Detailed Solutions

Test Booklet Code T 1

1. **(4)** $V = k\frac{\vec{p}.\vec{r}}{r^3} = \frac{k\,pr\cos\theta}{r^3} = k\frac{p\cos\theta}{r^2}.$

2. **(1)** Here, $u = 0;\ a = \frac{eE}{m};\ v = ?;\ t = t$

$\therefore\ v = u + at = 0 + \frac{eE}{m}t$

de-Broglie wavelength, $\lambda = \frac{h}{mv} = \frac{h}{m(eEt/m)} = \frac{h}{eEt}$

Rate of change of de-Broglie wavelength

$$\frac{d\lambda}{dt} = \frac{h}{eE}\left(-\frac{1}{t^2}\right) = \frac{-h}{eEt^2}$$

3. **(3)** $\vec{r} = 2t^2\hat{i} + 3t\hat{j} + 4\hat{k}$

$$\therefore\ \vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(2t^2\hat{i} + 3t\hat{j} + 4\hat{k}) = 4t\hat{i} + 3\hat{j}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}(4t\hat{i} + 3\hat{j}) = 4\hat{i}$$

$\therefore\ \vec{a} = 4\,ms^{-2}$ along x-direction

4. **(3)** By Gauss's theorem, $\phi = \frac{Q_{in}}{\epsilon_0}$

Thus, the net flux depends only on the charge enclosed by the surface. Hence, there will be no effect on the net flux if the radius of the surface is doubled.

5. **(3)** The trailing zero(s) in a number with a decimal point are significant.

6. **(3)** Electric field between plates given by, $E = \frac{q_1 - q_2}{2A\epsilon_0}$

(Here, $q_1 > q_2$)

The, the potential difference will be

$$V = Ed = \frac{q_1 - q_2}{2A\epsilon_0}d = \frac{q_1 - q_2}{2C} \qquad \left(\because\ C = \frac{\epsilon_0 A}{d}\right)$$

7. **(2)**

8. **(2)**

9. **(3)** Mass (m) = 0.3 kg $\Rightarrow$ F = m.a = – 15 x

$$a = -\frac{15}{0.3}x = \frac{-150}{3}x = -50x$$

$a = -50 \times 0.2 = 10\,m/s^2$

10. **(1)**

11. **(4)** The magnetic field at any point on the closed loop is due to all the three currents, but line integral of i_3 over the closed loop will be zero.

12. **(2)** Magnetic intensity on end side -on position is twice than broad side on position.

13. **(4)** $\phi = BA\cos\theta = 2.0 \times 0.5 \times \cos 60^\circ$

$$= \frac{2.0 \times 0.5}{2} = 0.5 \text{ weber.}$$

14. **(1)** According to Newton's second law of motion $a = \frac{F}{m}$

i.e. magnitude of the acceleration produced by a given force is inversely proportional to the mass of the body. Higher is the mass of the body, lesser will be the acceleration produced i.e. mass of the body is a measure of the opposition offered by the body to change a state, when the force is applied i.e. mass of a body is the measure of its inertia.

15. **(4)** Though an equal and opposite force acts on the road but since road does not undergo any displacement, hence no work is done on the road.

16. **(3)** Apply conservation of momentum,

$$m_1v_1 = (m_1 + m_2)v;\ v = \frac{m_1 v_1}{(m_1 + m_2)}$$

Here $v_1 = 36$ km/hr = 10 m/s, $m_1 = 2$ kg, $m_2 = 3$ kg

$$v = \frac{10 \times 2}{5} = 4\ m/s$$

$$\text{K.E. (initial)} = \frac{1}{2} \times 2 \times (10)^2 = 100\,J$$

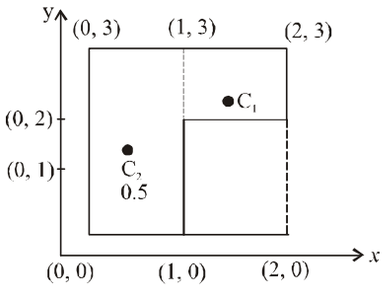
$$\text{K.E. (Final)} = \frac{1}{2} \times (3+2) \times (4)^2 = 40\ J$$

Loss in K.E. = 100 – 40 = 60 J

Alternatively use the formula

$$-\Delta E_k = \frac{1}{2}\frac{m_1 m_2}{(m_1 + m_2)}(u_1 - u_2)^2$$

17. (2)



For given Lamina

$$x \quad y$$

$m_1 = 1, C_1 = (1.5, 2.5)$

$m_2 = 3, C_2 = (0.5, 1.5)$

$$X_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2} = \frac{1.5 + 1.5}{4} = 0.75$$

$$Y_{cm} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2} = \frac{2.5 + 4.5}{4} = 1.75$$

$\therefore$ Coordinate of centre of mass of flag shaped lamina $(0.75, 1.75)$

18. (4)

19. (3) It is applicable to both small and big bodies.

20. (3) When resistance is connected to A.C source, then current & voltage are in same phase.

