{5}) = \frac{7}{10}Mv^2$.

**Translational KE:** $\frac{1}{2}Mv^2$.

**Ratio:** $\dfrac{\frac{1}{2}Mv^2}{\frac{7}{10}Mv^2} = \dfrac{5}{7}$.

**Final Answer:** $\dfrac{5}{7} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

## Q22.

**Solution**

**Concept — Conservation of Angular Momentum:** $L = I\omega =$ const. When $I$ decreases (weights pulled in), $\omega$ must increase.

**Final Answer:** Angular velocity increases $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

## Q23.

**Solution**

**Concept — First Law of Thermodynamics:** $Q = \Delta U + W$, where $Q$ is heat absorbed, $\Delta U$ is change in internal energy, and $W$ is work done by the system.

**Final Answer:** $\boxed{\text{C}}$

Answer: (C) Go Back to Q23

## Q24.

**Solution**

**Concept — Isothermal Work:** At constant temperature $T$, $W = nRT\ln(V_2/V_1)$. Since $\Delta U = 0$ for an ideal gas in an isothermal process, $Q = W$.

**Final Answer:** $W = nRT\ln\left(\dfrac{V_2}{V_1}\right) \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

## Q25.

**Solution**

**Concept — Mayer's Relation:** $C_p - C_v = R$ for one mole of an ideal gas. This follows from the fact that at constant pressure, additional energy $R$ per mole is needed for work done against atmospheric pressure.

**Final Answer:** $C_p - C_v = R \Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q25

## Q26.

**Solution**

**Concept — Internal Energy of Ideal Gas:** For an ideal gas, intermolecular potential energy is zero (no interactions). Internal energy $U = nC_vT$, which depends only on temperature.

**Final Answer:** Only the temperature $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q26

## Q27.

**Solution**

**Concept — Adiabatic Process:** In an adiabatic process, no heat is exchanged with surroundings, i.e., $Q = 0$. This does not mean temperature, pressure, or volume is constant.

**Final Answer:** Heat exchanged = 0 $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q27

## Q28.

**Solution**

**Concept — Coulomb's Law:** $F = k\frac{q_1q_2}{r^2}$.

**Calculation:** $F = 9 \times 10^9 \times \frac{2 \times 10^{-6} \times 8 \times 10^{-6}}{(0.2)^2} = 9 \times 10^9 \times \frac{16 \times 10^{-12}}{0.04} = 9 \times 10^9 \times 4 \times 10^{-10} = 3.6\text{ N}$.

**Final Answer:** $3.6\text{ N} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q28

## Q29.

**Solution**

**Concept — Electric Field on Axial Line of Dipole:** $E_{axial} = \frac{2kp}{r^3}$ (directed along $\vec{p}$). On the equatorial line: $E_{eq} = \frac{kp}{r^3}$.

**Final Answer:** $\frac{2kp}{r^3} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

## Q30.

**Solution**

**Concept — Energy Stored in Capacitor:** $U = \frac{1}{2}CV^2$.

**Calculation:** $U = \frac{1}{2} \times 10 \times 10^{-6} \times (100)^2 = \frac{1}{2} \times 10^{-5} \times 10^4 = 0.05$ J.

**Final Answer:** 0.05 J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

## Q31.

**Solution**

**Concept — Parallel Plate Capacitor:** $C = \varepsilon_0 A/d$. If both $A \to 2A$ and $d \to 2d$: $C' = \varepsilon_0(2A)/(2d) = \varepsilon_0 A/d = C$. Unchanged.

**Final Answer:** Unchanged $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

## Q32.

**Solution**

**Concept — Electric Potential (superposition):** Potential at midpoint (distance $d/2$ from each charge): $V = k(+q)/(d/2)+k(-q)/(d/2) = kq/(d/2)-kq/(d/2) = 0$.

**Final Answer:** Zero $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

## Q33.

**Solution**

**Concept — Ohm's Law:** $I = V/R = 5/10 = 0.5$ A.

**Final Answer:** $0.5$ A $\Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q33

## Q34.

**Solution**

**Concept — Resistors in Parallel:** $\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1$, so $R_{eq} = 1\ \Omega$.

**Final Answer:** $1\ \Omega \Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q34

## Q35.

**Solution**

**Concept — Current Division:** For parallel branches, current divides inversely with resistance. $I_{8\Omega} = I_{total} \times \frac{R_1}{R_1 + R_2} = 12 \times \frac{4}{4+8} = 12 \times \frac{1}{3} = 4$ A.

