Physics

1. **(c)** Activity is given by slope of the graph, higher activity implies shorter mean life.

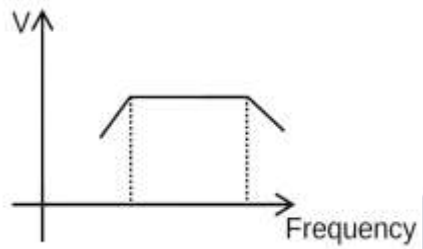
Slope of A is greatest ⇒ higher activity ⇒ shorter mean life

2. **(b)** As temperature increases, the number density of charge carriers increases according to the equation

$n = CT^{3/2}e^{(-E_2KT)}$

Thus, as temperature increases, the number density of charge carriers increases resulting in increased conductivity of semiconductors.

3. **(d)** The frequency response curve of the transistor amplifier shows that the voltage gain of a transistor amplifier is constant at mid frequency range only. It is low at high and low frequencies.



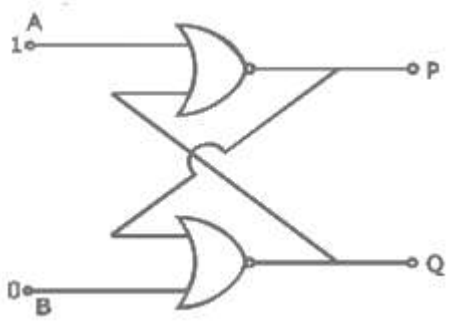
4. (**d**)

For both NOR gates

Output: $Y = \overline{A + B}$

For gate 1; $A = 1 \ \therefore \ P = 0$

For gate 2; $B = 0 \ \therefore \ Q = 1$



5. (**c**)

$C = f\lambda$

$\lambda = c/f = \frac{3 \times 10^8}{5 \times 10^6} = \frac{3}{5} \times 10^2 = 60 \text{ m}$

$\therefore$ Antenna length $= \frac{\lambda}{4} = \frac{60}{4} = 15 \text{ m}$

6. (**c**)$T = 2\pi\sqrt{\frac{I}{MB}}$

$$2 = 2\pi\sqrt{\frac{8\times10^{-6}}{5\times10^{-2}\times B}}$$

$\Rightarrow B = 1.6\times10^{-4}\ T$

7. (c)

Magnetic field inside a toroid

$B = \mu_0 NI$

Magnetic energy density inside the toroid

$$= \frac{B^2}{2\mu_0}$$
$$= \frac{\mu_0^2\ N^2I^2}{2\mu_0}$$
$$= \frac{\mu_0\ N^2I^2}{2}$$
$$= \frac{4\pi\times10^{-7}\times(500)^2\times2^2}{2}$$
$$= 0.628\ J/m^3$$

8. (a) Induced emf.: $\varepsilon = \ell.(\vec{V}\times\vec{B})$

$= (BV\sin\theta)\ell$
$= BV\ell$

$\therefore$ Induced current: $I = \frac{\varepsilon}{R}$

$\therefore$ If the straight wire is replaced by a semicircular wire resistance remain the same, therefore current remains same

9. (c) Time period: $T = \frac{1}{f} = \frac{1}{50}\sec$

Time taken by current to reach peak value in Ac $= \frac{T}{4}$

$$\Rightarrow \frac{T}{4} = \frac{1}{50\times4} = \frac{1}{200}$$

$= 5\times10^{-3}\ S$

10. (b)

As evident from question

$V_L = V_C$

$\Rightarrow$ Circuit is purely resistive

$\therefore\ V = 220\ V$

Also; $I = \frac{V}{R} = \frac{220}{100}$

$\Rightarrow\ I = 2.2\ A$

11. (d) Electric field: $E = \frac{V}{d}$

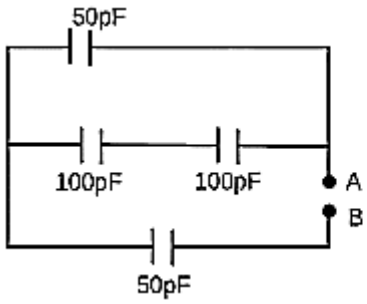
$V \rightarrow$ Potential difference

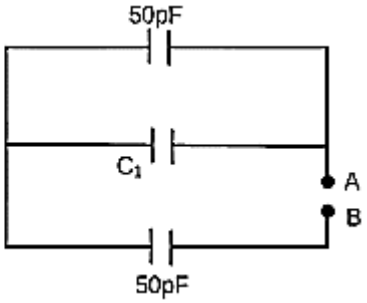
$d \rightarrow$ separation between plates

$\therefore \quad E = \frac{30 - (-10)}{2 \times 10^{-2}}$

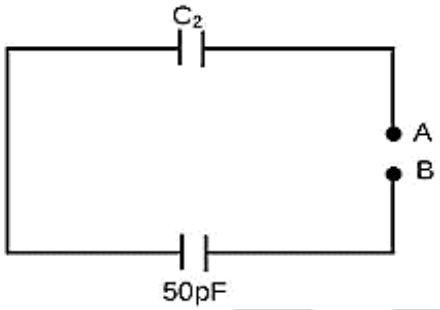
$\therefore \quad E = 2000\ V/m$

12. (a)





$\Rightarrow \quad C_1 = \frac{100 \times 100}{100 + 100} = 50pF$



$C_2 = 50 + C_1$

$= 50 + 50$

$= 100pF$

Now; C_2&50pF are in series across AB

$\therefore C_{AB} = \frac{50 \times 100}{50 + 100} = \frac{5000}{150}$

$\therefore \quad C_{AB} = \frac{100}{3} pF$

13. (d) Let the common potential attained by the two capacitor be " V_c "

$\therefore \quad V_c = \frac{\text{Totalcharge}}{\text{Total capacitance}} = \frac{Q + 0}{C + 2C}$

$\Rightarrow \quad V_C = \frac{Q}{3C}$

$\therefore$ Final charge on capacitors

$$Q_1 = CV_c = \frac{CQ}{3C} = \frac{Q}{3}$$

$$Q_2 = 2CV_c = \frac{2Q}{3}$$

14. (c) Current: $I = neAV\,d_d$

The large value of I is due to number density of free electron in a conductor (n),

