EXPLANATIONS

3. $[3(1+w^2)]+w]^4 = (2w)^4 = 16w^4 = 16w$

4. $\dfrac{1+i}{1-i} = \dfrac{(1+i)^2}{1-i^2}$

$= \dfrac{1-1+2i}{2} = i$

$\Rightarrow \quad i^n = 1$

$\therefore \quad n = 4$

5. Use method of differences.

7. $S_n = \dfrac{n}{2}[2a + (n-1)d]$

8. $(9)^{S_\infty} = 9^{1/2} = 3$

$\therefore \quad S_\infty = \dfrac{1/3}{1-\frac{1}{3}} = \dfrac{1}{2}$

9. $\Sigma n = \dfrac{1}{5}\Sigma n^2$

11. $ax^3 + bx + c = (x^2 + px + 1)(ax + c)$

Comparing co-efficients, $p = -\dfrac{c}{a}$,

and $a + cp = b \quad \Rightarrow \quad a + c\left(\dfrac{-c}{a}\right) = b$

$\Rightarrow \quad a^2 - c^2 = ab$

12. $x - 2 = 2^{2/3} + 2^{1/3}$

Cubing both sides, we get

$(x-2)^3 = 6 + 6(x-2)$

$\Rightarrow \quad x^3 - 6x^2 + 6x = 2$

16. $\log_4 256 = \log_4 4^4 = 4 = 2^2 \quad \Rightarrow T_1 = 1$

and, $2\log_{\sqrt{2}^2} = 2.2\log_{2^2} = 4 \quad \Rightarrow T_2 = 4$

$\therefore \quad A = 1 + 4 = 5$

17. $S_r = 2 - 1$

L.H.S. $= \left(5^{-1}\right)^{\log^{\sqrt{5}(2)-1}}$

$= 5^{2\log_5^2} = 5^{\log^{5^2}} = 4$

20. $\sum_{r=0}^{m} {}^{n+r}C_n = \sum_{r=0}^{m} {}^{n+r}C_r$

$= {}^nC_0 + {}^{n+1}C_1 + {}^{n+2}C_2 + \ldots + {}^{n+m}C_m$

$= {}^{n+m}C_m + 1 + {}^{n+m}C_m$

$= {}^{n+m+1}C_m$

$= {}^{n+m+1}C_{n+1}$

21. $44 = {}^nC_2 - n = \dfrac{1}{2}n(n-1) - n$

$\therefore \quad n = 11$

22. Number of triangles $= {}^{12}C_3 - {}^7C_3$

$= 220 - 35$

$= 185$

23. ${}^{10}C_5 \times {}^8C_4$

25. Sum of co-efficients $= (4)^{10} - (2)^{20}$

30. $\therefore$ 7th term $= 84$

32. Operating $C_3 - C_2$ and $C_2 - C_1$

Apply $R_3 - R_2$, $R_2 - R_1$

$$\Delta = \begin{vmatrix} x+1 & 1 & 1 \\ 2 & 1 & 0 \\ 4 & 1 & 0 \end{vmatrix} = 2$$

34. Above is skew symmetric deteminent of odd order because

$\cos(A + B) = -\cos C$ etc.

37. Probability to getting heads in both the trials

$= \dfrac{1}{2} \times \dfrac{1}{2} = \dfrac{1}{4}$.

38. Required probability $= \dfrac{4_{C_2}}{52_{C_2}} = \dfrac{1}{221}$

39. Let, n= Total number of ways $= 6 \times 6 = 36$

m = number of favourable ways

$= 3 + 2 + 1 = 6$

$\therefore \quad p = \dfrac{m}{n} = \dfrac{6}{36} = \dfrac{1}{6}$.

42. Here, n = total number of ways $= 6 \times 6 = 36$

Favourable ways = (1, 4), (2, 3), (3, 2), (4, 1) = 4

$\therefore \quad p = \dfrac{m}{n} = \dfrac{4}{36} = \dfrac{1}{9}$

46. $P = P_1 + P_2 = 2D + (-4D) = 2D - 4D = -2D$.