**Final Answer:** $4$ A $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q35

## Q36.

**Solution**

**Concept — Kirchhoff's Current Law (KCL):** Sum of currents into junction = Sum of currents out of junction.

**Calculation:** In: $3 + 5 + 2 = 10$ A. Out (known): $4 + 3 = 7$ A. Remaining out: $10 - 7 = 3$ A.

**Final Answer:** $3$ A $\Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q36

## Q37.

**Solution**

**Concept — Wheatstone Bridge Balance Condition:** $P/Q = R/S \Rightarrow S = QR/P$.

**Calculation:** $S = (30 \times 20)/10 = 600/10 = 60\ \Omega$.

**Final Answer:** $60\ \Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

## Q38.

**Solution**

**Concept — Critical Angle for Total Internal Reflection:** $\sin\theta_c = 1/\mu = 1/1.5 = 0.667$, so $\theta_c = \sin^{-1}(2/3) \approx 42$.

**Final Answer:** $\approx 42 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

## Q39.

**Solution**

**Concept — Thin Lens Formula:** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$. With $u = -30$ cm, $f = +10$ cm.

**Calculation:** $\frac{1}{v} = \frac{1}{10} + \frac{1}{-30} = \frac{3-1}{30} = \frac{2}{30}$. Thus $v = 15$ cm (real image).

**Final Answer:** $15$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

## Q40.

**Solution**

**Concept — Concave Lens:** $f = -20$ cm, $u = -40$ cm.

**Calculation:** $\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{-20} + \frac{1}{-40} = \frac{-2-1}{40} = \frac{-3}{40}$. So $v = -\frac{40}{3}$ cm (virtual, same side as object).

**Final Answer:** $-\frac{40}{3}$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

## Q41.

**Solution**

**Concept — Lens Maker's Equation:** $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$, where $\mu$ is the refractive index of the lens material, $R_1$ and $R_2$ are the radii of curvature of the two surfaces.

**Final Answer:** $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q41

## Q42.

**Solution**

**Concept — Power of Lens Combination:** $P_{net} = P_1 + P_2 = +5 + (-3) = +2$ D. Positive power $\Rightarrow$ convex (converging) lens.

**Final Answer:** $+2$ D, convex $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q42

## Q43.

**Solution**

**Concept — Speed of Transverse Wave on a String:** $v = \sqrt{T/\mu}$, where $T$ is tension and $\mu$ is linear mass density (mass per unit length).

**Final Answer:** $v = \sqrt{T/\mu} \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q43

## Q44.

**Solution**

**Concept — Young's Double Slit (Constructive Interference):** Bright fringes occur at path difference $\Delta = n\lambda$ $(n = 0, 1, 2, \ldots)$, i.e., the $n^{\text{th}}$ bright fringe has path difference $n\lambda$.

Options A and B describe dark fringes (half-integer multiples). Option C is incorrect for $n^{\text{th}}$ fringe.

**Final Answer:** $n\lambda \Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q44

## Q45.

**Solution**

**Concept — Standing Waves:** In a standing wave, nodes are points of zero displacement. Consecutive nodes are separated by half a wavelength ($\lambda/2$), as are consecutive antinodes.

**Final Answer:** $\lambda/2 \Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q45

## Q46.

**Solution**

**Concept — Closed Organ Pipe (Fundamental):** In a closed pipe, one end is a node and the open end is an antinode. The fundamental mode has $L = \lambda/4$, so $\lambda = 4L$.

**Final Answer:** $\lambda = 4L \Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q46

## Q47.

**Solution**

**Concept — Doppler Effect (Source Moving Towards Observer):** The apparent frequency increases: $f' = f\left(\frac{v}{v - v_s}\right)$.

**Final Answer:** $f\left(\frac{v}{v - v_s}\right) \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q47

## Q48.

**Solution**

**Concept — Stopping Potential:** The stopping potential $V_0$ is the potential that just stops the most energetic photoelectrons: $eV_0 = KE_{\text{max}} \Rightarrow V_0 = KE_{\text{max}}/e$.