Which is of the order of $n = 10^{28}$ per m^3

15. (b) Resistance of wire: $R = \frac{\rho L}{A}$

$\rho \rightarrow$ resistivity of wire

$$\text{Area: } A = \frac{\text{Volume}}{\text{Length}} = \frac{V}{L}, \text{ Volume } = \frac{\text{Mass}}{\text{Density}} = \frac{m}{d}$$

$$\Rightarrow R = \rho d \frac{L^2}{m}$$

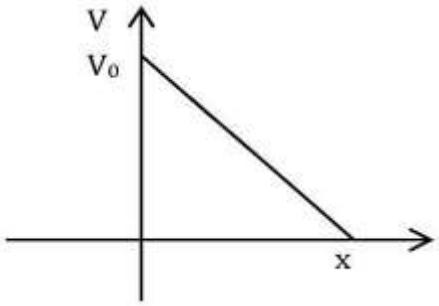
$$\Rightarrow R \propto \frac{L^2}{m}$$

$$\therefore R_1 : R_2 : R_3 = \frac{L_1^2}{m_1} : \frac{L_2^2}{m_2} : \frac{L_3^2}{m_3} = \frac{5^2}{1} : \frac{3^2}{3} : \frac{1^2}{5}$$

$$\therefore R_1 : R_2 : R_3 = 125 : 15 : 1$$

16. (c) By principle of Homogeneity; Addition & subtraction of physical quantities having different dimensions is not possible

17. (d) The equation for the given graph can be written as.



$$V = -mx + V_0 \quad \ldots\ldots(1)$$

m $\rightarrow$ slope of graph which is -ve

$V_0 \rightarrow$ Intercept of line which is +V and a constant

$$\therefore a = \frac{dv}{dt} = -m\frac{dx}{dt} + \frac{d}{dt}V_0$$

$$\Rightarrow a = -mV + 0$$

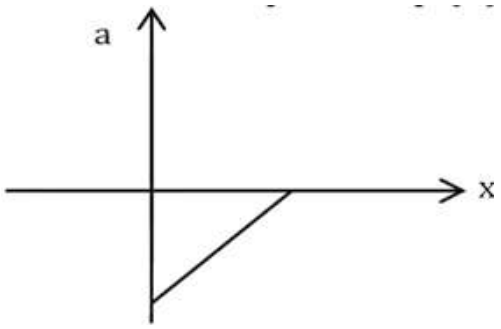
But from eq (1)

$$a = -m(-mx + V_0)$$

$$\Rightarrow a = +m^2x - mVV_0 \quad \ldots\ldots\ldots(2)$$

$\therefore$ Slope for given eq. (2): +Ve

Intercept for eq. (2): -Ve



18. (a) Given; $y = x - \frac{2x^2}{5}$

Comparing with standard equation of trajectory

i.e. $y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$

$\therefore \tan\theta = 1$

$\Rightarrow \theta = 45°$

Also $\frac{g}{2u^2\cos^2\theta} = \frac{2}{5}$

$$\Rightarrow \frac{g}{2u^2 \times \frac{1}{2}} = \frac{2}{5}$$

$$\Rightarrow u = 5\ m/s$$

19. (a) $\vec{F} = -3\hat{i} + 4\hat{j}$

$$\Rightarrow \vec{a} = \frac{\vec{F}}{m} == \frac{-3}{5}\hat{i} + \frac{4}{5}\hat{j}$$

$$\Rightarrow a_x = \frac{-3}{5}$$

At $t = 0; V_0 = 6\hat{i} - 12\hat{j}$

$\therefore V_{ox\ at} = 0 = 6$

For body to have velocity only along y-axis, velocity along x-axis should be zero

$\therefore V_x = V_{ox} + a_x t$

$$0 = 6 - \left(\frac{3}{5}\right)t$$

$$\Rightarrow t = 10sec$$

20. (d) Linear momentum always remains conserved for any type of collision

21. (c) For head on collision impact parameter is zero as it retraces its path

22. (b) Time period of revolution; $T = \frac{2\pi r}{V}$

$\therefore$ frequency; $f = \frac{V}{2\pi r}$

Also; $V \propto \frac{1}{n}$

And $r \propto n^2$

(By Bohr's model)

$\therefore f \propto \frac{1}{n^3}$

23. (c) By absorbing 10.2 eV electron goes to 2^{nd} orbit, ie $n = 2$

$\therefore$ Angular momentum increased by

$$L_2 - L_1 = \frac{2h - h}{2\pi}$$

$$= \frac{h}{2\pi} = \frac{6.6 \times 10^{-34}}{2 \times 3.14} = 1.05 \times 10^{-34} JS$$

24. (a)

$_{90}Th^{232} \longrightarrow {}_{82}Pb^{208}$

Hence; Mass number changes by 24 this implies 6α particles are emitted as 1 ∝ particle emitted decreases mass number by 4 , then proton number should decrease by 12 , but change in proton number is by 8 only, this implies 4β particles have been emitted.

25. (a) As separation is less than 10 nm , therefore $F_e >> F_n$ as nuclear force is short range force.

26. (a) Initially both A & B are at rest, hence initial momentum is zero, Also no external force is acting on the two particles as they are moving under mutual attraction so final momentum should also be zero, by conservation of linear momentum.

$\therefore V_{com} = 0$, as mass cannot be zero

27. (d) Angular momentum $= mvr$

Here r is perpendicular distance of particle from reference point i.e. 0 , so as m, v, r are constant for position A & B.

$\therefore$ Angular momentum remains constant.

28.(c) We known that escape velocity

$V_e = \sqrt{2}\, V_0$

$V_0 \rightarrow$ orbital velocity

When satellite is in orbit; $K = \frac{1}{2}mv_0^2$

$\therefore$ Kinetic energy required to escape; $K' = \frac{1}{2}mv_e^2 = mv_0^2 = 2K$

$\therefore$ Extra Kinetic energy $= 2K - K = K$

29. (c) Let L be the length and r be the radius of wire.