47. For a transformer, $\dfrac{I_p}{I_s} = \dfrac{n_s}{n_p} = \dfrac{4}{5}$

48. $Q = \dfrac{K\Delta\theta t}{d} \Rightarrow K \propto \dfrac{1}{t}$

$\Rightarrow \quad \dfrac{K_1}{K_2} = \dfrac{t_2}{t_1} = \dfrac{40}{20} = \dfrac{2}{1}$

50. $\dfrac{I_g}{I} = \dfrac{S}{S+G} = \dfrac{2.5}{2.5+25} = \dfrac{2.5}{27.5} = \dfrac{1}{11}$

51. When the particle is in its mean position, the kinetic energy will be maximum.

$$K_{max} = \frac{1}{2}m\omega^2a^2$$

$$16 = \frac{1}{2} \times 5.12 \times \frac{4\pi^2}{T^2} \times (0.25)^2$$

$$\Rightarrow \quad T^2 = \frac{2.56 \times 4\pi^2 \times 0.25}{4} \times 0.25$$

$$\Rightarrow \quad T = \frac{1.6 \times 2\pi \times 0.25}{4} = \frac{\pi}{5} \text{ sec}$$

52. Displacement for complete revolution = 0

Since, workdone = force × displacement

$\therefore$ Work done = 0

53. Surface tension of water = 0.06 Nm^{-1},

diameter of tube = 1 mm

$$\text{Capillary rise, } h = \frac{2\rho\cos\theta}{r\rho g}$$

$$= \frac{2 \times 0.06 \times \cos 0°}{0.5 \times 10^{-3} \times 10^3 \times 10}$$

$$= 0.244 \text{ m} = 2.44 \text{ cm}$$

54. When swimmer push the water backward, then according to third law, water push the swimmer in forward direction.

55. $$E = \sqrt{V_R^2 + V_L^2}$$

$$= \sqrt{16^2 + 20^2} = \sqrt{656} = 25.6 \text{ V}$$

56. Energy stored between the plates of the capacitor, $U = \frac{1}{2}\left(\frac{K\varepsilon_0 A}{x}\right)V^2$

where x is the separation between the plates.

Let plates are pulled apart through a small distance dx. Then,

$$U' = \frac{1}{2}CV^2 = \frac{1}{2}\frac{K\varepsilon_0 AV^2}{(x + dx)}$$

Change in potential energy,

$$\Delta U' = U' - U = -\frac{1}{2}\frac{K\varepsilon_0 A dx}{x^2}V^2$$

Therefore, force between the plates of the capacitor,

$$F = -\frac{dU}{dx} = \frac{1}{2}\left(\frac{K\varepsilon_0 AV^2}{x^2}\right)$$

$$= \frac{1}{2}\frac{1}{\varepsilon_0 AK}C^2V^2 = \frac{q^2}{2\varepsilon_0 AK}$$

58. $I = F \times t$, $= 50 \times 10^{-5} \times 3 = 1.5 \times 10^{-3}$ N-s.

62. Given, $Y = 0.30 \sin (220\, t + 0.64)$

Comparing this equation with the standard equation of simple harmonic motion, we get

$Y = a \sin (\omega t + \theta)$

$\therefore$ $a = 0.30$ m and $\omega = 220$ sec^{-1}.

$\therefore$ Maximum velocity, $v = a\omega = 0.30 \times 220$

$= 66$ m/s.

$$\text{Frequency, } n = v\frac{\omega}{2\pi} = \frac{220 \times 7}{2 \times 22} = 35 \text{ Hz.}$$

63. $$\text{Kinetic energy} = \frac{p^2}{2m} = \frac{(2)^2}{2 \times 2} = 1\text{J.}$$

64. Here, $$\mu = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°} = \sqrt{2} = 1.414$$

$$\therefore \quad \frac{3 \times 10^8}{v_m} = 1.414$$

$$\Rightarrow \quad v_m = 2.12 \times 10^8 \text{ m/s.}$$

65. Velocity of body after 3 sec,

$v = u + gt$

$= 0 + 9.8 \times 3 = 29.4$ m/s.

$$\therefore \quad \text{K.E.} = \frac{1}{2}mv^2 = \frac{1}{2} \times 3 \times (29.4)^2 = 1296 \text{ J.}$$

66. Impulse imparted to each ball,

I = change in momentum

= mu – (– mu)

= 2mu = 2 × 0.06 × 4 = 0.48 kg m/s.