**Final Answer:** $V_0 = KE_{\text{max}}/e \Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q48

## Q49.

**Solution**

**Concept — Threshold Wavelength:** The minimum photon energy equals the work function: $hf_0 = \phi$, and since $f_0 = c/\lambda_0$, we get $\lambda_0 = hc/\phi$.

**Final Answer:** $\lambda_0 = hc/\phi \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q49

## Q50.

**Solution**

**Concept — de Broglie Wavelength (accelerated electron):** KE gained $= eV = \frac{p^2}{2m}$, so $p = \sqrt{2meV}$. Then $\lambda = h/p = h/\sqrt{2meV}$.

**Final Answer:** $\lambda = h/\sqrt{2meV} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q50

## Q51.

**Solution**

**Concept — Molar Mass:** Glucose = $C_6H_{12}O_6$. $M = 6(12) + 12(1) + 6(16) = 72 + 12 + 96 = 180$ g/mol.

**Final Answer:** $180$ g/mol $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q51

## Q52.

**Solution**

**Concept — Avogadro's Number:** Number of molecules $= n \times N_A = 0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$.

**Final Answer:** $3.011 \times 10^{23} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q52

## Q53.

**Solution**

**Concept — Limiting Reagent:** $N_2 + 3H_2 \rightarrow 2NH_3$. 2 mol $N_2$ requires $2 \times 3 = 6$ mol $H_2$, but only 3 mol $H_2$ available. $H_2$ is the limiting reagent.

**Check:** 3 mol $H_2$ reacts with $3/3 = 1$ mol $N_2$, leaving 1 mol $N_2$ unreacted.

**Final Answer:** $H_2 \Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q53

## Q54.

**Solution**

**Concept — Percentage Composition:** Urea = $NH_2CONH_2$. Mass of N $= 2 \times 14 = 28$ g/mol. Total molar mass $= 60$ g/mol.

**Calculation:** % N $= (28/60) \times 100 = 46.7\%$.

**Final Answer:** $46.7\% \Rightarrow \boxed{B}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q54

## Q55.

**Solution**

**Concept — Empirical Formula:** Mole ratio: C: $40/12 = 3.33$; H: $6.67/1 = 6.67$; O: $53.33/16 = 3.33$.

**Simplest ratio:** C:H:O = 1:2:1. Empirical formula = $CH_2O$.

**Final Answer:** $CH_2O \Rightarrow \boxed{C}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q55

## Q56.

**Solution**

**Concept — Bohr's Model Energy:** $E_n = -13.6/n^2$ eV. Negative sign indicates bound state. Ground state $(n = 1)$: $E_1 = -13.6$ eV.

**Final Answer:** $E_n = -13.6/n^2$ eV $\Rightarrow \boxed{D}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q56

## Q57.

**Solution**

**Concept — Bohr's Radius:** $r_n = 0.529n^2$ Å. The radius is proportional to $n^2$. As $n$ increases, orbital radius increases as $n^2$.

**Final Answer:** $r_n \propto n^2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q57

## Q58.

**Solution**

**Concept — Electronic Configuration of Fe (Z=26):** Filling order: $[\text{Ar}]\ 3d^6\ 4s^2$. The $3d$ orbitals are filled before $4s$ is completely filled. Correct: $[\text{Ar}]\ 3d^6\ 4s^2$.

**Final Answer:** $[\text{Ar}]\ 3d^6\ 4s^2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q58

## Q59.

**Solution**

**Concept — Quantum Numbers:** For any electron, $l$ can range from 0 to $n-1$. For $n = 2$, maximum $l = 1$. Option C has $n = 2, l = 2$, which violates the rule $l < n$.

**Final Answer:** Option C ($l = 2$ for $n = 2$) is not allowed $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q59

## Q60.

**Solution**

**Concept — de Broglie and Bohr:** For electron in $n^{\text{th}}$ orbit, de Broglie condition states that the circumference must equal an integral number of wavelengths: $2\pi r_n = n\lambda$, where $\lambda = h/(mv)$.

This gives $mvr_n = nh/(2\pi)$, which is Bohr's quantisation condition.

**Final Answer:** $2\pi r_n = n\lambda \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q60

## Q61.

**Solution**

**Concept — Ionic Character:** Ionic character is highest when the electronegativity difference between bonded atoms is largest. Na and F have the highest electronegativity difference ($\approx 3.1$). NaF is almost completely ionic.