$\therefore$ Volume: $V = \pi r^2 L$

Differentiating both sides

$\Delta V = \pi(2r\Delta r)L + \pi r^2 \Delta L$

As volume remains unchanged $\therefore \Delta L = 0$

$\therefore\ 0 = 2\pi rL\Delta r + \pi r^2 \Delta L$

$\therefore\ \dfrac{\Delta r/r}{\Delta L/L} = \dfrac{-1}{2}$

$$\text{Poisson's ratio } = \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$$
$$= -\frac{\Delta r/r}{\Delta L/L} = \frac{1}{2}0.5$$

30. (c)

$V_x = \sqrt{2gh}(h = 2 \times 10^{-2})$

$= \sqrt{2 \times 10 \times 2 \times 10^{-2}}$

$= \sqrt{\dfrac{4}{10}} = \sqrt{\dfrac{2}{5}}$

$H = 8 \times 10^{-2}$ m

$g = 10\ m/s^2$

$\therefore t = \sqrt{\dfrac{2H}{g}}$

$t = \sqrt{\dfrac{2 \times 8 \times 10^{-2}}{10}}$

$t = \dfrac{2}{5\sqrt{10}} sec$

$\therefore$ Maximum horizontal distance; $x = v \times t = \sqrt{\frac{2}{5}} \times \frac{2}{5\sqrt{10}} = \frac{2\sqrt{2}}{5\sqrt{50}} = \frac{2}{25}\ m = 8\ cm$

31. (d)

By Brewster's law; $n = \tan\theta p$

Also; $n = \dfrac{\sin i}{\sin r}$

But $\dfrac{\sin i}{\sin r} = \dfrac{1}{\text{Slope}}$

$$n = \frac{\sin i}{\sin r} = \frac{1}{\tan 30^\circ} = \sqrt{3}$$

$$n = \tan \theta_p = \sqrt{3}$$

$$\therefore \ \theta_p = \tan^{-1} \sqrt{3}$$

$$\therefore \ \theta_p = 60^\circ$$

32. (a) We know that

$$\Delta x = \frac{\lambda}{2\pi} \Delta\phi$$

$$\therefore \ \frac{\lambda}{3} = \frac{\lambda}{2\pi} \Delta\phi$$

$\therefore$ Phase difference; $\phi = \frac{2\pi}{3}$

$\therefore$ Intensity; $I = I_0 \cos^2 \phi$

$$\therefore \ I = K \cos^2 \left(\frac{2\pi}{3}\right)$$

$$I = K \left(\frac{-1}{2}\right)^2$$

$$I = \frac{K}{4}$$

33. (d)

Doppler shift: $\frac{\Delta\lambda}{\lambda} = \frac{V}{C}$

$$\therefore \ V = \frac{\Delta\lambda}{\lambda} . C$$

$$\therefore \ V = \frac{0.1}{6000} \times 3 \times 10^8$$

$$\therefore \ V = 5 \text{ km/s}$$

34. (c) Magnetic force on moving electron:

$$F = -e(V_0 \hat{i} \times B_0 \hat{j})$$

$$\Rightarrow \ F = -eVV_0 \ B_0 \hat{k}$$

So, Force is perpendicular to both $\vec{V}$&$\vec{B}$ so the magnitude of V will not change it means momentum will not change.

Now; by De - Broglie

$$\lambda = \frac{h}{mv} = \frac{h}{p}$$

$\therefore$ As momentum remains constant

$\Rightarrow$ De Broglie wavelength remains constant

35. (a) We know that photo electric current is directly proportional to the intensity of light, given that incident frequency is greater than threshold frequency.

$\therefore$ When intensity is doubled.

⇒ Photo electric saturation current doubles

36. (d) Force of interaction between two charges $q_1 \& q_2$ will be maximum when

$$q_1 = q_2 = \frac{2Q}{2} = Q$$

$$\therefore \frac{Q}{q_1} = \frac{Q}{Q} = 1$$

37. (d) Velocity gained after moving a distance y :

$$V^2 = u^2 + 2ay$$

Here; $u = 0$

$$F = qE$$

$$ma = qE$$

$$\Rightarrow \quad a = \frac{qE}{m}$$

$$\therefore \quad V^2 = 0 + 2\left(\frac{qE}{m}\right)y$$

$\therefore$ Kinetic energy

$$E = \frac{1}{2}mv^2$$

$$E = \frac{1}{2} \times m \times \left(2 \times \frac{qE}{m} \times y\right)$$

$$E = qEy$$

38. (c) An electric dipole in non-uniform electric field generally experiences a force and a torque.

39. (a) In region A, $V \rightarrow$ constant $\therefore \ E_A = 0$ as $E = \frac{dV}{dx}$

In region B, $E_B = \frac{4-2}{2} = 1 v/m \Rightarrow E_B = 1 \ V/m$

In region C, $V \rightarrow$ constant $\Rightarrow \ Ec = 0$

In region D, $E_D = \frac{4-2}{1} = 2 \ V/m \ \Rightarrow \ E_D = 2 \ V/M$

$\therefore \ E_A = E_C \& E_D > E_B$

40. (d) Potential energy of system of 2 charges

$$U = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r}$$

$r \rightarrow$ separation between 2 charges $q_1 \& q_2$

If both charges are of same type, then on increasing the separation, potential energy decreases.

If the charges are of opposite type, then on increasing separation, potential energy increases.

41. (c) In a cyclotron a charged particle experiences electric force between the dees and a magnetic force inside the dees while circulating, hence it always experiences a force and hence acceleration.

42. (a) Current sensitivity: $S_I = \frac{\phi}{I} = \frac{NBA}{K}$

Voltage sensitivity: $S_v = \frac{\phi}{V} = \frac{NIBA}{KV} = \frac{NBA}{KR}$

When we triple " N " then R is also tripled

Hence;

$\frac{\phi}{I} \rightarrow$ becomes 3 times

But

$\frac{\phi}{V} \rightarrow$ Remain unchanged

43. (b) Even when the coil is rotated, about an axis perpendicular to its plane, the potential energy does not change.

