

PHYSICS

- 1.(d) $[MLT^{-2} A^{-2}]$ is the dimensional formula for magnetic permeability.
- 2.(c) All given measurements are correct up to two decimal places. Here, 5.00 mm has the smallest unit and the error in 5.00 mm is the least (commonly taken as 0.01 mm if not specified), hence, 5.00 mm is the most precise.
- 3.(c) Displacement of an object can be less than or equal to the distance covered by the object, because the magnitude of displacement is not equal to the distance. However, it can be so if the motion is along a straight line without any change in direction. So, the ratio of displacement to distance is equal to or less than 1.
- 4.(a) Since, the block is resting (not moving) $\therefore F = mg \sin \theta \neq \mu_s mg \cos \theta$ Or, $m = \frac{F}{g \sin \theta} = \frac{10}{10 \times \sin 30} = 2 \text{ kg}$
- 5.(b)
- 6.(a) $\frac{g}{g'} = \left(\frac{R+h}{R}\right)^2 \Rightarrow 4 = \left(\frac{R+h}{R}\right)^2 \Rightarrow R+h = 2R \quad \therefore h = R$
- 7.(a) Time taken to go from $x = 0$ to $x = \frac{A}{2}$ is T_1 and $T_1 = \frac{T}{12}$
 Time taken to go from $x = \frac{A}{2}$ to $x = A$ is $\frac{T}{6} \quad \therefore T_1 < T_2$
- 8.(b) $v = u + at \therefore$ since, $u = 0 \Rightarrow v = at$
 According to Newton's second law, the force F acting on the body is given by: $F = ma$
 Where m is the mass of the body, and a is the constant acceleration.
 $\therefore$ Power P is defined as the rate at which work is done, and it can also be expressed as the product of force and velocity
 $F = P \cdot v$
 Substituting the expressions for force and velocity, we get $P = (ma)(at) = ma^2t \quad \therefore P \propto t$
- 9.(d) $\text{Stress} = \frac{\text{Force}}{\text{Area}} \propto \frac{1}{r^2} \Rightarrow \frac{S_B}{S_A} = \frac{r_A^2}{r_B^2} = (3)^2 = 9S_A \quad \therefore S_B = 9S_A$
- 10.(b) With the rise of temperature force of attraction, between the liquid decreases. While in the case of gases, with the rise of temperature collision increases in gases.
- 11.(d) In stretching of wire $R \propto \ell^2 \Rightarrow \frac{R_1}{R_2} = \left(\frac{\ell_1}{\ell_2}\right)^2$
 If $\ell_1 = 100$, then $\ell_2 = 110 \Rightarrow \frac{R_1}{R_2} = \left(\frac{100}{110}\right)^2 \quad \therefore R_2 = 1.21 R_1$
 Resistivity doesn't change with stretching.
- 12.(d) $\frac{X}{l} = \frac{20}{80} \Rightarrow X = \frac{1}{4} \Omega = 0.25 \Omega$.
- 13.(c) $\text{Heat} = I^2 R$
- 14.(c) $B \propto \frac{1}{r} \Rightarrow \frac{B_1}{B_2} = \frac{r_2}{r_1} = \frac{2r}{r} = 2$.
- 15.(a) Since, $\vec{F}$ and $\vec{v}$ are perpendicular to each other, the work done by the force is zero. Hence, K.E. is constant.
- 16.(b) Repelled due to the induction of similar poles.
- 17.(c) $L = \frac{N \Phi}{I} = \frac{500 \times 4 \times 10^{-3}}{2} \text{ henry} = 1 \text{ H}$
- 18.(b) With the increasing speed, ω increases. Thus, current reduces due to an increase in the back e.m.f. Moreover $i = \frac{V - K\omega}{R}$. More ω will lead to a lesser current.
- 19.(a) The impedance of the series LCR circuit is: $Z = \sqrt{R^2 + (X_C - X_L)^2} = \sqrt{(3)^2 + (14 - 10)^2} = 5 \Omega$.
- 20.(b) $V_{\text{rms}} = \sqrt{\frac{3P}{\rho}} = \sqrt{\frac{3PV}{m}} \Rightarrow V_{\text{rms}} \propto \sqrt{\frac{P}{m}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{P_1 \times m_2}{P_2 \times m_1}} \Rightarrow \frac{v}{2v} = \sqrt{\frac{P_0 \times \frac{m}{2}}{P_2 \times \frac{m}{m}}} \Rightarrow P_2 = 2P_0$
- 21.(d) Latent heat is defined as the amount of heat required to change the state of a substance, while the temperature remains constant. Here, the state changes from solid to liquid; hence, it is defined as the latent heat of fusion.

- 22.(c)** As the coefficient of cubical expansion of metal is less as compared to the coefficient of cubical expansion of liquid, we may neglect the expansion of the metal ball. So, when the ball is immersed in alcohol at 0°C , it displaces some volume V of alcohol at 0°C and has a weight W_1 .

$$W_1 = W_0 - V\rho_0 g$$

Where, W_0 = weight of ball in air

$$\text{Similarly, } W_2 = W_0 - V\rho_{50} g$$

Where ρ_0 = density of alcohol at 0°C

And ρ_{50} = density of alcohol at 50°C

$$\text{As } \rho_{50} < \rho_0, \Rightarrow W_2 > W_1 \text{ or, } W_1 < W_2$$

- 23.(c)** $C_V = \frac{R}{0.67} = 1.5 R = \frac{3}{2} R$. This is the value for monoatomic gases.