**Final Answer:** NaF $\Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q61

## Q62.

**Solution**

**Concept — VSEPR $BeCl_2$:** Be has 2 bond pairs and 0 lone pairs. Electron geometry = linear. Bond angle = $180^\circ$. Shape = linear.

**Final Answer:** Linear $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q62

## Q63.

**Solution**

**Concept — VSEPR $NH_3$:** N has 3 bond pairs + 1 lone pair = 4 electron pairs (tetrahedral arrangement). Molecular shape with 3 bonds and 1 lone pair = trigonal pyramidal. Bond angle $\approx 107$.

**Final Answer:** Trigonal pyramidal $\Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q63

## Q64.

**Solution**

**Concept — Hybridization of $SF_6$:** S forms 6 bonds with F. To accommodate 6 bond pairs, S uses $3s+3p+2d$ orbitals = $sp^3d^2$ hybridization. Octahedral geometry.

**Final Answer:** $sp^3d^2 \Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q64

## Q65.

**Solution**

**Concept — Dipole Moment:** $CCl_4$ is tetrahedral with all four C–Cl bond dipoles cancelling symmetrically, giving net dipole moment = 0. $CHCl_3$, $H_2O$, and $NH_3$ are all polar with net dipole moments.

**Final Answer:** $CCl_4 \Rightarrow \boxed{A}$

**Answer: (A)** Go Back to Q65

## Q66.

**Solution**

**Concept — Hess's Law:** Target: $H_2 + O_2 \to H_2O_2$. $\Delta H_f(H_2O_2) = \Delta H_f(H_2O) + (-\Delta H_{\text{decomp}}) = -286 + 98 = -188$ kJ/mol.

**Final Answer:** $-188$ kJ/mol $\Rightarrow \boxed{B}$

**Answer: (B)** Go Back to Q66

## Q67.

**Solution**

**Concept — Energy Profile Diagram:** In the diagram, the products (P) are at a higher energy level than the reactants (R). $\Delta H = E_P - E_R > 0$, so the reaction is endothermic.

**Final Answer:** Endothermic $\Rightarrow \boxed{C}$

**Answer: (C)** Go Back to Q67

## Q68.

**Solution**

**Concept — Bond Enthalpy:** $\Delta H = \sum E_{broken} - \sum E_{formed}$.

Bonds broken: H–H (436) + Cl–Cl (242) = 678 kJ. Bonds formed: $2\times$(H–Cl) = $2 \times 431 = 862$ kJ.

$\Delta H = 678 - 862 = -184$ kJ.

**Final Answer:** $-184$ kJ $\Rightarrow \boxed{D}$

**Answer: (D)** Go Back to Q68

## Q69.

**Solution**

**Concept — Standard Enthalpy of Formation:** By convention, the standard enthalpy of formation of a pure element in its most stable allotropic form at standard conditions is defined as zero.

**Final Answer:** Zero $\Rightarrow \boxed{\text{A}}$

**Answer: (A)** Go Back to Q69

## Q70.

**Solution**

**Concept — Spontaneity ($\Delta G = \Delta H - T\Delta S$):** For spontaneity, $\Delta G < 0$ at all temperatures. This requires $\Delta H < 0$ (exothermic) AND $\Delta S > 0$ (increasing entropy), so $\Delta G = \Delta H - T\Delta S < 0$ for all $T > 0$.

**Final Answer:** $\Delta H < 0$ and $\Delta S > 0 \Rightarrow \boxed{\text{B}}$

**Answer: (B)** Go Back to Q70

## Q71.

**Solution**

**Concept — Equilibrium Constant Expression:** For $N_2 + 3H_2 \rightleftharpoons 2NH_3$: $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$. Products over reactants raised to stoichiometric powers.

**Final Answer:** $\boxed{\text{C}}$

**Answer: (C)** Go Back to Q71

## Q72.

**Solution**

**Concept — $K_p$ vs $K_c$:** $K_p = K_c(RT)^{\Delta n}$. For $PCl_5 \rightleftharpoons PCl_3 + Cl_2$: $\Delta n = 2 - 1 = 1$. So $K_p = K_c \cdot RT$.