67. According to first law of thermodynamics,

$\Delta Q = \Delta U + \Delta W$

= 333 cal + 167 cal = 500 cal

70. Frequency = Number of waves passing through a point per second.

$$\therefore \quad v = \frac{3600 \text{ waves}}{2 \text{ min}} = 30 \text{ sec}^{-1}.$$

$$\therefore \quad \lambda = \frac{v}{\upsilon} = \frac{760}{30} = 25.33 \text{ m.}$$

71. Luminous flux, $\varphi = 4\pi I = 4 \times 3.14 \times 42$ lumen

$$\therefore \quad \text{Power} = \frac{4 \times 3.14 \times 42}{2} = 263.76$$

$= 264$ W.

72. In isothermal process,

T = constant

$$\therefore \quad \Delta T = 0 \text{ C} = \frac{\Delta\theta}{m\Delta T} = \infty$$

73. The volume of big drop should be equal to the volume of 1000 small drops.

$$\therefore \quad 1000 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$\Rightarrow \quad r = \frac{R}{10}$$

74. K.E. per gm molecule

$$= \frac{3}{2} RT = \frac{3}{2} \times 8.31 \ (300)$$

$$= 3739.5 \text{ J} = 3.74 \times 10^3 \text{ J}.$$

76. According to Stefan's law of radiation, $E = \sigma T^4$

Where, σ = Stefan's constant

$$\therefore \quad \frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4$$

$$\Rightarrow \quad \frac{2\times10^5}{32\times10^5} = \left(\frac{T_1}{T_2}\right)^4$$

$$\Rightarrow \quad \left(\frac{1}{2}\right)^4 = \left(\frac{T_1}{T_2}\right)^4$$

$$\Rightarrow \quad T_2 = 2T_1 = 2 \times 400 = 800 \text{ K} = 527°\text{C}.$$

79. Number of half lives $= \frac{40}{3.6} = 11.1$

Atoms left after 11 half lives,

$$N = N_0\left(\frac{1}{2}\right)^n \frac{20}{2^{11}} = 9.76 \times 10^{-3} \text{ mg}.$$

82. We know, $q = i\,t \quad \Rightarrow i = \frac{q}{t}$

$$\therefore \text{ Displacement current} = \frac{dq}{dt} = 1.8 \times 10^6 \text{ A}$$

83. Velocity of body in SHM,

$$v = \omega\sqrt{a^2 - x^2}$$

$$= 2\sqrt{(60\times10^{-3})^2 - (20\times10^{-3})^2}$$

$$= 2 \times 10^{-3}\sqrt{3200} = 113 \text{ mm/s}$$

84. $\lambda = \frac{v}{\upsilon} = \frac{330}{250} = 1.29 \text{ m}$

85. $g = \frac{GM}{R^2} = \frac{6.667\times10^{-11}\times7.34\times10^{22}}{R^2}$

$$\therefore \quad R = \sqrt{\frac{6.67\times10^{-11}\times7.34\times10^{22}}{1.4}}$$

$$= 1.86 \times 10^6 \text{ m}$$

86. Enthalpy change, $\Delta H = -2.5 \times 10^3$ cals

Entropy change, $\Delta S = 7.4$ Kcal deg^{-1}

Temperature, $T = 298$ K

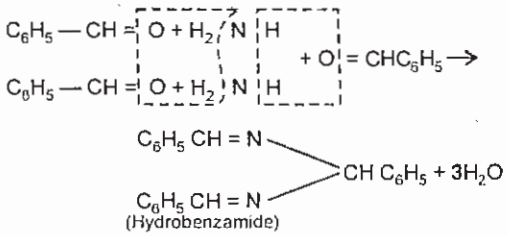
$$\therefore \quad \Delta G = \Delta H - T\Delta S$$

$$= -2.5 \times 10^{-3} - 298 \times 7.4$$

$$= -\text{ve value}$$

For spontaneity of reaction, negative value of ΔG is required, so the reaction is spontaneous.