24.(c) $\Delta Q = \Delta U + \Delta W$

$$\therefore \Delta Q = 200 \text{ cal} = 200 \times 4.2 = 840 \text{ J and } \Delta W = 40 \text{ J}$$

$$\Rightarrow \Delta U = \Delta Q - \Delta W = 840 - 40 = 800 \text{ J}$$

- 25.(c)** Coefficient of performance

$$K = \frac{T_2}{T_1 - T_2} = \frac{273}{303 - 273} = \frac{273}{30} = 9.1 \approx 9.$$

- 26.(c)** Searle's bar method is an experimental procedure to measure the thermal conductivity of a material. A bar of material is being heated by steam on one side and the other side is cooled down by water, while the length of the bar is thermally insulated. This is done until the temperature gradient at all the points along the bar becomes the same.

- 27.(d)** Velocity and wavelength change, but frequency remains the same.

28. (d) $\frac{\sin \frac{A + \delta_m}{2}}{\sin \frac{A}{2}} = \mu$, But $\frac{A + \delta_m}{2} = i = 45^\circ$ So, $\frac{\sin 45^\circ}{\sin \left(\frac{A}{2}\right)} = \sqrt{2} \Rightarrow \frac{1}{2} = \sin \frac{A}{2} \Rightarrow A = 60^\circ$

- 29.(d)** Hypermetropia is removed by a convex lens.

- 30.(b)** Diffraction is obtained when the slit width is of the order of the wavelength of EM waves (or light). Here, the wavelength of X-rays (1-100 Å) is very-very lesser than the slit width (0.6 mm). Therefore, no diffraction pattern will be observed.

- 31.(d)** By using $\mu = \tan \theta_p \Rightarrow \mu = \tan 60^\circ = \sqrt{3}$, also $C = \sin^{-1}\left(\frac{1}{\mu}\right) \Rightarrow C = \sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

- 32.(a)** The shape of interference fringes formed on a screen in case of a monochromatic source is a straight line. Remember for double hole experiment a hyperbola is generated.

33.(c) $I \propto P_{\max}^2 \Rightarrow \frac{I_1}{I_2} = \left(\frac{P_2}{P_1}\right)^2 = \left(\frac{3P}{P}\right)^2 = 9$

- 34.(c)** Separation between two successive nodes

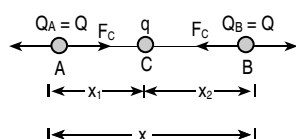
$$\frac{\lambda}{2} = 5 \text{ cm} \Rightarrow \lambda = 10 \text{ cm} = 0.10 \text{ m} \quad \therefore n = \frac{v}{\lambda} = \frac{2}{0.10} = 20 \text{ Hz.}$$

- 35.(b)** Here, $q_1 = 3\mu\text{C} = 3 \times 10^{-6}\text{C}$, $q_2 = 3\mu\text{C} = 3 \times 10^{-6}\text{C}$

$$\begin{aligned} \vec{r}_1 &= \hat{i} + \hat{j} + \hat{k}, \quad \vec{r}_2 = 2\hat{i} + 3\hat{j} + 3\hat{k} \quad \therefore \vec{r} = \vec{r}_2 - \vec{r}_1 = (2\hat{i} + 3\hat{j} + 3\hat{k}) - (\hat{i} + \hat{j} + \hat{k}) = \hat{i} + 2\hat{j} + 2\hat{k} \\ |\vec{r}| &= \sqrt{(1)^2 + (2)^2 + (2)^2} = 3. \text{ According to Coulomb's law, } F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2} = \frac{9 \times 10^9 \times 3 \times 10^{-6} \times 3 \times 10^{-6}}{(3)^2} = 9 \times 10^{-3} \text{ N.} \end{aligned}$$

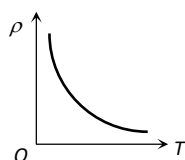
- 36.(b)** Suppose in the following figure, the equilibrium of charge B is considered.

Hence, for its equilibrium, $x_1 = x_2 = \frac{x}{2} \Rightarrow \frac{K \cdot Q^2}{x^2} + \frac{KQ \cdot q}{\left(\frac{x}{2}\right)^2} = 0 \Rightarrow 4q = -Q \Rightarrow q = \frac{-Q}{4}$



- 37.(a)** P.E. $U_0 = \frac{Q^2}{2C}$; When a slab of dielectric constant k is inserted, then $C' = Ck$; $U' = \frac{Q^2}{2C'} = \frac{Q^2}{2Ck} = \frac{U_0}{k}$.

- 38.(c)** When a dielectric slab is inserted between the plates of a parallel plate capacitor connected to a battery, the capacitance of the capacitor increases. Since the capacitor is connected to a battery, the potential difference across the plates remains constant. The electric field also remains constant because it is determined by the potential difference and the separation between the plates. However, the stored energy in the capacitor increases because the capacitance increases while the potential difference remains the same. The E.M.F. of the battery is not affected by the insertion of the dielectric slab.
- 39.(c)** Cathode rays are produced when the pressure is of the order of 0.01 mm of Hg
- 40.(b)** Stopping potential $V_0 = \frac{hc}{e} \left[\frac{1}{\lambda} - \frac{1}{\lambda_0} \right]$. As, λ decreases, so V_0 increases.
- 41.(b)** $W_0 = \frac{12375}{\lambda_0} = \frac{12375}{5420} = 2.28 \text{ eV}$
- 42.(d)** The Compton effect is the scattering of particles due to radiation and proves that photons have momentum.
- 43.(c)** Radius of the nth orbit of an electron is given by $r_n = r_0 n^2 = r_0 \times 3^2 = 9r_0$.
- 44.(c)** ${}_{83}X^{224}$: By using $n_\alpha = \frac{A - A'}{4}$ and $n_\beta = 2n_\alpha - Z + Z' \Rightarrow A' = A - 4n_\alpha = 236 - 4 \times 3 = 224$
 and $Z' = (n_\beta - 2n_\alpha + Z) = (1 - 2 \times 3 + 88) = 83$
- 45.(b)** Ga has a valency of 3.
- 46.(d)** A reverse-biased P-N junction diode offers very high resistance (of the order of megaohms) because only a very small leakage current flows through it. The resistance of the reversed-biased P-N junction diode is about 10^6 ohms.