21. (4)

22. (4)

23. (2) Speed of satellite, $v = \sqrt{\frac{GM}{r}}$

Time, $T = \frac{2\pi r}{v} = \frac{2\pi r}{\sqrt{\frac{GM}{r}}} = 2\pi\sqrt{\frac{r^3}{GM}}$

$$\therefore T_B - T_A = \frac{2\pi}{\sqrt{GM}}\left[r_B^{3/2} - r_A^{3/2}\right]$$

$$= \frac{2\pi}{\sqrt{GM}}\left[(8\times10^6)^{3/2} - (7\times10^6)^{3/2}\right]$$

$$= \frac{2\pi}{\sqrt{6.67\times10^{-11}\times6\times10^{24}}}\times10^9[8^{3/2} - 7^{3/2}]$$

≈ 1300 s

24. (3) Since the circular motion is uniform, therfore there is no change of angular velocity. Thus angular acceleration is zero.

25. (4) Hydraulic machines & lifts are based on

$$P_1 = P_2;\ \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

26. (4) Surface tension = 0.075 N/m; diameter = 30 cm = 0.30 m

$\therefore$ Force = $0.075 \times 0.30 = 0.0225$ N = 2.25×10^{-2}N.

27. (3) Initial diameter of tyre = (1000 – 6) *mm* = 994 *mm*, so

initial radius of tyre $R = \frac{994}{2} = 497mm$

and change in diameter $\Delta D = 6$ *mm* so $\Delta R = \frac{6}{2} = 3$ *mm*

After increasing temperature by $\Delta\theta$ tyre will fit onto wheel

Increment in the length (circumference) of the iron tyre

$$\Delta L = L\times\alpha\times\Delta\theta = L\times\frac{\gamma}{3}\times\Delta\theta \qquad [\text{As } \alpha = \frac{\gamma}{3}]$$

$$2\pi\Delta R = 2\pi R\left(\frac{\gamma}{3}\right)\Delta\theta \Rightarrow \Delta\theta = \frac{3}{\gamma}\frac{\Delta R}{R} = \frac{3\times3}{3.6\times10^{-5}\times497}$$

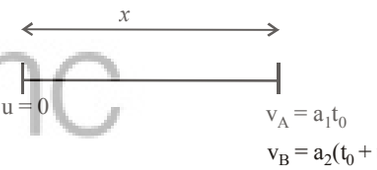
$\Rightarrow \Delta\theta \simeq 500°C$

28. (3) $W = \frac{\pi r_1 r_2}{2} = \frac{\pi\times1\times1}{2} = \pi/2$ J

29. (2)

30. (3) Let time taken by A to reach finishing point is t_0

$\therefore$ Time taken by B to reach finishing point = $t_0 + t$



$v_A - v_B = v$

$\Rightarrow v = a_1 t_0 - a_2 (t_0 + t) = (a_1 - a_2)t_0 - a_2 t$ ...(i)

$x_B = x_A = \frac{1}{2}a_1 t_0^2 = \frac{1}{2}a_2 (t_0 + t)^2$

$\Rightarrow \sqrt{a_1}t_0 = \sqrt{a_2}(t_0 + t) \Rightarrow \left(\sqrt{a_1} - \sqrt{a_2}\right)t_0 = \sqrt{a_2}t$

$\Rightarrow t_o = \frac{\sqrt{a_2}t}{\sqrt{a_1} - \sqrt{a_2}}$

Putting this value of t_0 in equation (i)

$$v = (a_1 - a_2)\frac{\sqrt{a_2}t}{\sqrt{a_1} - \sqrt{a_2}} - a_2 t$$

$$= \left(\sqrt{a_1} + \sqrt{a_2}\right)\sqrt{a_2}t - a_2 t = \sqrt{a_1 a_2}t + a_2 t - a_2 t$$

or, $v = \sqrt{a_1 a_2}\,t$

31. **(1)** The significant result deduced from the Rutherford's scattering is that whole of the positive charge is concentrated at the centre of atom i.e. nucleus.

32. **(2)** As momentum is conserved, therefore,

$$\frac{m_1}{m_2} = \frac{A_1}{A_2} = \frac{v_2}{v_1} = \frac{1}{2}$$

$$\therefore \quad \frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{1}{2}\right)^{1/3} = 1 : 2^{1/3}$$

33. **(1)** To find the refractive index of glass using a travelling microscope, a vernier scale is provided on the microscope.

34. **(1)** For adiabatic process, $V \propto T^{\frac{1}{1-\gamma}}$

And for isothermal process, temperature is constant.

Let $\gamma = 1.5$

then, $V \propto \frac{1}{T^2}$

Hence, (c) is the correct *V*-*T* graph.

Also for adiabatic process, $P \propto T^{\frac{\gamma}{\gamma-1}}$

Let $\gamma = 1.5$

Then, $P \propto T^3$

Hence, (d) is the correct *P*-*T* graph.

35. **(4)** Apply Boyle's law, at constant temperature

$$P \propto \frac{1}{V}$$

36. **(4)**

37. **(1)** Let $x_1 = A\sin(\omega t + \phi_1)$ and $x_2 = A\sin(\omega t + \phi_2)$

$x_2 - x_1 = A[\sin(\omega t + \phi_2) - \sin(\omega t - \phi_1)]$

$$= 2A\cos\left(\frac{2\omega t + \phi_1 + \phi_2}{1}\right)\sin\left(\frac{\phi_2 - \phi_1}{2}\right)$$

The resultant motion can be treated as a simple harmonic motion with amplitude $2A\sin\left(\frac{\phi_2 - \phi_1}{2}\right)$.

Given, maximum distance between the particles

$\therefore$ Amplitude of resultant S.H.M.