Hence, work done is zero

44. (d) Even in case of permanent magnets all the domain are not perfectly aligned due to thermal agitation

45. (d) Coercivity refers to the intensity of magnetic field (B) where the magnets get demagnetized

For solenoid; $B = \mu_0 n I$

n → No of turns per unit length

I → current through each turn

μ0 → Absolute permeability

B → magnetic field in solenoid

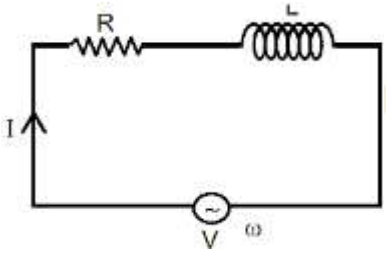
Also $\mu_0 H = \mu_0 nI$

H → intensity of magnetic field

$\therefore\ I = H/n$

$$I = \frac{3 \times 10^3}{\frac{100}{0.1}} = 3\ A$$

46. (a)



$$Z = \sqrt{R^2 + X_L^2}$$

$$Z = \sqrt{R^2 + (\omega L)^2}$$

$$P = I^2 R$$

$$I = \frac{V}{\sqrt{R^2 + \omega^2 L^2}}$$

$$P = \frac{V}{(R^2 + \omega^2 L^2)}$$

47. (b)

$\overrightarrow{E_y} = E_0 \sin(Kx - \omega t)\hat{j}$

$C = \frac{E_0}{B_0}$

$\Rightarrow B_0 = \frac{E_0}{C}$

$\therefore \overrightarrow{B_z} = \frac{E_0}{C}\sin(Kx - \omega t)\hat{k}$

48. (a) The phenomenon involved in the reflection of radio-waves by ionosphere is similar to total internal reflection of light in air during a mirage

49. (b) Focal length $= 2.5$ cm

At $t = 0$, object is at a distance of $x_i = 50$ cm

At $t = 0.25$ object is at a distance of $x_f =$ speed $\times$ time

$= 0.1 \times 0.25$

$= 0.25$ m

$= 25$ cm

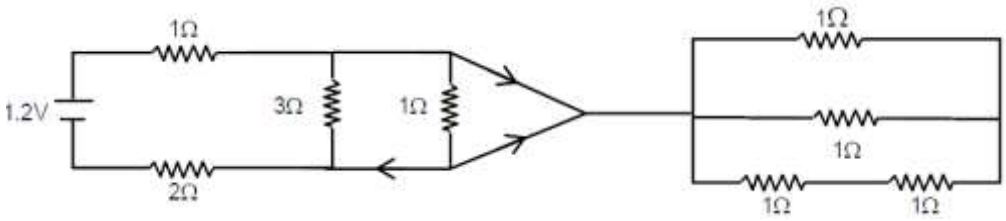
$\therefore$ At $t = 0.25$ image will beat infinity

$\therefore V_{avg} = \frac{\Delta x}{\Delta t} = \infty$

50. (d)

$\delta_{min} = 38°$
$i = \frac{A + \delta}{2}$
$\delta \rightarrow$ deviation
$i \rightarrow$ angle of incidence
$A \rightarrow$ Angle of prism
$\delta = (r_1 + r_2) - A$
$-A = 44 - 104$
$\therefore A = 60°$
$\Rightarrow i = \frac{60 + 38}{2} = 49$

51. (d) The circuit can be redrawn as.



$\therefore R_{eq} = 1 + 2 = 3\Omega$

$$I = \frac{V}{R_{eq}} = \frac{1.2}{3} = 0.4\ A$$

52. (b) Kirchhoff's junction rule is based on conservation of charges.

53. (a) From the given graph, we can form the following equation

$V = E - Ir$

When $I = 0, \Rightarrow E = V = 3\ V$

When $V = 0 \Rightarrow I = 6A$

$$\therefore\ r = \frac{E}{I} = \frac{3}{6} = 0.5\Omega$$

54. (a) Internal resistance of a cell is given by:

$$r = R\left(\frac{\ell_1}{\ell_2} - 1\right)$$

$$r = 2\left(\frac{240}{120} - 1\right)$$

$r = 2 \times 1$

$r = 2\Omega$

55. (a) Here $\theta = 300°$ as can be seen from given diagram

$$\therefore \text{ Number of turns; } n = \frac{300}{360} = \frac{5}{6}$$

$$B = \mu_0 \frac{nI}{2R} = \mu_0 \times \frac{5}{6} \times \frac{I}{2R}$$

$$\therefore\ B = \frac{5\mu_0 I}{12R}$$

56. (c) Buoyancy at 0°C; $F_B = V\rho_0\ g$

Buoyancy at 4°C; $F_B{}' = V\rho 4\ g$

$$\frac{F_B}{F_B{}'} = \frac{\rho_0}{\rho_4}$$

As we know ρ at 4°C is more than ρ at 0°C

$$\therefore \quad \rho_4 > \rho_0$$
$$\Rightarrow \quad F_B < F_B'$$

57. (d)

Work done $= P\Delta V$

Also; work done = area of $\triangle ABC$

$$W = \frac{1}{2}(10 - 5) \times (100 - 400)$$

$W = -750\ J$

58. (b) If at constant pressure, volume is doubled then temperature also gets doubled.

$$T_1 = 300\ K,\ T_2 = 600\ K$$
$$\therefore \quad \Delta T = 600 - 300 = 300\ K$$
$$\therefore \quad Q = nC_p\Delta T = 1 \times \frac{7}{2}R \times 300$$
$$= 1050R$$

59. (c) $f = 0.5$ Hz

$\omega = 2\pi f$

$= 2 \times \pi \times \frac{1}{2}$

$= \pi$

For block to remain in contact with the piston, at amplitude position of SHM

Weight of block = force due to oscillation

$mg = ma$
$mg = m(\omega^2 A)$
$A = \frac{g}{\omega^2} = \frac{10}{\pi^2}$
$\therefore A \cong 1$ m

60. (c) $y = 2\sin\left(\frac{\pi x}{15}\right)\cos(48\pi t)$

$\frac{2\pi}{\lambda} = \frac{\pi}{15}$

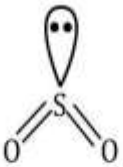
$\Rightarrow \lambda = 30$

$\therefore$ Distance between node & next antinodes

$\Rightarrow \frac{\lambda}{4} = \frac{30}{4} = 7.5$

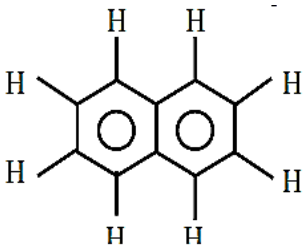
Chemistry

61. (b) By seeing geometry, we can easily find out the net dipole moment $BeCl_2$ & CO_2 have linear geometry, BF_3 has triangular planar geometry with zero dipole moment. While SO_2



geometry is in bent shape.