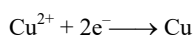
- 47.(c)** ρ vs T : With rise in temperature, the resistivity of semiconductors decreases exponentially.
- 48.(c)** The W and Z bosons are the mediators of the weak nuclear force, which is responsible for processes like beta decay. Photons mediate the electromagnetic force, gluons mediate the strong nuclear force, and gravitons are hypothetical mediators for gravity.
- 49.(b)** The neutron consists of two down quarks (d) and one up quark (u), so its quark composition is "udd."
- 50.(c)** Activity is proportional to the number of undecayed nuclei.

CHEMISTRY

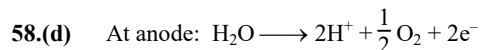
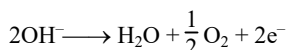
- 51.(d)** Volume of oxygen = $\frac{21}{100} \times 1 = 0.1$ litres
 at STP, 1 mole oxygen = 22.4 ℓ
 Therefore, mole of O₂ = $\frac{0.21 \text{ moles}}{22.4 \text{ ℓ}} = 0.0093$ moles.
- 52.(b)** Equivalent mass of NaOH = Molar mass of NaOH = 40
 0.2N NaOH solution means 0.2 g eq. of NaOH present in 1000 mL of the solution.
 i.e. 1000 mL of solution contain NaOH = $0.2 \times 40 = 8$ g
 $\therefore$ 500 mL of solution will contain NaOH = 4 g
- 53.(a)** $n = 3, \ell = 1$ means 3p orbital.
 The value of $m = 0$ means there is only one orbital.
- 54.(a)** BF₃ and NO₂⁻ are sp² hybridized while NH₂⁻, NH₃ and H₂O are sp³ hybridized.
- 55.(c)** According to Ostwald's dilution law, the degree of dissociation of a weak electrolyte is given by the formula $\alpha = \sqrt{\frac{K_a}{C}}$.
- 56.(b)** CH₃COOH – weakly acidic – PH < 7
 CH₃COONa – weakly basic P^H ≈ 9
 NH₄Cl – weakly acidic P^H < 7
 KOH – strongly basic P^H > 12
- 57.(c)** When an aqueous solution of CuSO₄ is subjected to electrolyze using copper electrodes, the following reaction will take place at cathode and anode.

$$\text{CuSO}_4 \longrightarrow \text{Cu}^{2+} + \text{SO}_4^{2-}$$

Reduction at cathode



Oxidation at anode



$$E_{\text{O}_2} = \frac{0.5 \times 32}{2} = 8$$

$$W_{\text{O}_2} = ZIt = \frac{8 \times 2 \times 193}{96500} = 0.032 \text{ g}$$

$$n_{\text{O}_2} = \frac{0.032}{32} = 0.001 \text{ mole}$$

$$V_{\text{O}_2} (\text{STP}) = 22400 \times 0.001 = 22.4 \text{ cc}$$



$$n\text{-factor} \times M_1 V_1 = n\text{-factor} \times M_2 V_2$$

$$2 \times K \times 25 = 1 \times 0.1 \times 35 \text{ (since } n\text{-factor of } \text{Ba}(\text{OH})_2 = 2 \text{ and } \text{HCl} = 1)$$

$$K = 0.07 \text{ M}$$

60.(b)

61.(c) Suppose mass of each of H_2 , O_2 and CH_4 taken = wg

$$\text{wg } \text{H}_2 = \frac{w}{2} \text{ mole, wg } \text{O}_2 = \frac{w}{32} \text{ mole, wg } \text{CH}_4 = \frac{w}{16} \text{ mole}$$

As under identical conditions, volumes are in the ratio of moles. Hence,

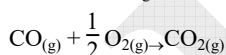
$$\text{Volume of } \text{H}_2 : \text{O}_2 : \text{CH}_4 = \frac{w}{2} : \frac{w}{32} : \frac{w}{16} = \frac{1}{2} : \frac{1}{32} : \frac{1}{16} = 16 : 1 : 2$$

62.(d) $\Delta S^{\circ} = 2S_{\text{HCl}}^{\circ} - (S_{\text{H}_2}^{\circ} + S_{\text{Cl}_2}^{\circ})$

$$= 2 \times 186.7 - (130.6 + 223.0)$$

$$= 19.8 \text{ JK}^{-1} \text{ mol}^{-1}$$

63.(c) $\Delta H = \Delta E + \Delta n_g RT$



$$\Delta n_{(\text{g})} = n_p - n_{\text{r}(\text{gaseous})} = 1 - \left(1 + \frac{1}{2}\right) = 1 - \frac{3}{2} = \frac{2-3}{2} = -\frac{1}{2}$$

$$\Delta H = \Delta E - \frac{1}{2} RT \quad \Delta E = \Delta H + \frac{1}{2} RT \quad \therefore \Delta H < \Delta E$$

64.(a) Charge on NO is +1 (NO^{+})

H_2O is a neutral ligand.

The oxidation state of iron (Fe) can now be calculated as follows:

$$\Rightarrow X + (+1) + 5(0) = +2$$

$$\Rightarrow X = +1$$

65. (d) $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$

x	x	0	0
2x	2x		

$$K_c = \frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]} = \frac{2x \cdot 2x}{x \cdot x} = 4$$

66. (a) $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$:

On increasing oxidation number Acidic strength increases.