**Final Answer:** $K_p = K_c \cdot RT \Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q72

## Q73.

**Solution**

**Concept — Le Chatelier's Principle (Pressure):** $N_2 + 3H_2 \rightleftharpoons 2NH_3$: 4 moles of gas on left, 2 on right. Increasing pressure shifts equilibrium to the side with fewer moles of gas $\Rightarrow$ towards $NH_3$ (right).

**Final Answer:** Shift right $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q73

## Q74.

**Solution**

**Concept — Le Chatelier (Temperature):** For an exothermic reaction ($\Delta H < 0$), increasing temperature favours the reverse (endothermic) reaction. Yield of $SO_3$ decreases and $K_c$ decreases.

**Final Answer:** Yield of $SO_3$ decreases $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q74

## Q75.

**Solution**

**Concept — Degree of Dissociation:** $PCl_5 \rightleftharpoons PCl_3 + Cl_2$. Starting 1 mol $PCl_5$: at equilibrium — $PCl_5$: $1-\alpha$; $PCl_3$: $\alpha$; $Cl_2$: $\alpha$. Total moles $= (1-\alpha)+\alpha+\alpha = 1+\alpha$.

**Final Answer:** $1+\alpha \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q75

## Q76.

**Solution**

**Concept — pH of Strong Acid:** HCl is a strong acid, fully dissociated. $[H^+] = 0.01\ \text{M} = 10^{-2}$ M. pH $= -\log(10^{-2}) = 2$.

**Final Answer:** pH $= 2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q76

## Q77.

**Solution**

**Concept — Henderson-Hasselbalch Equation:** For a weak acid buffer: $\text{pH} = \text{p}K_a + \log\frac{[\text{A}^-]}{[\text{HA}]}$.

When $[\text{A}^-] = [\text{HA}]$, pH = p$K_a$ (at half-equivalence point).

**Final Answer:** $\boxed{\text{A}}$

**Answer: (A)** Go Back to Q77

## Q78.

**Solution**

**Concept — Buffer Action:** A buffer contains a weak acid and its conjugate base (or weak base and conjugate acid). The weak acid component neutralises added base ($\text{OH}^-$) and the conjugate base neutralises added acid ($\text{H}^+$), thereby resisting large pH changes.

**Final Answer:** $\boxed{\text{B}}$

**Answer: (B)** Go Back to Q78

## Q79.

**Solution**

**Concept — Half-Equivalence Point:** At the half-equivalence point, half the acid has been neutralised, so $[\text{HA}] = [\text{A}^-]$. By Henderson-Hasselbalch: $\text{pH} = \text{p}K_a + \log(1) = \text{p}K_a$.

**Final Answer:** $\text{pH} = \text{p}K_a \Rightarrow \boxed{\text{C}}$

**Answer: (C)** Go Back to Q79

## Q80.

**Solution**

**Concept — Hydrolysis of Salts:** A salt of strong acid + weak base (e.g., $NH_4Cl$) gives an acidic solution (pH $< 7$) because the cation of the weak base hydrolyses to produce $\text{H}^+$ ions.

**Final Answer:** Acidic (pH $< 7$) $\Rightarrow \boxed{\text{D}}$

**Answer: (D)** Go Back to Q80

## Q81.

**Solution**

**Concept — IUPAC Naming:** $CH_3$-$CH(CH_3)$-$CH_2$-$CH_3$. Parent chain = longest chain = 4C (butane). Methyl branch at C2. Name: 2-methylbutane.

**Final Answer:** 2-methylbutane $\Rightarrow \boxed{A}$

**Answer: (A)** Go Back to Q81

## Q82.

**Solution**

**Concept — Structural Isomers of $C_4H_{10}$:** Two isomers exist: (1) $n$-butane ($CH_3CH_2CH_2CH_3$) and (2) isobutane / 2-methylpropane ($CH_3CH(CH_3)CH_3$).

**Final Answer:** 2 isomers $\Rightarrow \boxed{B}$

**Answer: (B)** Go Back to Q82

## Q83.

**Solution**

**Concept — Functional Groups:** $CH_3COOH$ (acetic acid) contains the carboxyl group ($-COOH$), which consists of a carbonyl and a hydroxyl group together.