$= X_0 + A - X_0 = A$

$$\therefore \quad 2A\sin\left(\frac{\phi_2 - \phi_1}{2}\right) = A.$$

$\Rightarrow \quad \phi_2 - \phi_1 = \pi/3.$

38. **(4)** The speed of sound in liquid,

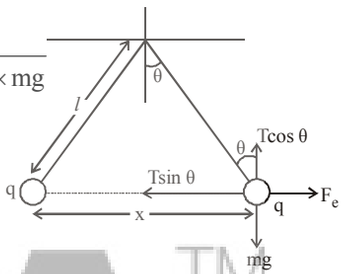
$$v = \sqrt{\frac{k}{\rho}} = \sqrt{\frac{2\times10^9}{8000}} = \sqrt{\frac{1}{4}\times10^6}$$

$$v = \frac{1}{2}\times10^3 = 500\,\text{m s}^{-1}.$$

39. **(4)** In equilibrium, $F_e = T\sin\theta$

$mg = T\cos\theta$

$$\tan\theta = \frac{F_e}{mg} = \frac{q^2}{4\pi\epsilon_0 x^2 \times mg}$$



also $\tan\theta \approx \sin = \frac{x/2}{l}$

Hence, $\frac{x}{2l} = \frac{q^2}{4\pi\epsilon_0 x^2 \times mg}$

$$\Rightarrow x^3 = \frac{2q^2 l}{4\pi\epsilon_0 mg} \therefore x = \left(\frac{q^2 l}{2\pi\epsilon_0 mg}\right)^{1/3} \Rightarrow x \propto l^{1/3}$$

40. **(4)** Kirchhoff's first law is based on conservation of charge and Kirchhoff's second law is based on conservation of energy.

41. **(1)** (A) $\rightarrow$ (4) ; (B) $\rightarrow$ (3) ; (C) $\rightarrow$ (1) ; (D) $\rightarrow$ (2)

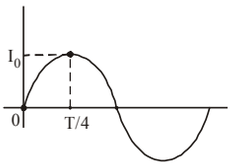
42. **(4)** Mutual inductance between two coil in the same plane with their centers coinciding is given by

$$M = \frac{\mu_0}{4\pi}\left(\frac{2\pi^2 R_2^2 N_1 N_2}{R_1}\right) henry.$$

43. **(4)** We have

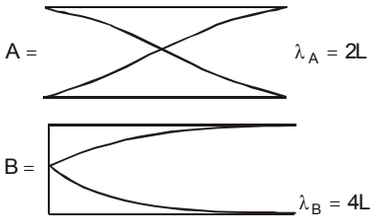
$\omega = 120\pi$

and, $T = \frac{2\pi}{\omega} = \frac{2\pi}{120\pi} = \frac{\pi}{60\pi} = \frac{1}{60}$



So, req. time $= \frac{T}{4} = \frac{1}{240}$ s

44. **(3)** $\frac{\lambda_A}{\lambda_B}=\frac{1}{2} \Rightarrow \frac{n_A}{n_B}=\frac{2}{1}$



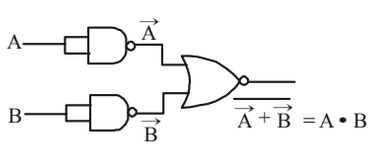
45. **(4)** 20 divisions on the vernier scale
= 16 divisions of main scale
$\therefore$ 1 division on the vernier scale
$= \frac{16}{20}$ divisions of main scale $= \frac{16}{20}\times 1\text{mm} = 0.8\text{ mm}$
We know that least count = 1MSD – 1VSD
= 1 mm – 0.8 mm = 0.2 mm

46. **(4)** $P_2 = P - P_1 = \frac{100}{80} - \frac{100}{20} = -3.75$ D

47. **(4)**

48. **(2)** $^a\mu_g = \tan\theta_P$ where θ_P = polarising angle.
or, $^a\mu_g = \tan 60°$
or, $\frac{c}{v_g} = \sqrt{3}$
or, $v_g = \frac{c}{\sqrt{3}} = \frac{3\times 10^8}{\sqrt{3}} = \sqrt{3}\times 10^8\ \text{ms}^{-1}$

49. **(2)** The equivalent circuit is AND gate.
Output $y = \overline{\overline{A}+\overline{B}} = A.B$



50. **(4)** $n_i^2 = n_e n_h$
$(1.5\times 10^{16})^2 = n_e(4.5\times 10^{22})$
$\Rightarrow \quad n_e = 0.5\times 10^{10}$
or $\quad n_e = 5\times 10^9$
Given $\quad n_h = 4.5\times 10^{22}$
$\Rightarrow n_h >> n_e$
$\therefore$ Semiconductor is p-type and
$n_e = 5\times 10^9\ \text{m}^{-3}$.

51. **(4)** The size of an anion will be larger than that of the parent atom because the addition of one or more electron(s) would result in increased repulsion among the electrons and a decrease in effective nuclear charge.

52. **(2)** A – (r), B – (p), C – (q), D – (s)
For spontaneity, $\Delta H - T\Delta S < 0$

53. **(2)** Number of solute particles going into solution will be equal to the solute particles separating out and a state of dynamic equilibrium is reached.
solute + solvent $\rightleftharpoons$ solution.
i.e., rate of dissolution = rate of unsaturation.

54. **(3)** Formation of CO and CO_2 illustrates the law of multiple proportion that is constant mass of C reacts with different masses of oxygen. These masses here bears simple ratio of 1 : 2.