67. (c) $t_{1/2} \propto \frac{1}{a^{n-1}}$

For 2nd order reaction n = 2 then,

$$t_{1/2} \propto \frac{1}{a^{2-1}} \Rightarrow t_{1/2} \propto \frac{1}{a}$$

68. (b) Reactivity decreases as the steric hindrance. Now steric hindrance increases in I < II < III < IV. Therefore, reactivity increases in the reverse order.

$$\text{IV} < \text{III} < \text{II} < \text{I}$$

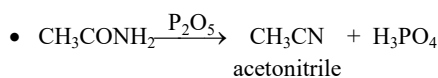
69. (c) • Compound + Amm. AgNO₃ or Fehling. So, compound solution must → No reaction idofom
 • Compound → +ve↓ test idofom.

$$\begin{array}{c} \text{O} \\ || \\ \text{CH}_3 - \text{C} - \end{array}$$

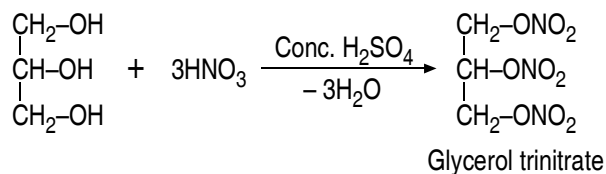
So, the compound must have CH₃ – C – group i.e. compound is CH₃CH₂COCH₂.

70. (b) This is called soda lime decarboxylation and occurs by release of CO₂.

71. (c) Acetonitrile:

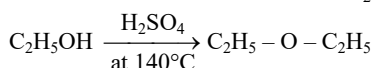


72. (d)



73. (b)

74. (b) When ethanol is heated with conc. H₂SO₄ at 140°C, the product obtained is diethyl ether.

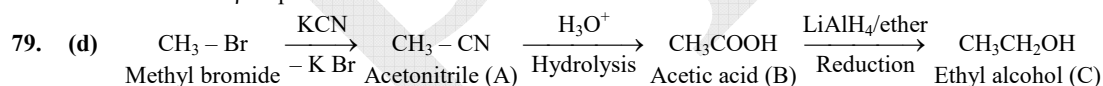


75. (c) • Basic strength of aliphatic amine
 In gaseous phase,
 Basic strength α + effect
 3° amine > 2° amine > 1° amine
 In aqueous medium,
 2° amine > 1° amine > 3° amine > NH₃
 • This occurs due to solvation (hydration) effect and steric effect.

76. (b)

77. (b) • Friedel-craft reaction involves the introduction of an alkyl or acyl group into benzene ring in the presence of a catalyst.
 • The presence of an electron withdrawing group in the ring hinders the reaction. So, phenyl acetanilide is not used.

78. (d) Only aromatic 1° amines form a brilliant-coloured dye on treatment with NaNO₂ in dil. HCl followed by addition of an alkaline solution of β-naphthol.



80. (a) Compounds having the same molecular formula but different functional groups are called functional isomers and the phenomenon is called functional isomerism. Methoxy methane and ethanol have the same molecular formula C₂H₆O but different functional groups. There, CH₃-O-CH₃ is the correct answer.

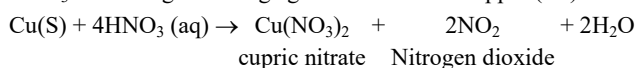
81. (b)

82. (d) Grignard reagent reacts with compound containing multiple bonds like > C = O, > C = S, -C ≡ N.

83. (c) Carbonyl compound have more dipole moment as compared carboxylic acids and alcohols.

84. (d) Due to presence of -NO₂ (electron withdrawing group), molecule stabilizes after the release of hydride.

85. (b) HNO₃ is a strong oxidizing agent that oxidizes copper (Cu) while itself get reduced.



86. (a) Brine is an aqueous solution of NaCl.

87. (a) Colloidal Pd > Crystalline pd > Pt > Au:

The occlusion properties of different metal are Colloidal Pd > Crystalline pd > Pt > Au > Ni > Fe.

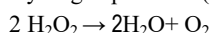
88. (a) ZnO, SnO, Cr₂O₃ are amphoteric oxides except MgO.

MgO is base oxide.

89. (b) Order of the purest form of carbon:

Diamond > Fullerenes > Sugar charcoal (Anthracite) > Graphite

90. (d) Hydrogen peroxide (H₂O₂) is unstable and slowly decomposes into water and oxygen:



Glass contains small amounts of alkaline oxides such as sodium oxide (Na_2O) and potassium oxide (K_2O). These can catalyze the decomposition of H_2O_2 , causing it to break down faster.

Therefore, H_2O_2 is generally stored in dark-colored plastic or specially treated containers, away from light and catalytic impurities.

91. (c) The inner lining of a blast furnace is made of fire-clay (refractory) bricks, which can withstand the very high temperature inside the furnace and resist chemical attack by the materials being processed.

Fire-clay bricks → highly heat-resistant and commonly used as refractory lining.

Silica bricks → used in certain high-temperature furnaces, but not the standard answer for the blast furnace lining.

Graphite bricks → not the usual general lining material.

Basic bricks → mainly used in basic oxygen and other furnaces where basic slags are involved.

92. (c) Greater solubility of the impurity in the molten state than in the solid: The method of zone refining of metals is based on the principle of greater solubility of the impurity in the molten state than in the solid. Elements which are used as semiconductor like Si, Ge, Ga etc. are refined by this method.

93. (b) $\text{Cs}^+ > \text{Li}^+$ (ionic radii); $\text{I}^- > \text{F}^-$ (ionic radii)

Hence, CsF has highest cation to anion size ratio

94. (a) $\text{Pb} + \text{Sn} = \text{Solder}$ $\text{Cu} + \text{Sn} + \text{Zn} = \text{Gun metal}$ $\text{Cu} + \text{Sn} = \text{Bell metal}$

95. (d) • A zwitterion is a dipolar ion. It is also known as inner salt.
 • In the zwitterion of amino acids, the carboxylic group will be in its ($-\text{COO}^-$) ionized form and the amino group will be in its ($-\text{NH}_3^+$) ionized form.

96. (a) A breath test used by traffic police to check drunken driving uses potassium dichromate. Potassium dichromate is a crystalline ionic solid with a very bright, red orange colour.