62. (a) We can find out by drawing structure of Naphthalene



5π bonds

19σ bonds

5,19

63. (a) In the reaction

$CaCO_3(s) \longrightarrow CaO(S) + CO_2(g)$

Here $\Delta n = +1$

$\Delta H = \Delta U + \Delta ng_{gR}$

So, $\Delta H > \Delta U$

64. (b)

$$\overset{+6}{Cr_2}O_7^{2-} \longrightarrow 2\overset{+3}{Cr}$$

Here one mole $Cr_2O_7^{2-}$ requires 6 mole of electrons 0.2 mol requires $\frac{0.2\times6}{1} = 1.2$ mole of electrons.

65. (c) Boric acid is a weak acid it acts as Lewis acid by accepting electrons from OH^- ions.

66. (b) The compound will be more acidic when its conjugate base is more stable. In case of these given compounds, more the electron with drawing group, present more the compound will be more acidic.

67. (c) Sodium metal can be used because when sodium metal reacts with ethanol, H_2 gas is evolved.

$$C_2H_5OH + Na \longrightarrow C_2H_5ONa + \frac{1}{2}H_2$$

68. (d) Reagent A should be such that it reduces aldehyde to alcohol but do not affect double bond. Reagent B should be such that it oxidizes alcohol to aldehyde without affecting double bond. Reagent C should be such that it reduces aldehyde to alcohol and double bond to sigma bond.

PCC & $NaBH_4$ does not affect double bond.

69. (b) Since in question the product is already mentioned. The product formed is chloropropanoic acid

∵ a chlorine atom is also attached to molecule which acts as EWG and increases acidic strength.

70. (d)

$$\underset{(P)}{C_6H_5COCl} \xrightarrow{H_2/Pd-BaSO_4} \underset{(Q)}{C_6H_5CHO}$$

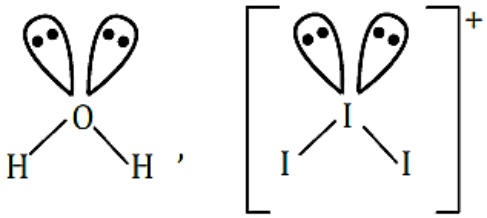
$$C_6H_5CHO \xrightarrow[(2)\,Dil\,HCl]{(1)\,Con.\,NaOH} C_6H_5CHO + C_6H_5CH_2OH$$

71. (c) The reactions that occur in blast furnace during extraction of iron are:

$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

$CaO + SiO_2 \longrightarrow CaSiO_3$

72. (b) The structures of I_3^+ and H_2O are:



They contain 2 lone pair of electrons on central atom.

73. (d)

$2\ F_2(\ g) + 2H_2O(\ell) \longrightarrow 4H^+(aq) + 4\ F-(aq) + O_2(\ g)$

$X_2(\ g) + H_2O(\ell) \longrightarrow HX(aq) + HOX(aq)$

$x = Cl_2$ or Br_2

So, by seeing above reactions we can conclude that F_2 oxidizes H_2O to O_2 but Cl_2 does not.

74. (d)

$$\underset{1:1}{XeF_6} + H_2O \longrightarrow \underset{1}{XeOF_4} + \partial HF$$

0.1 Mole of XeF_6 reacts with 0.1 mol of $H_2O(1.8\ g)$ to give $XeOF_4$

75. (d) Writing equation of reaction of gold with aquaregia

$$\underbrace{Au + 4H^+ + NO_3^{-5} + 4Cl^-}_{\text{aquaregia}} \longrightarrow AuCl_4^- + \overset{+2}{NO} + 2H_2O$$

Here, the oxidation state changes from +5 to +2 .

76. (c) Vitamin K helps in clotting of blood. During injuries when blood flow occurs then, vitamin k is responsible for clotting blood and stopping the blood flow from our body.

77. (a) Nylon-6, the monomer has five methyl groups. $H_2\ N - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - COOH$.

78. (c) Cis-1,4-polyisoprene, which is also called isoprene rubber, is a major ingredient of natural rubber.

79. (a) When soap reacts with hard water containing impurities of calcium and magnesium then scum of insoluble calcium stearate is formed.

$$2C_{17}H_{35}COONa + CaCl_2 \longrightarrow 2NaCl + \underset{\text{insoluble calcium stearate (soap)}}{(C_{17}H_{35}COO)_2\ Ca}$$

80. (b) Brompheniramine is antihistamine. Antihistamines are drugs which treat allergic rhinitis and other allergies.

81. (d) In lanthanoid the electrons are filled in 4 f orbitals, while in halogens they are filled in porbitals and in transition elements, electrons are progressively filled in d-orbitals.

82. (b) Cl^{+4} is an oxidizing agent ∵ it cannot attain oxidation state higher than +4 due to decrease of stability.

83. (d) The given reaction is of chromyl chloride test $4Cl^- + Cr_2O_7^{2-}(s) + 6H^+(\text{conc.}) \rightarrow 2CrO_2Cl_2 + 3H_2O$. When deep red vapours of CrO_2Cl_2 are passed into sodium hydroxide solution, a yellow solution of sodium chromate is formed, which when treated with lead acetate gives yellow precipitate of lead chromate

$CrO_2Cl_2 + OH^- \rightarrow CrO_4^{2-} + 2Cl^- + 2H_2O$

$CrO_4^{2-} + Pb^{2+} \rightarrow PbCrO_4(\downarrow)$ yellow.

84. (c) Zinc contains completely filled d-orbitals and exhibit stable electronic configuration therefore, it's does not easily lose their electrons and hence does not exhibit variable valency.

85. (d) Here CO is the strongest ligand, due to synergic effect of σ&π bond. In this effect some bonds are self-strengthening in nature, when a pi-back donation of electron density occurs from one atomic orbital of one atom to the anti-bonding pi-orbital of another.