55. **(2)** We know, $R \propto \frac{\ell}{A}$ or $R = \rho\left(\frac{\ell}{A}\right)$, where proportionality constant ρ is called resistivity. If $\ell = 1$m and $A = 1\text{m}^2$, then $R = \rho$ *i.e.*, Resistance = Resistivity.

56. **(3)** The fourth orbital of nitrogen in all amines contains an unshared pair of electrons. Due to the presence of unshared pair of electrons, the angle C–N–E, (where E is C or H) is less than 109.5°.

57. **(3)** CO_2, SiO_2 are acidic, CaO is basic and SnO_2 is amphoteric.

58. **(1)** Ligands present in the compound are
(i) NH_3
(ii) Cl (chlorido; di prefixed to represent two ligands.)
The oxidation number of platinum in the compound is 2.
Hence, correct IUPAC name is
Diamminedichloridoplantinum (II)

59. **(3)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$
$\therefore \quad K = [NH_3]^2/[N_2][H_2]^3$ .... (i)

$\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$

$$\therefore \quad K' = \frac{[NH_3]}{[N_2]^{1/2}[H_2]^{3/2}} \qquad \text{.... (ii)}$$

Dividing equation (i) by equation (ii), we get

$$K' = \sqrt{K}$$

60. (1) HCl is added before NH_4OH to decrease conc. of $[OH^-]$

61. (2) $m = -l$ to $+l$, through zero thus for $l = 2$, values of m will be $-2, -1, 0, +1, +2$.
Therefore for $l = 2$, m cannot have the value -3.

62. (3) Rate of reaction does not remain constant during the complete reaction because rate depends upon the concentration of reactants which decreases with time.

63. (4) The compound is an aldehyde containing longest chain of 6 C-atoms and side chains.

64. (1) Commercially, acids are reduced to alcohols by converting them to the esters, followed by their reduction using hydrogen in the presence of catalyst (catalytic hydrogenation).

$$RCOOH \xrightarrow[H^+]{R'OH} RCOOR' \xrightarrow[\text{Catalyst}]{H_2} RCH_2OH + R'OH$$

65. (4)

66. (3) Acetone and benzaldehyde both do not react with Fehling's solution.

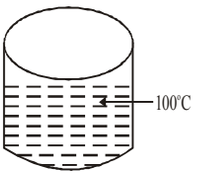
67. (4) The minimum oxidation state in transition metal is equal to the number of electrons in 4*s* shell and the maximum oxidation state is equal to the sum of the 4*s* and 3*d* electrons.
Ti = [Ar] $3d^2 4s^2$
Hence, minimum oxidation state is +2 and maximum oxidation state is +4. Thus, the common oxidation states of Ti are +2, +3 and +4

68. (3) According to molecular orbital theory, bond order of Li_2 is 1 , while in all other cases bond order is 0, so they do not exist. Li_2 molecules are known to exist in the vapour phase.

69. (3) When the proteins are subjected to the action of heat, mineral acids or alkali, the water soluble form of globular protein changes to water insoluble fibrous protein. This is called denaturation of proteins. During denaturation secondary and tertiary structures of protein destroyed but primary structures remains intact.

70. (1) Benzaldehyde undergoes Cannizzaro reaction, which forms benzoic acid and benzylalcohol as the product.

71. (1) 18 g of water at 100°C



10 g of Cu at 25°C is added.

$$q_p = C_{p,m}\,dT$$

$$= 75.32 \times \frac{J}{K\,mol} \times \frac{18g}{18g/mol}(373 - 298)K$$

$$= 75.32\ \frac{J}{K} \times 75\ K = 5649\ J$$

If now 10g of copper is added $C_{p,m} = 24.47$ J/ mol K
Amount of heat gained by Cu

$$= 24.47\ \frac{J}{K\,mol} \times \frac{10g}{63g/mol}(373 - 298)\,K = 291.3\ J$$

Heat lost by water = 291.30 J

$$-291.30\ J = 75.32\ \frac{J}{K} \times (T_2 - 373\ K)$$

$$\Rightarrow -3.947\ K = T_2 - 373\ K$$
$$\Rightarrow T_2 = 369.05\ K$$

72. (4) [A] is 

73. (3) In aqueous solution BA(salt) hydrolyses to give

$$BA + H_2O \rightleftharpoons \underset{\text{Base}}{BOH} + \underset{\text{acid}}{HA}$$

Now pH is given by

$$pH = \frac{1}{2}pK_w + \frac{1}{2}pKa - \frac{1}{2}pK_b$$

substituting given values, we get

$$pH = \frac{1}{2}(14 + 4.80 - 4.78) = 7.01$$

74. (2) Physical state of iodine is different from other halogens as iodine is solid, bromine is a liquid whereas fluorine and chlorine are gases.

75. (2) Pyruvic acid is $CH_3 - \overset{\overset{O}{\|}}{C} - COOH$.