97. (b) Ammonium chloride (NH_4Cl) undergoes sublimation—it changes directly from solid to vapour on heating and can then be condensed back to solid. Sodium chloride (NaCl) does not sublime under these conditions and remains behind. So, on heating:

$\text{NH}_4\text{Cl} \rightarrow \text{vapour} \rightarrow \text{solid NH}_4\text{Cl}$

$\text{NaCl} \rightarrow \text{remains as residue}$

Therefore, the mixture is separated by sublimation

98. (c) $\text{CaO} + \text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{MgO} + \text{Fe}_2\text{O}_3$: The chemical formula of portland cement is $\text{CaO} + \text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{MgO} + \text{Fe}_2\text{O}_3$

99. (b) Addition polymer:

- Condensation polymer → step growth polymer, e.g.: Nylon, terylene etc
- Thermosetting plastic → e.g.: Bakelite, Melamine etc.

100. (a) Castner–Kellner process → manufacture of NaOH

- Carbon reduction process → not the standard industrial process for Na_2CO_3
- Leblanc process → an older method for manufacturing Na_2CO_3 , largely replaced by the Solvay process

ZOOLOGY

- 101.(a) During sporogony in the oocyst, the diploid zygote first undergoes **meiosis**, producing haploid nuclei. This is followed by repeated **mitotic divisions**, resulting in the formation of numerous sporozoites.

- 102.(a) Benign tertian malaria → *Plasmodium vivax* Benign quartan malaria → *Plasmodium malariae*
 Benign sub-tertian malaria → *Plasmodium ovale* Malignant tertian malaria → *Plasmodium falciparum*

- 103.(b) The **coelomic fluid acts as a hydrostatic skeleton**, providing internal support and helping the earthworm maintain body rigidity during movement and burrowing.

- 104.(c) Earthworms perform **cutaneous respiration through their moist integument**. Moisture allows oxygen to dissolve and diffuse through the skin into the blood.

- 105.(a) Frogs have mucous glands to keep the skin moist for respiration and poison (granular) glands for defense. They do not have sweat or mammary glands

- 106.(a) In the heart of a frog, the sinus venosus is a thin-walled triangular chamber that collects deoxygenated blood before it enters the right atrium. It receives blood from Right precaval vein, Left precaval vein and one postcaval vein. Thus, the sinus venosus is formed by the union of two precavals and one postcaval vein.

- 107.(d) Nodes of Ranvier are small gaps between successive myelin sheath segments along a myelinated axon. They are important for saltatory conduction, in which the nerve impulse effectively jumps from one node to the next.

- 108.(a) The biceps and triceps muscles of the upper arm work in opposite directions, so they form an antagonistic pair.

Biceps contracts → flexes the forearm at the elbow.

Triceps contracts → extends the forearm at the elbow.

Because one muscle produces an action opposite to the other, they are called antagonistic muscles.

- 109.(b)

- 110.(a)** The peritoneum is a serous membrane that lines the abdominal and pelvic cavities and covers many abdominal organs. Its surface is lined by simple squamous epithelium, specifically called mesothelium.
- 111.(b)** Cutting or blocking the vasa differentia (vasectomy) prevents sperm from being transported from the testes to the urethra. Spermatogenesis and testosterone production continue normally, but semen lacks sperm.
- 112.(d)** The zona pellucida is an acellular glycoprotein layer surrounding the oocyte. The granulosa cells and theca layers are cellular components.
- 113.(d)** Wisdom tooth that does not have a matching molar to bite against in the opposing jaw does not serve a useful purpose. Generally, people have four wisdom teeth
- 114.(c)** Brunner's glands are specialized glands located in the submucosa of the duodenum, which is the first part of the small intestine. These glands secrete an alkaline mucus-rich fluid that helps to:
- Neutralize the acidic chyme coming from the stomach
 - Protect the intestinal lining from acid damage
 - Provide a suitable pH for intestinal enzymes to function
- 115.(a)**
- Alveoli → Residual air mainly remains here to keep alveoli inflated.
 - Bronchus → Conducting passage; not the main site of residual air.
 - Nostrils → Air entry passage only.
 - Trachea → Conducts air to bronchi; does not store residual air mainly
- 116.(b)** At high altitudes, the atmospheric pressure is lower, so less oxygen enters the lungs with each breath. To adapt to this low-oxygen environment, the kidneys release a hormone called erythropoietin (EPO), which stimulates the bone marrow to produce more red blood cells. As a result, the haemoglobin concentration in the blood increases. Higher haemoglobin levels allow the blood to carry more oxygen, helping the body's tissues receive an adequate oxygen supply despite the reduced oxygen availability in the air.
- 117.(c)** The ascending limb of the loop of Henle is often called the "diluting segment" because it actively transports sodium and chloride ions out of the filtrate but is almost impermeable to water. As a result, the filtrate becomes more dilute as it moves upward.
- 118.(c)** Diabetes insipidus is caused by a deficiency of ADH (antidiuretic hormone). Due to this, kidneys cannot reabsorb water properly, resulting in frequent urination of large amounts of dilute urine, but no glucose is present in urine.
- 119.(a)** Veins carry blood towards the heart at relatively low pressure. To prevent the backward flow of blood, veins contain valves. Arteries carry blood away from the heart under high pressure, so they generally do not have valves (except at the base of major arteries leaving the heart).
- 120.(b)** The Bundle of His carries electrical impulses from the AV node to the ventricles, ensuring coordinated ventricular contraction.
- 121.(a)** Meissner's corpuscles are touch receptors present in the skin that respond to gentle touch and light pressure.
- Meissner's corpuscles → Touch
 - Pacinian corpuscles → Deep pressure and vibration
- 122.(c)** The malleus (hammer) is the first auditory ossicle of the middle ear. Its handle (manubrium) is directly attached to the tympanic membrane (eardrum). Sound vibrations from the eardrum are transmitted through the ossicles in the sequence: Malleus → Incus → Stapes. The stapes is attached to the oval window, while the cochlea is part of the inner ear and is not an ossicle.
- 123.(b)** The sodium-potassium pump (Na^+/K^+ -ATPase) is a transport protein present in the cell membrane of neurons and other cells. It uses ATP energy to move ions against their concentration gradients.
- During one cycle:
- 3 Na^+ ions are pumped out of the neuron.
 - 2 K^+ ions are pumped into the neuron.
 - 1 ATP molecule is consumed.
- 124.(c)** SA node: SA nodes lie near the opening of the superior vena cava in the right auricle. AV node is also known as pace setter of heart. The impulses pass through bundle of His are non-rhythmic
- 125.(b)** The pituitary gland is attached to the hypothalamus by the infundibular stalk and is located in the sella turcica of the sphenoid bone.
- Blood vessels → Help transport hormones but do not form the attachment.
 - Malleus → An auditory ossicle of the middle ear.
 - Pituitocytes → Supporting cells of the posterior pituitary, not the connecting structure
- 126.(a)** The Widal test is a serological test used to detect antibodies against *Salmonella* antigens, particularly *Salmonella Typhi* and *S. Paratyphi*, which cause enteric (typhoid) fever.
- Widal test → Detects antibodies against *Salmonella* O and H antigens.
 - Mantoux test → Detects immune response to *Mycobacterium tuberculosis*.
 - ELISA for HIV → Detects HIV infection markers, commonly antibodies/antigen.
 - Spirometry → Measures lung function.