86. (a) In a network solid or covalent network atoms are bonded by covalent bonds in continuous network extending throughout the material. In network solid there are no individual molecules and the entire crystal considered as macromolecules.

87. (b) Using formula $d = \frac{zm}{a^3 N_A}$

$$m = \frac{d \times a^3 \times N_A}{z} = \frac{10 \times (200)^3 \times 10^{-30} \times 6 \times 10^{23}}{2} = 2u$$

24 g contains 6×10^{23}

2.4 g will contain 6×10^{22}

88. (b) 1 mole $SrCl_2$ gives 1 cationic valancy 10^{-5} moles of $SrCl_2$ gives 10^{-5} mole cationic valancy.

∴ Number of cationic vacancies in 1 mole of NaCl. When it is doped with 10^{-5} moles of $SrCl_2$ is 6.022×10^{18}.

89. (b) For applying formula of ΔT_f we have to final α,

$$\alpha = \frac{80}{100} = 0.8$$

$$\alpha = \frac{1 - i}{1 - \frac{1}{n}} \Rightarrow \alpha = \frac{1 - i}{1 - \frac{1}{4}}; = \frac{1 - i}{\frac{3}{4}}$$

$i = 0.4$

$\Delta T_f = 0.3$

$$0.3 = \frac{i \times K_f \times w_2 \times 1000}{m_2 \times 100}$$

$$m_2 = \frac{0.4 \times 1.86 \times 2.5 \times 10}{0.3}$$

$m_2 = 62$ g/mol.

90. (c) Acetone-carbon disulphide solution shows positive deviation from Raoult's law. The observed vapor pressure of each component and total, vapor pressure is greater than predicted by Raoult's law. Acetone + Chloroform give negative deviation.

91. (d)

$NaCl + AgNO_3 \longrightarrow NaNO_{3.} + AgCl$

58.5 g 170 143.5 g

(Limiting reagent)

$NaCl: AgNO_3$

Required ratio 58.5: 170

Given ration 11.70: 3.4 (Limiting reagent)

$170 g ANO_3 \longrightarrow 143.5(\ g) AgCl$

$\therefore 3.4 g AgNO_3 \rightarrow x$

$$x = \frac{3.4 \times 143.5}{170} = 2.879$$

92. (c) By de Broglie equation $\lambda_A = \frac{h}{PA}$ and $\lambda = \frac{h}{PB}$

$$\frac{\lambda_A}{\lambda_B} = \frac{P_B}{P_A}$$

But $P_B = \frac{1}{2} P_A$ (Given)

$$\therefore \frac{\lambda_A}{\lambda_B} = \frac{\frac{1}{2} P_A}{P_A} = P_A; \lambda_B = 2 \times \lambda_A$$

$$\lambda_B = 2 \times 5 \times 10^{-8} \text{ m}$$

$$= 10^{-7} \text{ m}$$

93. (c) ∵ As we move from left to right in periodic table, the ionization energy increases and as we move down the table ionization energy decreases as number of shells increases, hence zeffective decreases.

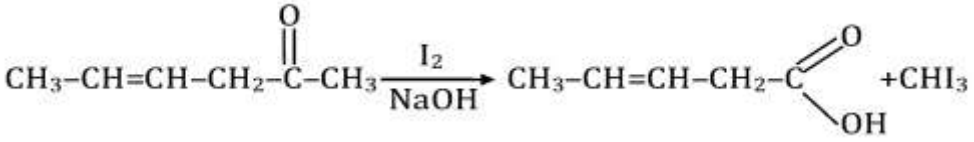
94. (c) Solubility of AgCl is least in $0.1 M AlCl_3$ due to common ion effect.

95. (d) Charles law: $\frac{V}{T} = K$

If we take log on both sides then

$$\log v - \log T = \log K.$$

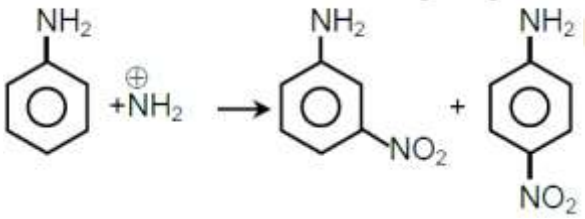
96. (a) $I_2/NaOH$ since the byproduct formed is in gaseous state and hence can be easily separated.



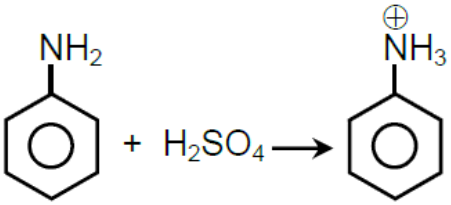
97. (a) $(CH_3)_3 N$ shows no H -Bonding hence it is least soluble.

98. (a)

∵ $HNO_3 + H_2SO_4 \rightarrow NO_2 + SO_2 + H_2O$



In presence of acid, aniline gets protonated to anilinium ion which is meta directing.



99. (a) Nucleic acids and nucleotides are joined by phosphodiester linkage.

A nucleotide has three components nitrogeneous base, a pentose sugar; ribose in case of RNA and deoxyribose in case of DNA. A nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage to form a nucleoside. The nucleotides are linked through 3-5 phosphodiester linkage to form dinucleotide.

100. **(b)** Vitamin A, D, E, K are water insoluble vitamins. While B, C are water soluble vitamins

101. **(d)**

$$\frac{P^0 - P}{P^0} = \frac{w_2}{m_2} \times \frac{m_1}{w_1}$$

$$0.002 = \frac{w_2}{m_2} \times \frac{18}{1000}$$

$$\frac{w_2}{m_2} = 0.11 \text{ mole}$$

$$\text{molality} = \frac{w_2}{m_2} \times \frac{1000}{w_1} = 0.11 \times \frac{1000}{1000} = 0.11 \text{ m}$$

102. **(b)**

$$m = \frac{EIZ}{96500} = \frac{12 \times 1 \times 965}{96500} = 12 \times 10^{-2} \text{ g}$$

$$\text{Molarity} = M = \frac{w_2}{m_2} \times \frac{1000}{vm_1} = \frac{12 \times 10^{-2}}{24} \times \frac{1000}{1000}$$

$$= 0.5 \times 10^{-2} = 5 \times 10^{-3} \text{ m}$$

103. **(d)** We can find the answer by writing equations of electrolysis of $CuSO_4$.