87.



88. CH_4 has a regular tetrahedral geometry, so it has zero dipole moment. Again all the C–H bonds are identical.

PH_3 has pyramidal geometry while NH_4^+ is polar due to presence of +ve charge.

In CH_2Cl_2 the C–Cl bonds are polar, so the molecule has a considerable amount of dipole moment.

89. In 10^{-8}M HCl solution,

total [H] = [H] from acid +[H+] from water

$$= 10^{-8} \text{ M} + 10^{-7} \text{ M}$$

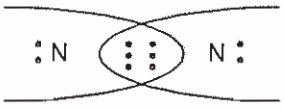
$$= 1.1 \times 10^{-7}\text{M}$$

$$pH = -\log(1.1 \times 10^{-7})$$

$$= -(0.0414 - 7) = 6.9586$$

90. Nitrogen (z = 7) has electronic configuration $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$

Therefore the three 2p electrons are shared by each Nitrogen atom in N_2 molecule.



N ≡ N

91. For extraction of silver from $AgNO_3$, first it is treated with HCl solution, so that silver chloride ppt. is formed.

AgCl precipitate when fused with Na_2CO_3 silver metal is obtained.

$$AgNO_3 + HCl \rightarrow AgCl + HNO_3$$

$$2AgCl + Na_2CO_3 \rightarrow 2Ag + 2NaCl + CO_2 + \frac{1}{2}O_2$$

(silver metal)

93. From Ideal gas equation, $PV = nRT$

Putting the values of n = 2 mol, R = 0.0821 T = 540 K and V = 44.8 L,

we get

$$P = \frac{nRT}{V} = \frac{2\times0.0821\times540}{44.8}$$

$$= 1.98 \text{ atm} \approx 2 \text{ atm}$$

94. Anhydrous $AlCl_3$ is prepared by passing dry HCl gas over heated aluminium turnings in the absence of air.

$$2\,Al + 6\,HCl \longrightarrow 2AlCl_3 + 3H_2$$

95. $CHCl_3 + HNO_3 \longrightarrow \underset{\text{(Chloropicrin)}}{CCl_3NO_2} + H_2O$

Chloropicrin is used as insecticide and as tear gas.

96. $\Delta T = 273 - 271.9 = 1.1$ K

$$\text{Moles of solute} = \frac{\text{mass of solute}}{\text{molecular mass}}$$

$$= \frac{1.25}{\text{molecular mass}}$$

But $\Delta T = K_f\, m$

where, $K_f = 1.86$ K Mol^{-1}, m = molality

$$\therefore \quad 1.1 = 1.86 \times \frac{1.25/M}{20\times1000}$$

$$\Rightarrow \quad M = \frac{1.86\times1.25\times1000}{1.1\times20} = 105.68$$

98. $CH_3{-}\underset{\underset{O}{\|}}{C}{-}Cl + H_2 \xrightarrow[\text{Sulphur}]{Pd/BaSO_4} CH_3 - \underset{\underset{O}{\|}}{C} - H + HCl$

Acetly chloride — Acetaldehyde

When H_2 gas is passed through a solution of acetyl chloride in xylene in presence of Pd and $BaSO_4$ poisoned by sulphur acetaldehyde is formed. This reaction is called as Rosenmund's reduction reaction.

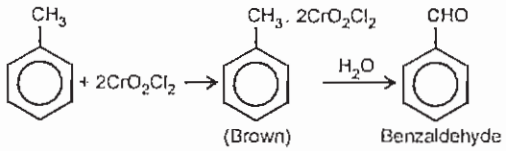
99. Lyophilic sols are more stable due to the fact that lyophilic colloids are extensively solvated, which means the colloidal particles are covered by a layer of dispersion medium.

100. Bond strength of H – X (Halide) decreases from HF to HI. The decrease in stability is due to decrease in electro negativity from F to I. So the correct order of acidity is

HF < HCl < HBr < HI

101. In diamond, each carbon is bonded covalently to four other carbon atoms by sp^3 hybridisation. In graphite, each carbon atoms is linked to three other carbon atom by sp^2 hybridisation. In acetylene, there is sp hybridisation.