- 127.(c) IgM is the first antibody produced during the primary immune response, appearing early after antigen exposure, before IgG production increases.
- 128.(a) Influenza viruses undergo frequent **antigenic changes**, especially antigenic drift. Therefore, circulating strains may differ from those targeted by previous vaccines, requiring regular updating of the vaccine.
- 129.(b) An effective vaccine exists for Hepatitis B and is included in routine immunization schedules; no widely available vaccine exists yet for Hepatitis C.
- 130.(c) Atavism is the reappearance of a trait that was present in distant ancestors but absent in recent generations. It occurs due to the expression of dormant ancestral genes. For example: Human baby born with a tail and Extra nipples (supernumerary nipples)
- 131.(c) **Industrial melanism** in the peppered moth (*Biston betularia*) is a classic example of **natural selection**. In polluted environments, dark moths had a survival advantage and reproduced more successfully than light-colored moths.
- 132.(d) "Lucy" is a fossil of Donald Johanson's famous discovery, belonging to the species *Australopithecus afarensis*, which is part of the genus *Australopithecus*. It provides important evidence for early human evolution and bipedalism.
- 133.(c) *Antedon* belongs to Class Crinoidea of Phylum Echinodermata. Crinoids are commonly called sea lilies or feather stars. Although adult *Antedon* is free-swimming, it resembles a sea lily in appearance.
- Sea star → Class Asteroidea (e.g., *Asterias*)
 - Brittle star → Class Ophiuroidea (e.g., *Ophiura*)
 - Sea cucumber → Class Holothuroidea (e.g., *Holothuria*)
- 134.(b) A mature proglottid of **Taenia** contains both **male reproductive organs (testes)** and **female reproductive organs (ovaries)**. Therefore, each proglottid is **bisexual/hermaphroditic**.
- 135.(c) *Euplectella* is known as Venus flower basket that is given as gift in Japan. The trapped **shrimp pair** symbolizes lifelong partnership and fidelity.
- 136.(a) **Sea-mica** is the common name of **Chiton**, a marine mollusc belonging to class **Polyplacophora**. Chiton possesses **eight dorsal shell plates**.
- Unio → Freshwater mussel.
Teredo → Shipworm, bores into wood.
Nautilus → Cephalopod with a chambered shell.
- 137.(d) **Cursorial**: Cursorial (running) vertebrates are also characterized by short muscular upper legs and thin, elongated lower legs
- 138.(a) **Rheotaxis** is the movement or orientation of an organism in response to water current. Many fishes show positive rheotaxis by swimming against the current.
- Rheotaxis → Response to water current
 - Phototaxis → Response to light
 - Chemotaxis → Response to chemicals
 - Hygrotaxis → Response to moisture
- 139.(c) **Amniocentesis** is a prenatal diagnostic procedure in which amniotic fluid containing foetal cells and chemicals is examined to obtain information about the developing foetus.
- 140.(b) *Saccharomyces cerevisiae* ferments sugars to produce ethanol and carbon dioxide.

BOTANY

- 141.(c) Carbohydrates are produced by organisms capable of **photosynthesis**, including green plants, algae, and some bacteria.
- 142.(d) Allosteric enzymes can change their **three-dimensional conformation (shape)** when an activator or inhibitor binds to an allosteric site. This conformational change affects the enzyme's activity.
- 143.(a) In the five-kingdom classification proposed by R.H. Whittaker, Kingdom Monera includes all prokaryotic organisms, such as: Blue-green algae (cyanobacteria), Nitrogen-fixing bacteria, Methanogenic archaeobacteria
- 144.(c)
- 145.(b) Due to the presence of mentioned characters in question, this group is also called fungi imperfecti.
- 146.(c) In lichens, fungus partner or mycobiont (mostly ascomycete) and an algal partner called photobiont or phycobiont (mostly blue-green alga).
- 147.(a) **Hypnospores** are thick-walled, non-motile spores formed to tide over unfavorable condition. They germinate on the arrival of favorable conditions. e.g., *Chlamydomonas*, *Ulothrix*.
- 148.(d) Thallus of *Anthoceros* shows symbiotic association with a nitrogen fixing blue green alga. i.e., *Nostoc*.
- 149.(d) Ferns are generally the first colonizers of burnt down forest area. This is due to the persistence of their underground rhizomes while the above ground parts get burnt up.
- 150.(c)
- 151.(c) The two anterior petals are often united and form a boat-shaped structure called the **keel**, which encloses the reproductive organs.
- 152.(c) Depending on the factors, there are three types of ecological pyramids: Pyramid of number, Pyramid of biomass and Pyramid of energy.