It can be prepared by oxidation of acetaldehyde cyanohydrin.

$$CH_3 - CH = O + HCN \longrightarrow CH_3 - \underset{OH}{\underset{|}{CH}} - CN$$

$$\xrightarrow[H_2O]{H^+} CH_3 - \underset{OH}{\underset{|}{CH}} - COOH \xrightarrow{[O]} CH_3 - \underset{O}{\overset{\|}{C}} - COOH$$

Pyruvic acid

76. **(4)**

77. **(1)** **Reason** is the correct explanation of **Assertion.**

78. **(3)** Bohr model can explain spectrum of any atom or ion containing one electron only (that is H-like species)

79. **(4)** $[Fe(CO)_5]$ (Z=26) O. S. of Fe is zero . Electronic configuaration is [Ar] $3d^6$, $4s^2 4p^0$. After pairing of electrons of *d* and *s* orbitals, we have one *d* atomic orbital empty. C. N. is 5 so hybridisation is dsp^3 which is trigonal bipyramidal.

80. **(2)** If K_c is in the range of 10^{-3} to 10^3 appreciable concentrations of both reactants and products are present.

81. **(1)** Given vapour pressure of pure solvent $(P°) = 121.8$ mm Hg; Weight of solute $(w) = 15$ g

Weight of solvent $(W) = 250$ g; Vapour pressure of solution $(P) = 120.2$ mm Hg and Molecular weight of solvent $(M) = 78$

From Raoult's law $= \frac{P^o - P}{P^o} = \frac{w}{m} \times \frac{M}{W}$

$$\frac{121.8 - 120.2}{121.8} = \frac{15}{m} \times \frac{78}{250}$$

or $$m = \frac{15 \times 78}{250} \times \frac{121.8}{1.6} = 356.2$$

82. **(2)** 7 periods 18 groups.

83. **(4)** Oxidation number of hydrogen when it is bonded to metals in binary compounds is –1.

84. **(3)** The coordination number of central metal atom in a complex is equal to number of monovalent ligands, twice the number of bidentate ligands and so on, around the metal ion bonded by coordinate bonds.

Hence coordination number = no. of σ bonds formed by metals with ligands

85. **(3)** It is S_N1.

86. **(4)**

87. **(3)** Complex formed in ring test is $[Fe(H_2O)_5NO]^{2+}$

88. **(1)** Alkanenitriles (other than methanenitrile) and benzonitrile give ketones with Grignard reagents.

89. **(2)**

$$CH_3 - \underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} - CH = CH_2 \xrightarrow[NaBH_4]{Hg(OAc)_2,\ H_2O} H_3C - \underset{CH_3OH}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} - CH = CH_3$$

(A)
(Markovnikov product)

$$\xrightarrow[B_2H_6]{H_2O_2/OH^-} CH_3 - \underset{CH_3}{\overset{CH_3}{\overset{|}{C}}} - CH_2CH_2 \quad (OH)$$

(B)
(Anti Markovnikov product)

90. **(1)**

91. **(1)** C > B > A: percentage yield.

During nitration process of aniline in strong acidic (HNO_3, H_2SO_4) medium, aniline changes to anilinium ion that can withdraws electron density. Its effect is felt maximum at ortho followed by meta and then para position. Consequently, very little of ortho nitrated product is formed.

92. **(3)** $\Delta G = -nFE^\circ_{cell}$

$$Sn^{2+} + 2e^- \rightarrow Sn \quad \Delta G_1^\circ = +2 \times 0.140 \times F \quad .....(i)$$
$$Sn^{4+} + 4e^- \rightarrow Sn \quad \Delta G_2^\circ = -4 \times 0.01 \times F \quad .....(ii)$$

Subtracting (i) from (ii), we get

$$Sn^{4+} + 2e^- \rightarrow Sn^{2+} \quad \Delta G_3^\circ = -2 \times E^\circ_{Sn^{4+}/Sn^{2+}} \times F$$

$$\Delta G_3^\circ = \Delta G_2^\circ - \Delta G_1^\circ \Rightarrow -2 \times E^\circ \times F = -(0.04 + 0.28) \times F$$

$$E^\circ = 0.16 \text{ volt} = 16 \times 10^{-2} \text{ V}$$

93. (4) $\log_{10}\frac{K_2}{K_1}=\frac{E_a}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$

$T_1=300\text{K}, T_2=309\text{K}$

$$\log_{10}\frac{K_2}{K_1}=\frac{E_a}{2.303R}\left(\frac{1}{300}-\frac{1}{309}\right)$$

$$0.3=\frac{E_a}{2.303\times 8.3}\left(\frac{9}{300\times 309}\right)$$

$$E_a=\frac{0.3\times 2.303\times 8.3\times 300\times 309}{9}=59065.04\text{J/mol}$$

94. (3) Cyclopropylmethyl carbocation is especially stable because of conjugation between the bent orbitals of the cyclopropyl ring and the vacant *p*-orbitals of the cationic carbon.

95. (1) A – (q), B – (p), C – (r), D – (s)

96. (3) Equiv. mass of

$$MnO_4^- =\frac{\text{molar mass}}{7-2}=\frac{\text{molar mass}}{5}.$$

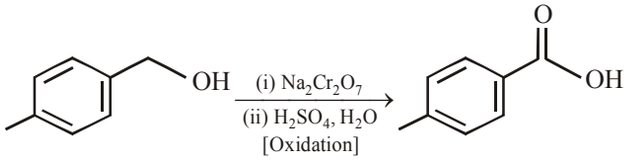
Equiv. mass of

$$C_2O_4^{2-}=\frac{\text{molar mass}}{2(4-3)}=\frac{\text{molar mass}}{2}$$

Meq. of $KMnO_4 = 50\times 5\times 0.04 = 10 =$ meq of $H_2C_2O_4$
$= 50\times 2\times 0.1 = 10.$

97. (1) The ortho and para isomers can be easily separated due to large difference in their melting points. Fluoro compounds are not prepared by electrophillic substitution method due to high reactivity of fluorine.