**Final Answer:** Carboxyl ($-COOH$) $\Rightarrow \boxed{C}$

**Answer: (C)** Go Back to Q83

## Q84.

**Solution**

**Concept — IUPAC naming of alkyne:** $HC{\equiv}C$-$CH_2$-$CH_3$ has 4 carbons with triple bond starting at C1. IUPAC name: but-1-yne.

**Final Answer:** but-1-yne $\Rightarrow \boxed{D}$

**Answer: (D)** Go Back to Q84

## Q85.

**Solution**

**Concept — Degree of Unsaturation (DoU):** DoU $= \dfrac{2C + 2 - H}{2}$ (for hydrocarbons). Benzene $C_6H_6$: DoU $= \dfrac{12 + 2 - 6}{2} = \dfrac{8}{2} = 4$ (3 double bonds + 1 ring).

**Final Answer:** DoU $= 4 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q85

## Q86.

**Solution**

**Concept — Markovnikov's Rule:** The H of HBr adds to the carbon of the double bond that already has more H atoms. In propene $CH_3$-CH=$CH_2$, the terminal carbon (=$CH_2$) has 2 H's, so H adds there, and Br adds to C2 (–CH–). Product: $CH_3$-CHBr-$CH_3$ = 2-bromopropane.

**Final Answer:** 2-bromopropane $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q86

## Q87.

**Solution**

**Concept — Ozonolysis:** Ozonolysis of $CH_3$-CH=CH-$CH_3$ (2-butene): cleaves the double bond. Each fragment gives an aldehyde/ketone. Both carbons of the double bond carry $CH_3$, so both give $CH_3CHO$ (acetaldehyde).

**Final Answer:** Two molecules of acetaldehyde $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q87

## Q88.

**Solution**

**Concept — Hydration of Alkyne (Markovnikov):** For propyne $CH_3$-C≡CH, anti-Markovnikov hydration gives propanal (minor). Markovnikov addition ($H_2SO_4$/$HgSO_4$) adds –OH to the middle carbon (more substituted), giving an enol that tautomerises to propan-2-one (acetone, a ketone).

**Final Answer:** Propan-2-one (acetone) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q88

## Q89.

**Solution**

**Concept — Bromine Water Test for Alkenes:** Bromine adds across the C=C double bond via electrophilic addition, forming a dibromo compound. The brown colour of $Br_2$ disappears, decolourising bromine water.

**Final Answer:** Electrophilic addition $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q89

## Q90.

**Solution**

**Concept — Carbocation Stability:** More alkyl groups attached to the positively charged carbon stabilise the carbocation through hyperconjugation and inductive effect. Order: tertiary > secondary > primary.

**Final Answer:** Tertiary > Secondary > Primary $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q90

## Q91.

**Solution**

**Concept — Oxidation States of Mn:** Mn exhibits oxidation states from $-3$ to $+7$: $+2$ (MnO), $+4$ ($MnO_2$), $+6$ ($K_2MnO_4$), and $+7$ ($KMnO_4$). The $+7$ state in $KMnO_4$ is the highest known.

**Final Answer:** $+7$ (as in $KMnO_4$) $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q91

## Q92.

**Solution**

**Concept — Colour of Transition Metal Compounds:** Partially filled $d$-orbitals split in the ligand field. Electrons can undergo $d$-$d$ transitions by absorbing visible light, making the compound appear coloured (complementary colour).

**Final Answer:** Partially filled $d$-orbitals allow $d$-$d$ transitions $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q92

## Q93.

**Solution**

**Concept — Paramagnetism:** A species is paramagnetic if it has one or more unpaired electrons. $Cu^{2+}$: $[Ar]3d^9$ — 1 unpaired electron $\Rightarrow$ paramagnetic. $Zn^{2+}$: $[Ar]3d^{10}$ — all paired. $Cu^{+}$: $[Ar]3d^{10}$ — all paired. $Sc^{3+}$: [Ar] — no $d$ electrons.

**Final Answer:** $Cu^{2+} \Rightarrow \boxed{A}$

**Answer: (A)** Go Back to Q93

## Q94.

**Solution**

**Concept — Oxidation State of Cr in $K_2Cr_2O_7$:** Let Cr $= x$. $K_2Cr_2O_7$: $2(+1)+2x+7(-2)=0 \Rightarrow 2+2x-14=0 \Rightarrow 2x=12 \Rightarrow x=+6$.