- 153.(c) Keystone species play a crucial role in maintaining the structure of an ecological community, influencing the abundance of other species.
- 154.(b) A hydrosere is an ecological succession that begins in a water body such as a pond or lake.
The succession typically begins with phytoplankton, which act as the pioneer community.
- 155.(d) Because lamb is a primary consumer and it is grazing the grass and small herbs. Wolf eats lamb so it is secondary consumer. The tiger eats wolf (the secondary consumer) so it is called tertiary consumer.
- 156.(a) Lateral meristems occur laterally in the axis, parallel to the sides of stems and roots. The cambium of vascular bundles and the cork cambium (phellogen) belongs to this category.
- 157.(a) The term xylem was introduced by Nageli (1858). Xylem is a conducting tissue. Xylem consists of Tracheids, Trachea (Xylem vessels), wood fibres and xylem parenchyma.
- 158.(d) In the upper epidermis, there are some large cells found in groups, which are known as motor cells or bulliform cells. They help the leaf **roll inward during water stress**, reducing water loss.
- 159.(a) DPD (Diffusion Pressure Deficit) is the force that drives the movement of water from one cell to another. It represents the difference between the water potential of the soil (or surrounding solution) and that within the plant cells.
- 160.(d) Transpiration occurs in plants, only from living cells. Transpiration occurs from any free surface. Both from living and non-living surface.
- 161.(c) During night, sugar is converted to starch because of decrease in pH , it results in decrease in the concentration of cell sap in the guard cells resulting in closure of stomata.
- 162.(c) Chlorella is an unicellular alga used by Ruben Kamen and Warburg because algae carry out 90% of photosynthesis.
- 163.(b) During photosynthesis, PGA is reduced by $NADPH_2$ into phosphoglyceraldehyde.
- 164.(a)
- 165.(b) The sickle cell trait provides a protective advantage against malaria, particularly in regions where the disease is prevalent.
- 166.(b) Mendel selected seven pairs of contrasting characters except plant colour.
- 167.(c) In this experiment, Mendel stated that each character is governed by a single gene and there is no linkage and gene interaction. He failed to explain his law of independent assortment in the presence of linkage.
- 168.(c) Haploid number of chromosomes = Linkage groups.
- 169.(d) Termination codons are also known as the non-sense codons or stop codons because they stop the process of protein synthesis, being not coded for amino acid during translation.
- 170.(a) DNA dependent RNA polymerase is the enzyme that synthesizes RNA from a DNA template during transcription.
- 171.(c) The complex of sugar polymers and proteins which are patchily distributed on the plasma membranes of animal cells is called Glycocalyx.
- 172.(c) The cell plate is formed during cytokinesis in plant cells. It develops at the center of the dividing cell and eventually becomes the middle lamella, which is the layer that separates two daughter cells and helps them stick together.
- 173.(d) Endoplasmic reticulum is scattered from plasma membrane to nuclear membrane, by which they provide mechanical support. Ribosomes are found in the surface of ER, that is why, they participate in protein synthesis, they also transfer many enzymes.
- 174.(a) In mitosis, the nuclear envelope disappears and chromosomes become distinct during prophase, initiating the condensation and organization of genetic material. This crucial stage sets the foundation for subsequent steps in cell division.
- 175.(b) 1 cell $\xrightarrow{I}$ 2 cells $\xrightarrow{II}$ 4 cells $\xrightarrow{III}$ 8 cells $\xrightarrow{IV}$ 16 cells $\xrightarrow{V}$ 32 cells $\xrightarrow{VI}$ 64 cells $\xrightarrow{VII}$ 128 cells $\xrightarrow{VIII}$ 256 cells.
- 176.(c) In wind pollination, as characteristic of the grass family, pollen grain is Small, very light, smooth, dry, and unwettable. This helps the pollen to be easily carried by the wind over long distances.
- 177.(b) Self-sterility occurs when the pollen grains from the same flower do not fertilize the stigma of that flower, often leading to a lack of fertilization or even detrimental effects.
- 178.(a) Antibiotics are chemical substances derived from living organisms that can inhibit the growth of or destroy microbes, particularly bacteria.
- 179.(c) Allopolyploid means a mixture of two different genetic forms. Intergeneric hybridization of cereal crops *i.e. Secale cereale* and *Triticum* formed by man called Triticale.
- 180.(a) Synthetic insulin called "Humulin" was produced by an American pharmaceutical firm Eli-Lilly on July 5, 1983.

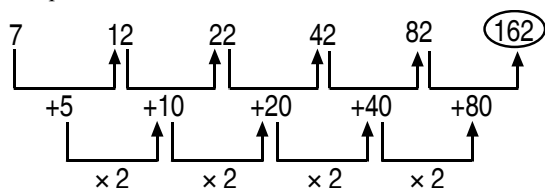
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- 181.(a) Since Harsh has no brother and sister, so he is his father's only son. So, wife of Harsh's father's son – Harsh's wife. Thus, Harsh's wife is the man's mother or the man is Harsh's son.
- 182.(a) Glutton is one who eats too much, Garrulous is one who talks too much.
- 183.(b) 1st Column $\rightarrow \sqrt{9} + \sqrt{4} + \sqrt{1} = 6$
 2nd Column $\rightarrow \sqrt{36} + \sqrt{16} + \sqrt{9} = 13$

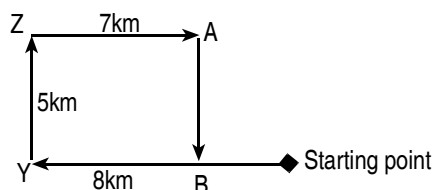
3rd Column $\rightarrow \sqrt{25} + \sqrt{9} + \sqrt{4} = \boxed{10}$

184.(b) Series pattern: cccbbbaaa/ccbbbaaa/c

185.(c) The pattern is as follows:



186.(a)



Required distance = $xy - yB = (8 - 7) = 1 \text{ km}$.