98. (4)



99. (4) Fuel cells produce electricity with an efficiency of about 70% compared to thermal plants whose efficiency is about 40%.

100. (3) Bond strength ∝ Bond order

Removal of electron from antibonding MO increases B.O. NO and O_2 have valence e^- in π^* orbital.

101. (2) Ratio of the volume of CO_2 produced to the volume of O_2 consumed in respiration over a period of time is known as respiratory quotient.

102. (2) A - III, B - IV, C - II, D - I

103. (4) Bryophytes are known as 'amphibians of plant kingdom'. In their vegetative structure, bryophytes have become adapted to land but they depend on water for sexual reproduction because the swimming habit is retained by their sperms.

104. (3)

105. (4) Two kingdom classification (founded by Linnaeus) worked a long time. But this system did not distinguish between karyotes and prokaryotes, unicellular and multicellular ..ms, photosynthetic and non-photosynthetic organisms. .., classification of organism (into plants and animals) was one and was easy to understand, but a large number of .. did not fall into either category. Hence, the two kingdom ..ation used for a long time was found inadequate.

106. (1) Amphibian species diversity is more in Western Ghat than in Eastern Ghat.

107. (3) Two nucleotides are linked through 3' – 5' phosphodiester linkage to form a dinucleotide. The chromatin that is more densely packed and stains dark is called heterochromatin.

108. (4) ***Kinetochore*** is the portion of the chromosome centromere to which the mitotic spindle fibres (microtubules) attach. It is the location on the centromere where the spindle fibre attaches.

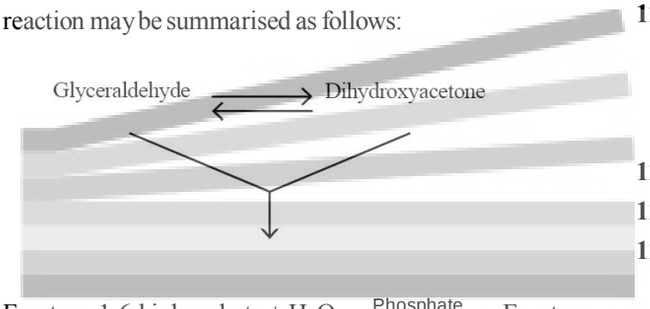
109. (2) A – II; B – I; C – IV; D – III

110. (1) **Primary treatment** of sewage is a physical process and concerned mainly with the removal of coarse solid materials through filtration and sedimentation.

111. (1) Double fertilisation is a characteristic feature of angiosperms. It involves two fusions in which one male gamete fuses with egg cell to form zygote and other male gamete fuses with the diploid secondary nucleus to produce triploid primary endosperm nucleus.

112. (1) Asteraceae is another name of Family Compositae.

113. (2) Glyceraldehyde-3-phosphate also known as triose phosphate, is a chemical compound that occurs as an intermediate is several central metabolic pathways of all organisms. It is an intermediate in photosynthesis. A part of triose phosphate is translocated to cytosol from chloroplast and is utilised for the synthesis of glucose, sucrose etc. The reaction may be summarised as follows:



Fructose-1,6-biphosphate + H_2O $\xrightarrow{\text{Phosphate}}$ Fructose-6-phosphate + PO

Fructose-6, phosphate is then converted into other sugars depending upon plants need.

114. (1) A – II; B – III; C – IV; D – I

115. (4) **Gibberellins (GAs)** are plant hormones that regulate growth and influence various developmental processes, including stem **elongation**, **germination**, **dormancy**, **flowering**, **sex expression**, **enzyme induction**, and **leaf** and **fruit senescence**. GA is also responsible for **bolting** (internode elongation just prior to flowering).

116. (2) Lipids present in the outer and inner side of the bilayer are commonly different, e.g., ***lecithin*** on the outer side and cephalin on the inner side of erythrocyte membrane. peripheral proteins are attached to external surface of bio-membrane. They are absent on the inner side.

117. (4) Four important functional aspects of the ecocystem are (i) productivity (ii) decomposition, (iii) energy flow, (iv) nutrient cycling. Stratification is the occurrence of **vertical zonation** in the ecosystem & indicates the presence of favourable environmental conditions.

118. (3) ***Chrysophytes*** are a group of diatoms, ***golden algae (desmids)*** and ***golden brown*** photosynthetic microscopic protists. Their body is covered by a transparent siliceous shell.

119. (1) A – II; B – III; C – I; D – IV

120. (4) The leaves in pteridophyta are small (microphylls) as in selaginella or large (macrophylls) as in ferns.

121. (3) The outer covering of endosperm separates the embryo by a proteinous layer called **aleurone layer**. The embryo is small and situated in a groove at one end of the endosperm. It consists of one large and shield shaped cotyledon known as **scutellum** and a short axis with a **plumule** and a **radicle**. The plumule and radical are enclosed in sheaths which are called **coleoptile** and **coleorhizae** respectively.

122. (2) Endodermis or innermost layer of cortex has casparian strips in roots. It is called starch sheath in dicot stems. It separates cortex from stele. The cell walls are thickened at the corners in angular collenchyma.