At cathode: $Cu^{+2}(aq) + 2e^- \rightarrow Cu(s)$

At anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Production of H^+ions will decrease PH

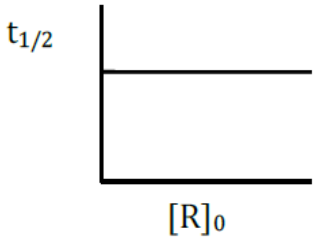
104. **(d)**

$$Mn^{+7} + 3e^- \rightarrow Mn^{4+}$$
$$\Delta G^\circ = -nFE^0 \; \Delta G^\circ = -5 \text{ F}1.5$$
$$Mn^{+4} + 2e^- \rightarrow Mn^{+2} \; \Delta G^\circ = -2 \text{ F}1.2$$

Required equation

$$Mn^{+7} + 3e^- \rightarrow Mn^{4+}$$
$$\therefore -3FE^\circ = -7.5 \text{ F} + 2.4 \text{ F}$$
$$E^\circ = 1.7 \text{ V}$$

105. **(c)** $\because t_{1/2}$ is independent of initial concentration of the reactant and is first order reaction.



106. **(a)** $4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$

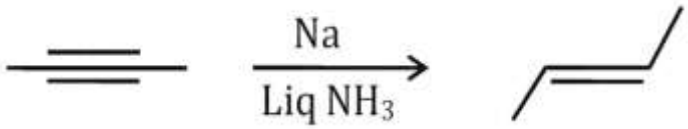
$LiNO_3$ is metal nitrate that librate NO_2 on heating.

107. **(c)** The critical temperature of hydrogen is low hence, cannot be easily liquefied It's combustion is ecofriendly, it does not librate harmful gases on combustion. It has high calorific value.

108. **(c)** ∵ For lone pair nitrogen atom no conjugations of Pi electrons are present hence will not show resonance.

109. **(a)** 2-butyne can be reduced to transbut-2-ene using Na in liq NH_3.

This reaction is called Birch reduction.



110. **(b, d)** Eutrophication refers to excessive increase in minerals and nutrients in aquatic system, resulting in excess of algae growth and reduction in dissolved oxygen.

111. **(d)** $[Pb(CH_3)_4]Cl_2 \rightarrow [Pd(NH_3)_4]^{2+} + 2Cl^-$

It is 1:2 i.e. AB_2 type of electrolyte.

112. **(d)** Formula of penta aquanitrato chromium III nitrate is $[Cr(H_2O)_5(NO_3)](NO_3)_2$.

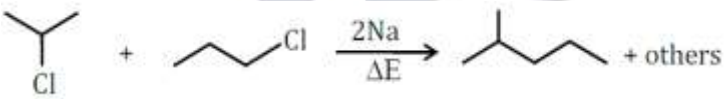
The prefix penta indicates the presence of $5H_2O$ ligands. The names of ligands are written in alphabetical order.

Oxidation state of chromium is written in roman numbers in parenthesis.

113. **(c)** As number of EWG at ortho and para position increases, reactivity towards nucleophilic substitution reaction increases.

114. **(a)**

115. **(d)**



116. **(c)** Lnk v/s $\frac{1}{T}$ graph is a straight-line graph but presence of catalyst will alter the value of Ea.

117. **(b)** For finding rate of reaction we have to write the equation of esterification

$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

$r = k[CH_3COOH][C_2H_5OH]$

Order $= 2$

When equal volumes of two solutions are mixed, concentration of the solutions reduces to half of the initial value. Hence, rate of reaction gets reduced to $\frac{1}{4}$ of initial rate.

118. **(d)** When both reactants and catalysts are in the same phase, then the catalysis is homogeneous.

$2SO_2(g) + O_2(g) \overset{NO(g)}{\rightarrow} 2SO_3(g)$

119. **(b)** Micelles are associated with colloids when the temperature increases above kraft temperature then particles get associated with each other and get into colloidal range called 'micelle'. For formation of micelles, concentration of soap should exceed CMC value.

120. **(a)** In Cu_2O cuprite oxidation state of Cu is +1 .

Cu_2O let oxidation state of Cu is x

$2x + (-2) = 0$

$2x = 2; x = 2/2 \Rightarrow x = +1$

Mathematics

121. **(d)** $\sqrt[3]{y} \cdot \sqrt{x} = \sqrt[6]{(x+y)^5}$

Apply log both side

$\Rightarrow \log\left(y^{1/3} \cdot x^{1/2}\right) = \log(x+y)^{5/6}$

$\Rightarrow \frac{1}{3}\log y + \frac{1}{2}\log x = \frac{5}{6}\log(x+y)$

$\Rightarrow \frac{1}{3y} \cdot \frac{dy}{dx} + \frac{1}{2x} = \frac{5}{6(x+y)} \cdot \left(1 + \frac{dy}{dx}\right)$

$\Rightarrow \frac{1}{3y}\frac{dy}{dx} - \frac{5}{6(x+y)}\frac{dy}{dx} = \frac{5}{6(x+y)} - \frac{1}{2x}$

$\Rightarrow \frac{dy}{dx}\left[\frac{1}{3y} - \frac{5}{6(x+y)}\right] = \frac{5x - 3(x+y)}{6x(x+y)}$

$\Rightarrow \frac{dy}{dx} = \left[\frac{2x-3y}{6x(x+y)}\right]\left[\frac{6y(x+y)}{2x-3y}\right]$

$\frac{dy}{dx} = \frac{y}{x}$

122. **(c)** Check option:

Option (a):

(1) f(x) is continuous function in [1,3]

(2) f(x) is differentiable in (1,3)

Option (b):

(1) f(x) is continuous function in [0,1]

(2) f(x) is differentiable in (0,1)

Option (c):

(1) f(x) is continuous function in $[-2,2]$

(2) f(x) is not differentiable at point $x = 0$ in $(-2,2)$

Option (d):

(1) f(x) is continuous function in [2.5, 2.7]