187.(a)

M I S C H I E E
 $+1\downarrow +2\downarrow +3\downarrow +4\downarrow +5\downarrow +6\downarrow +7\downarrow +8\downarrow$
 N K V G M O L N

Similarly,

R E L I E V E D
 $+1\downarrow +2\downarrow +3\downarrow +4\downarrow +5\downarrow +6\downarrow +7\downarrow +8\downarrow$
 S G O M J B L L

188.(c) Iron with specific gravity less than that of mercury but more than that of water, floats in the former but gets immersed in the second

189.(a) Let the monthly salary of man be m

So, the remaining salary after deposit in PF and saving = $m \frac{90}{100} \times \frac{70}{100} = 0.63 m$

The ratio of expense on medicine and groceries = 3:4

Let the total expense of medicine and groceries

$$= 3n + 4n = 7n$$

Given that $3n = 2700$

$$\therefore n = 900$$

Now, $7n = 0.63 m$

$$\Rightarrow 7 \times 900 = 0.63 m$$

$$\Rightarrow m = \frac{7 \times 900}{0.63} = 10000$$

Hence, the salary of the man = Rs. 10000.

190.(a) Let the number of tables purchases be x .

Then, number of chairs purchased = $(12 - x)$

$$\therefore 50x + 40(12 - x) = 500$$

$$\Rightarrow 50x - 40x = 500 - 480$$

$$\Rightarrow 10x = 20 \Rightarrow x = 2$$

So, number of tables = 2 and number of chairs = 10

Hence, required ratio = $10 : 2 = 5 : 1$

191.(c) Let the highest marks obtained by the student be x .

Then, second highest marks = $x - 2$

$$\begin{aligned} \text{Sum of marks of these 2 subjects} &= (87 \times 8) - (85 \times 6) \\ &= 696 - 510 = 186 \end{aligned}$$

$$\therefore x + (x - 2) = 186 \Rightarrow 2x = 188 \Rightarrow x = 94$$

- 192.(c)** Let A and B together take x hours to complete the work. Then, A alone takes $(x + 8)$ hrs and B alone takes $\left(x + \frac{9}{2}\right)$ hrs to complete the work.

$$\text{Then, } \frac{1}{(x+8)} + \frac{1}{\left(x + \frac{9}{2}\right)} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{(x+8)} + \frac{2}{(2x+9)} = \frac{1}{x}$$

$$\Rightarrow x(4x+25) = (x+8)(2x+9)$$

$$\Rightarrow 2x^2 = 72 \Rightarrow x^2 = 36 \Rightarrow x = 6.$$

- 193.(c)** Let John's age at marriage be x . Then, Kiara's age be $(x + 3)$.

We know that,

$$x + (x + 3) = 45$$

$$2x = 42 \Rightarrow x = 21$$

John's age at marriage was 21 years. Since, Sam is 5 years younger than John.

$\therefore$ Age of Sam at marriage = $21 - 5 = 16$ years

- 194.(b)** Suppose they meet x hrs after 9 a.m. Then,

Distance travelled by car X in $(x - 1)$ hrs + Distance travelled by car Y in x hrs = 700 km

$$\Rightarrow 60(x - 1) + 60x = 700 \Rightarrow 120x = 760$$

$$\Rightarrow x = \frac{760}{120} = \frac{19}{3} \text{ hrs} = 6 \text{ hr } 20 \text{ min.}$$

So, they cross each other 6 hr 20 min after 9 a.m. i.e., at 3 : 20 p.m.

- 195.(a)** Let the number of persons be x . Then,

$$\frac{96}{x-4} - \frac{96}{x} = 4 \Rightarrow \frac{1}{x-4} - \frac{1}{x} = \frac{4}{96}$$

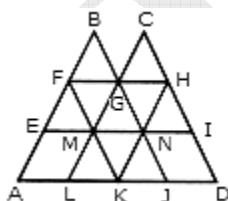
$$\Rightarrow \frac{x - (x - 4)}{x(x - 4)} = \frac{1}{24}$$

$$\Rightarrow x^2 - 4x - 96 = 0 \Rightarrow (x - 12)(x + 8) = 0 \Rightarrow x = 12.$$

So, required number = $x - 4 = 8$.

- 196.(d)** The arrow moves 4, 3, 2 and 1 spaces clockwise sequentially and the pin moves 5, 4, 3, and 2 spaces anti-clockwise sequentially.

- 197.(b)**



The simplest triangles are BFG, CGH, EFM, FMG, GMN, GHN, HNI, LMK, MNK and KNJ i.e., 10 in number.

The triangles composed of three components each are FAK and HKD i.e., 2 in number.

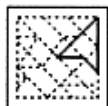
The triangles composed of four components each are BEN, CMI, GLJ and FHK i.e., 4 in number.

The triangles composed of eight components each are BAJ and OLD i.e., 2 in number.

Thus, there are $10 + 2 + 4 + 2 = 18$ triangles in the given figure.

- 198.(b)** When the sheet shown in fig. (X) is folded to form a cube, then the two half-shaded faces lie opposite to each other, the face bearing a circle lies opposite to one of the two blank faces and the two remaining blank faces lie opposite to each other. Therefore, the cubes shown in fig. (4) which has the two half-shaded faces adjacent to each other cannot be formed by folding the sheet (X). Also, the cube shown in fig. (2) has the face bearing circle adjacent to two blank faces. This is not possible since there is one blank face opposite to the circle and one blank face opposite to the third blank face. Hence, only the cube figure (1) and (3) can be formed.

- 199.(a)** A



- 200.(a)** The number of components in each row either increases or decreases from left to right. In the third row, it increases.

...The End...