123. (4) A – II; B – III; C – IV; D – I

124. (3) **125. (2)**

126. (1) Glycocalyx or mucilage is the outermost coating of bacterial cells/cell wall which is rich in polysaccharides. A thick and tougher mucilage is called capsule which gives gummy or sticky trait to cells. It protects the cells from dessication, toxins and preventing attachment to foreign invaders.

127. (4) Auxins inhibit the growth of axillary buds and promote apical dominance. It induces parthenocarpic development of fruits and such fruits are seedless and auxin is also responsible for phototropism and geotropisms. Ripening and maturity of fruits are related to ethylene.

128. (2) Okra is a member of family Malvaceae.

129. (1) Cytokinins are mildly basic growth hormones which are usually amino purine derivatives and promote cell division in plants. **Cytokinins** inhibit **apical dominance** while **auxins** promote **apical dominance**.

130. (1) C_4 pathway is an adaptation of tropical plants to reduce/avoid the photorespiratory loss. In C_4 pathway, first acceptor of CO_2 is a 3 carbon compound - phosphoenol pyruvate.

131. (1) One cell produces 4 daughter cells after meiotic division. Thus, for the formation of 100 pollen grains, $\frac{100}{4} = 25$ PMC are needed and each will undergo one reduction/meiotic division.

132. (3) Brood parasitism in birds is an interesting example of parasitism in which the parasitic bird lays its eggs in the nest of its host and the host incubates them.

133. (1) A – II; B – I; C – IV; D – III

134. (2) Reproduction refers to the production of progeny possessing features more or less similar to those of parents. The fungi, the filamentous algae, the protonema of mosses, all easily multiply by fragmentation.

135. (1) Net primary productivity is the rate of organic matter build up or stored by producers in their bodies per unit time and area. Net productivity is equal to gross primary productivity minus loss due to respiration and other reasons. Rate of increase in energy containing organic matter or biomass by heterotrophs or consumers per unit time and area is known as secondary productivity.

136. (1) The first mRNA codon to specify an amino acid is always AUG. A DNA strand with the sequence TAC will corresponds to the first amino acid *i.e.*, AUG. On DNA strand A always pairs with T while on RNA strand A always pairs with U.

137. (3) Diplotene is the longest and the most active sub-phase of prophase I of meiosis. In diplotene, the homologous chromosomes separate due to repulsion as the nucleoprotein complex of synapsed chromosomes dissolves, but are yet held by chiasmata.

138. (1) A – IV, B – I, C – II, D – III

139. (4) The oxygen obtained from cellular respiration combines with the hydrogen obtained from the oxidation of organic molecules to form water.

140. (4) **141. (4)**

142. (4) The criteria must a molecule fulfil to act as genetic material is it should be chemically and structurally stable and do not allow show mutation.

143. (1) Meiosis I is known as reductional division due to reduction in the number of chromosomes. Meiosis II is called equational division because of maintaining the same number of chromosomes.

144. (2) A – I, B – III, C – II, D – IV

145. (4) All the given statements are the function of anther.

146. (3) The order and sequence of amino acid are defined by the sequences of bases in the mRNA.

147. (2) Axillary buds are present in the axils of leaves and are capable of forming a branch or a flower.

148. (4) Biological classification is the scientific arrangement of organisms in a hierarchial series of groups and subgroups on the basis of similarities and differences in their traits. It helps in building evolutionary pathways and in identifying new organisms.

149. (1) A-III; B-IV; C-I; D-II

150. (2)

- The stroma of chloroplast contain enzymes for reduction or fixation of CO_2. Assimilatory power (ATP and $NADPH_2$) is mainly produce in light reaction in the thylakoid membrane.
- Photosynthesis mostly occur in mesophyll cells (ground tissue) of leaves.

151. (2) The part of fallopian tube closest to the ovary is infundibulum. Infundibulum possess finger-like projections called fimbriae that help in collection of ovum after ovulation. It leads to wider part of oviduct called ampulla. The last part of oviduct is isthmus that has a narrow lumen and joins the uterus.

152. (1) A – IV, B – II, C – III, D – I

153. (4) The squamous epithelium is made of a single thin layer of flattened cells. They are present in the walls of blood vessels and air sacs lungs.

154. (1) A – I; B – II; C – III; D – IV

155. (1) At the point of fusion of ilium, ischium and pubis, there is a cavity called acetabulum to which the thigh bone articulates.

156. (2) In normal person, the normal blood pressure is ***120/80 mm Hg***. The normal systolic (pumping) pressure is 120 mm Hg and normal diastolic (resting) pressure is 80 mm Hg.

157. (1) Oral administration of small doses of either progestogens or progestogen–estrogen combinations (in the form of pills) is one of the contraceptive methods used by the females.

158. (1)

159. (4) The cell mediated immunity inside the human body is carried out by T-lymphocyles.

160. (1) Filariasis is caused by *Wuchereria bancrofti*. It is a filarial worm. It causes chronic inflammation of the organs.

161. (2) ***Aldosterone*** and ***ADH*** maintains the volume of urine. Aldosterone, produced by the adrenal cortex, causes the retention of water in the body by increasing the levels of sodium and potassium ions in the blood, which causes the body to reabsorb more water. Antidiuretic hormone (ADH) produced by the hypothalamus and released by the posterior pituitary, causes more water to be retained by the kidneys when water levels in the body are low.

162. (1) Both assertion and reason are correct but reason is not the correct explanation of assertion.