**Final Answer:** $+6 \Rightarrow \boxed{B}$

**Answer: (B)** Go Back to Q94

## Q95.

**Solution**

**Concept — Catalytic Activity of Transition Metals:** Their variable oxidation states allow them to act as electron donors/acceptors in reaction intermediates. Their ability to form coordination complexes also helps bind and activate reactants.

**Final Answer:** Variable oxidation states and complex formation $\Rightarrow \boxed{C}$

**Answer: (C)** Go Back to Q95

## Q96.

**Solution**

**Concept — Primary vs Secondary Pollutants:** A primary pollutant is emitted directly from a source (e.g., CO, $SO_2$, particulates from vehicles/factories). A secondary pollutant forms in the atmosphere through reactions of primary pollutants (e.g., ozone from $NO_x$+VOCs).

**Final Answer:** Primary pollutant $\Rightarrow \boxed{D}$

**Answer: (D)** Go Back to Q96

## Q97.

**Solution**

**Concept — Biochemical Oxygen Demand (BOD):** BOD measures the amount of dissolved oxygen consumed by microorganisms to decompose organic matter in a water sample. Higher BOD = more organic pollution = more water pollution.

**Final Answer:** Degree of water pollution by organic matter $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q97

## Q98.

**Solution**

**Concept — Ozone Depletion by CFCs:** UV radiation releases Cl· radicals from CFCs. The Cl radical attacks ozone: Cl· + $O_3 \rightarrow$ ClO· + $O_2$. Then ClO· + O $\rightarrow$ Cl· + $O_2$ (Cl is regenerated, acting as a catalyst).

**Final Answer:** Cl· + $O_3 \rightarrow$ ClO· + $O_2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q98

## Q99.

**Solution**

**Concept — Greenhouse Gases:** Greenhouse gases absorb and emit infrared radiation, warming the Earth. $CO_2$, $CH_4$, $N_2O$, water vapour, and CFCs are greenhouse gases. $N_2$ (dinitrogen) is NOT a greenhouse gas — it is transparent to infrared radiation.

**Final Answer:** $N_2$ is NOT a greenhouse gas $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q99

## Q100.

**Solution**

**Concept — Acid Rain:** Acid rain is caused by $SO_2$ (from burning fossil fuels/volcanic activity) and $NO_x$ (from vehicles/industry). These react with atmospheric water to form $H_2SO_4$ and $HNO_3$, lowering rain pH below 5.6.

**Final Answer:** $SO_2$ and $NO_x \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q100

## Answer Key

| Q | Ans | Q | Ans | Q | Ans | Q | Ans | Q | Ans |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 2 | B | 3 | C | 4 | D | 5 | A |
| 6 | B | 7 | C | 8 | D | 9 | A | 10 | B |
| 11 | C | 12 | D | 13 | A | 14 | B | 15 | C |
| 16 | D | 17 | A | 18 | B | 19 | C | 20 | D |
| 21 | A | 22 | B | 23 | C | 24 | D | 25 | A |
| 26 | B | 27 | C | 28 | D | 29 | A | 30 | B |
| 31 | C | 32 | D | 33 | A | 34 | B | 35 | C |
| 36 | D | 37 | A | 38 | B | 39 | C | 40 | D |
| 41 | A | 42 | B | 43 | C | 44 | D | 45 | A |
| 46 | B | 47 | C | 48 | D | 49 | A | 50 | B |
| 51 | C | 52 | D | 53 | A | 54 | B | 55 | C |
| 56 | D | 57 | A | 58 | B | 59 | C | 60 | D |
| 61 | A | 62 | B | 63 | C | 64 | D | 65 | A |
| 66 | B | 67 | C | 68 | D | 69 | A | 70 | B |
| 71 | C | 72 | D | 73 | A | 74 | B | 75 | C |
| 76 | D | 77 | A | 78 | B | 79 | C | 80 | D |
| 81 | A | 82 | B | 83 | C | 84 | D | 85 | A |
| 86 | B | 87 | C | 88 | D | 89 | A | 90 | B |
| 91 | C | 92 | D | 93 | A | 94 | B | 95 | C |
| 96 | D | 97 | A | 98 | B | 99 | D | 100 | D |