102. Etard reaction –Chromium chloride dissolved in CCl_4 is made to react with toluene and product formed is decomposed with water.



103. Liebermann nitroso reaction: If 2° amine is treated with HNO_2, nitrosoamines are obtained. This may be converted again to 2° amine by heating it with conc. H_2SO_4

104. $4\,Au + 8CN^- + 2H_2O + O_2 \rightarrow 4\,[Au(CN)_2] + 4OH^-$

(gold) — Auric complex

105. Some of the oxygen molecules dissociate when silent electric discharge is passed. Then atomic oxygen combines with oxygen molecules.

$$O_2 \xrightarrow[\text{discharge}]{\text{electric}} O + O$$

$$O + O_2 \longrightarrow O_3$$

Energy is absorbed in this reaction.

106. $\underset{\underset{CH_2}{\|}}{CH_2} \xrightarrow{\text{Cold } KMnO_4} \underset{\underset{CH_2-OH}{|}}{CH_2-OH}$

ethylene — ethylene glycol

107. One mole = 6.023×10^{23} particles

$\therefore$ One mole of $CO_2 = 6.023 \times 10^{23}$ CO_2 Molecules.

108. A sudden large jump between the values of 2nd and 3rd ionisation energies of an element indicates, that the element has two-electrons in its valence shell. Then the possible electronic configuration may be $\longrightarrow 1s^2, 2s^2, 2p^6, 3s^2$

109. Potassium dichromate reacts with hydrochloric acid to evolve chlorine.

$$K_2Cr_2O_7 + 14HCl \longrightarrow 2KCl + 2\,CrCl_3 + 7H_2O + 3Cl_2$$

110. Oxalic acid when heated with concentrated H_2SO_4 it gives carbon monoxide and carbon dioxide.

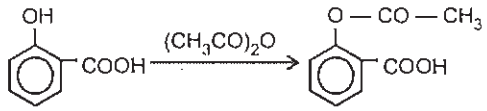
$$\begin{matrix}COOH\\|\\COOH\end{matrix} + H_2SO_4\ (conc.) \rightarrow H_2O + CO + CO_2$$

111. Lipids are constituents of plants and tissues. They include fats, oils, carbohydrates, phospholipids, wax, steroids etc. and mainly made up of carbon, hydrogen and oxygen. These are ester class of compounds, while amino acids do not belong to lipids.

112. $CH \equiv CH + 2NaNH_2 \rightarrow Na{-}C \equiv C{-}Na + 2NH_3 \uparrow$

As acetylene has two acidic hydrogen atoms so it reacts with strong base like $NaNH_2$ giving sodium acetylide.

113.



Aspirin
(Acetyl salicylic acid)

114. Nitrosamines when warmed with phenol and conc. H_2SO_4, green solution is formed. When made alkaline with aq. NaOH, turns deep blue. This procedure may be used as a test for secondary amines.

115. $CaC_2 + N_2 \longrightarrow CaCN_2 + C$

(Calcium cyanamide, Nitrolim)

Nitrolim is used as fertilizers.

116. $CH_3{-}CH_2{-}I \xrightarrow[KOH]{alcoholic} CH_2$

ethyl iodide $-HI$

$$= CH_2 \xrightarrow{Br_2} \underset{\underset{Br}{|}}{CH_2} - \underset{\underset{Br}{|}}{CH_2} \xrightarrow{KCN} \underset{\underset{CN}{|}}{CH_2} - \underset{\underset{CN}{|}}{CH_2}$$

(X) (Y) (Z)

117. $$\text{Moles of NaCl} = \frac{\text{mass}}{\text{molecular mass}} = \frac{5.85}{58.5}$$

$$= 0.1 \text{ mol}$$

$$\text{Moles of water} = \frac{90}{18} = 5.0 \text{ mol}$$

Mole fraction of NaCl

$$= \frac{0.1}{0.1 + 5.0} = 0.0196$$

118. $_{90}Th^{228} \longrightarrow {}_{83}Bi^{212} + x_2\alpha^4 + y\ {}_{-1}\beta^0$