163. (2) The higher the concentration of agarose, the smaller will be the pore size. The DNA fragments separate according to their size through the agarose gel, with smaller fragments moving farther away as compared to large ones. The DNA fragments can be visualised by staining them with ethidium bromide followed by exposure to UV radiations.

164. (3) The ascending loop of Henle is permeable for sodium.

165. (2) A – II; B – I; C – III, D - IV

166. (3) Total lung capacity (TLC) is the total volume of air in the lungs after a maximum inspiration.
(RV + ERV + TV + IRV or VC + RV).

167. (3) Statements (i), (ii) and (iii) are the main functions of cerebrum. Cerebrum is the largest and most highly developed part of the human brain. The outer portion of the **cerebrum** is covered by a thin layer of **gray tissue** called the cerebral cortex. It is divided into right and left hemispheres that are connected by the corpus callosum. (iv) Cerebrum controls the hearing and sense of smell through the temporal lobe.

168. (4) Restriction enzymes and DNA ligases are used to make a stable recombinant DNA molecule, with DNA fragments that has been spliced together from two different organisms.

169. (4) Both the statements are correct.

170. (1) Phylum hemichordata consists of a small group of worm-like marine animals with organ system level of organization. They are bilaterally symmetrical, triploblastic and coelomate animals. Excretion takes place through proboscis gland.

171. (4) Anal style is a pair of short, thread-like structure present in males only. In both sexes, the 10th segment bears of pair of jointed filamentous structures called anal cerci.

172. (3) A – III; B – IV; C – I; D – II

173. (1) Endonuclease are restriction enzymes which cut the DNA internally.

174. (2)

175. (2) Resting membrane potential is determined by the uneven distribution of ions between the inside and the outside of the cell and by the different permeability of the membrane to different types of ions.

176. (4) Gel electrophoresis is used for separation of DNA fragments according to their size.

177. (4) Cockroach intake the food after grounding it by its **mandibles** and **gizzard**.

178. (4)

179. (3) Chikungunya is caused by virus.

180. (1)

181. (2) The DNA fragments separate according to their size through the agarose gel, with smaller fragments moving farther away as compared to large ones. The DNA fragments can be visualised by staining them with ethidium bromide followed by exposure to UV radiations.

182. (1) The signals for child birth (parturition) originate from the fully matured foetus and placenta which induce mild uterine contractions called **foetal ejection reflex**.

183. (1) When CO_2 compines with Hb then carbomino haemoglobin is formed.

184. (4) Receptors for protein hormone are found on the ***cell surface***.

185. (3) The gene gun was invented by John C. Sanford with Edward Wolf. A gene gun can be used to genetically infect cells or whole organisms with foreign DNA by aiming the barrel of the gun and firing. The microshot projectiles in the biolistic gene gun are made of microscopic (or nano) sized gold or platinum powders. These expensive powders are soaked in DNA or RNA (in raw or plasmid form) that are engineered for insertion into the genome of the cells or organisms under the gun. This method is used for transformation in plant cells.

186. (2)

187. (1) The genetically modified brinjal in India has been developed for insect resistance. *Bt*-cotton is a transgenic brinjal that is developed by inserting a crystal gene from the *Bacillus thuringiensis* into the cotton genome.

188. (2) Thyroid gland is an import gland that releases thyroid hormones like thyroxine (T4) and triirodothyronine (T3) into the blood stream. Iodine deficiency causes thyroid enlargement that result into goitre. Growth hormone secreted by Anterior pituitary
Corpus leutum secreted Progesterone
Oxytocin is secreted by Posterior pituitary

189. (3) PCR is a technique for enzymatically replicating DNA without using a living organism such as *E. coli* or yeast. The correct steps shown in the above figure are:
A – Denaturation at a temperature of about 94° to 98°C. During the denaturation, the double stranded DNA

open to single stranded DNA, and all enzymatic reactions stop.

B – Annealing (binding of DNA primer to the separated strands. Occurs at 50° to 65°C, which is lower than the optimal temperature of the DNA polymerases)

C – Extension or elongation of the strands using the DNA primer with heat-stable DNA polymerases, most frequently *Taq* (*Thermus aquaticus*) at 72ºC.

190. (3)

191. (4) Gastric ulcer, emphysema, lung cancer and bronchitis are associated with smoking nicotine.

192. (1) A-III; B-II; C-I; D-IV

193. (2) Injecting microbes during immunization induces active immunity. Colostrum secreted from the mother during the initial days of lactation has abundant antibodies (IgA) to protect the foetus. This protection provides passive immunity.

194. (1) Intra-uterine device (IUD), Copper-T is plastic or metal object placed in the uterus by a doctor. Copper-T prevents the fertilisation of the egg or implantation of the embryo.

195. (3) Hormones are secreted by endocrine glands directly into the blood. They are not used again and again like catalyst.

196. (1) Placenta secretes hCG and hPL during pregnancy while it secrete relaxin during later stages of pregnancy.

197. (1) A – IV; B – III; C – I; D – II

198. (2) It is not always possible that allergy will transfer from parents to their offspring. Some allergies are mild and therefore become dominant in next generation.

199. (4) Renal calculi is presence of stones or insoluble mass of crystallised salts (oxalates) formed with in the kidneys.

200. (4) Transgenic Rosie is actually cow. Restriction enzymes cut the DNA at specific sites.