Hence, $90 = 83 + 2x - y$

and $228 = 212 + 4x + y \times 0$

119. N_2O_5 in CCl_4 solution $\rightarrow 2NO_2$ (soln) $+ \frac{1}{2} O_2$

Rate of this reaction is given as :

rate = rate constant $\times [N_2O_5]^1$

$[N_2O_5]$ = concentration of N_2O_5

Putting the values of $[N_2O_5]$ and rate constant, we get

$$\text{rate} = 6.2 \times 10^{-4}\ s^{-1} \times 1.25 \text{ mol } L^{-1}$$

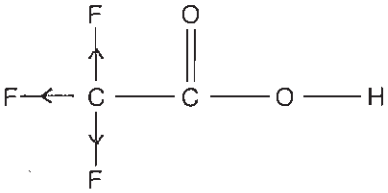
$$= 7.75 \times 10^{-4} \text{ mol } L^{-1}\ s^{-1}$$

120. Halogens are electrons - withdrawing agents they withdraw electrons from the neighbouring atoms. More the number of halogen atom, greater will be the acidity of acetic acid halogen derivatives. As electronegativity of halogen atom is in order:

$$F > Cl > Br > I$$

Therefore order of acidity of given compounds is

$$CF_3COOH > CCl_3COOH > CBr_3COOH > CH_3COOH$$



121. The electropositive character of alkaline earth metal increases down the group, therefore, larger alkaline earth metals are able to form ions more easily. So the ionic character of chlorides of these metals increases down the group.

i.e., $BaCl_2 < MgCl_2 < CaCl_2 < BeCl_2$ (Ionic character)

122. The benzoylation reaction of phenol with aromatic acyl chloride in presence of NaOH gives phenyl benzoate $\left(C_6H_5{-}\underset{\underset{O}{\|}}{C}{-}C_6H_5\right)$

This reaction is called as Schotten Baumann reaction

$$C_6H_5-OH + C_6H_5-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow{NaOH}$$

(Phenol) (Benzoyl chloride)

$$C_6H_5-\underset{\underset{O}{\|}}{C}-OC_6H_5 + NaCl + H_2O$$

(Phenyl benzoate)

123. Organic compound + $O_2 \rightarrow H_2O + CO_2$ + heat

0.2 gram 2.12 g 0.147

$\therefore$ Percentage of Carbon

$$= \frac{12}{44} \times \frac{\text{mass of } CO_2}{\text{mass of compound}} \times 100$$

$$= \frac{12}{44} \times \frac{0.147}{0.2} \times 100$$

$$= 20.04\ \%$$

$\therefore$ Percentage of Hydrogen

$$= \frac{2}{18} \times \frac{\text{mass of } H_2O}{\text{mass of compound}} \times 100$$

$$= \frac{2}{18} \times \frac{0.12}{0.2} \times 100$$

$$= 6.67\%$$

$\therefore$ Percentage of Oxygen

$$= 100 - (6.67 + 20.04)$$

$$= 73.29\%$$

124. Williamson's synthesis of ethers,

$$CH_3CH_2OH + Na \xrightarrow{\text{ether}} CH_3CH_2O^-Na^+ + \frac{1}{2}H_2$$

$$CH_3CH_2OH + CH_3CH_2O^-Na^+ \xrightarrow{H_2SO_4 \text{ conc.}} CH_3CH_2 - O - CH_2CH_3$$

Diethyl ether

125. According to Heisenberg's uncertainty principle,

$$\Delta x \times \Delta p \leq \frac{h}{4\pi}$$

where

Δx = uncertainty in measurement of position

Δp = uncertainty in measurement of momentum

h = Planck constant (6.63×10^{-34} Js)

$$\Rightarrow \quad \Delta x = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 1 \times 10^{-5}}$$

$$= 5.278 \times 10^{-30}\ \text{m.}$$

133. $$5\left[\frac{1}{\sqrt{3}}\right]^2 + 2\left[\frac{2}{\sqrt{3}}\right]^2 - 4\left[\frac{1}{\sqrt{3}}\right]^2$$

$$= \frac{5}{3} + \frac{8}{3} - \frac{4}{2} = \frac{7}{3}$$