(2) f(x) is differentiable in (2.5,2.7)

123. **(b)**

$F(x) = x^3 - 6x^2 + 9x + 10$

Differentiate with respect to

$F(x) = 3x^2 - 12x + 9$

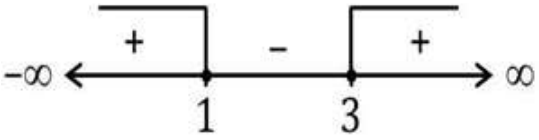
$f'(x) \geq 0$

$\Rightarrow 3x^2 - 12x + 9 \geq 0$

$\Rightarrow x^2 - 4x + 3 \geq 0$

$\Rightarrow x^2 - 3x - x + 3 \geq 0$

$\Rightarrow (x-3)(x-1) \geq 0$



$x \in (-\infty, 1] \cup [3, \infty)$

124. (d)

125. (a)

$$f(x) = \sqrt{x}$$
$$\Rightarrow \frac{dy}{dx} = \frac{1}{2\sqrt{x}}$$
$$\Delta y = \left(\frac{dy}{dx}\right)\Delta x \ldots\ldots\ldots\ldots (1)$$

Here $x = 25$ and $\Delta x = 0.1$

$$\Delta y = \sqrt{x} - \sqrt{(x - \Delta x)}$$
$$\frac{dy}{dx}(\Delta x) = \sqrt{25} - \sqrt{25 - 0.1}$$
$$\sqrt{24.99} = -\frac{1}{2 \times 5} \times 0.1$$
$$= 5 - 0.01$$
$$= 4.99$$

126. (b)

$$|3x - 5| \leq 2$$
$$\Rightarrow -2 \leq 3x - 5 \leq 2$$
$$\Rightarrow 3 \leq 3x \leq 7$$
$$\Rightarrow 1 \leq x \leq \frac{7}{3}$$

127. (a)

$\Sigma P(K) = 1$

$\Rightarrow K - 1 + 3K + K + 3K + 3K^2 + K^2 + K^2 + K = 1$

$\Rightarrow 5K^2 + 9K - 2 = 0$

$\Rightarrow 5K^2 + 10K - K - 2 = 0$

$\Rightarrow (5K - 1)(K + 2) = 0$

$5K - 1 = 0 \quad K + 2 = 0$

$K = \frac{1}{5} \quad K = -2$ (not possible)

128. (c)

Given that

$P(A) = 0.2$

$P(B) = 0.6$

$P(A \mid B) = 0.5$

Now

$P(A' \mid B) = 1 - P(A \mid B)$

$= 1 - 0.5$

$= 0.5 = \frac{1}{2}$

129. (d)

130. (d)

$S = \{1,2,3,4,5,6,7\}$

Total number $= 7$

$P(S_1)$ = Probability of even number $= \frac{3}{7}$

$P(S_2)$ = Probability of odd number $= \frac{4}{7}$

$P(E \mid S_1) = \frac{2}{3}$

$P(E \mid S_2) = 1 - \frac{2}{3} = \frac{1}{3}$

$$P(S_1 \mid E) = \frac{P(S_1)P(E \mid S_1)}{P(S_1)P(E \mid S_1) + P(S_2)P(E \mid S_2)}$$

$$= \frac{\frac{3}{7} \times \frac{2}{3}}{\frac{3}{7} \times \frac{2}{3} + \frac{4}{7} \times \frac{1}{3}} = \frac{3}{5}$$

131. (d)

Given that

$n(A) = 50$

$n(B) = 60$

$n(A \cap B) = 20$

Now,

$$n(A' \cap B') = P(A \cup B)'$$
$$= 100 - P(A \cup B)$$
$$= 100 - [P(A) + P(B) - P(A \cap B)]$$
$$= 100 - [50 + 60 - 20]$$
$$= 100 - 90$$
$$= 10$$

132. (a)

$f(x) = \sqrt{x^2 - 7x + 12}$

Now

$$x^2 - 7x + 12 \geq 0$$
$$x^2 - 4x - 3x + 12 \geq 0$$
$$(x - 4)(x - 3) \geq 0$$

$x \in (-\infty, 3] \cup [4, \infty)$

133. (b)

$\cos x = |\sin x|$

Case-1:

$\cos x = \sin x$ for $x \in [0, \pi]$

$\tan x = 1$ for $x = \frac{\pi}{4}$

Case-2:

$\cos x = -\sin x$ for $x \in [\pi, 2\pi]$

$\tan x = -1$ for $x \in \frac{7\pi}{4}$

Combining both the cases, we get the general is solution $2n\pi \pm \frac{\pi}{4}$

134. (c) $\sqrt{3}\text{cosec}\, 20° - \sec 20°$

$$\Rightarrow \frac{\sqrt{3}}{\sin 20°} - \frac{1}{\cos 20°}$$

$$\Rightarrow \frac{\sqrt{3}\cos 20° - \sin 20°}{\sin 20° \cos 20°}$$

$$\Rightarrow \frac{4[\sin 60° \cos 20° - \cos 60° \sin 20°]}{2\sin 20° \cos 20°}$$

$$\Rightarrow \frac{4\sin(60° - 20°)}{\sin 40°} \{\because 2\sin A \cos A = \sin 2A \& \sin A \cos B - \cos A \sin B = \sin(A - B)\}$$

$\Rightarrow \frac{4\sin 40^\circ}{\sin 40^\circ} = 4$

135. **(c)**

P(n): $2^n < n!$

Since

P(1): $2 < 1$ is false.

P(2): $2^2 < 2!$ is false.

P(3): $2^3 < 3!$ is false.

P(4): $2^4 < 4!$ is true.

P(5): $2^5 < 5!$ is true.

So, smallest positive integer is 4 .

136. **(a)** The Dr's of PA are

$x_1 - 1, y_1 - 3, z_1 - 4$

The Dr's $\overset{1}{n}$ are $2, -1, 1$

The Dr's of PA and $\overset{1}{n}$ are parallel

$\therefore \frac{x_1 - 1}{2} = \frac{y_1 - 3}{-1} = \frac{z_1 - 4}{1} = \lambda$

$x_1 = 2\lambda + 1, y_1 = -\lambda + 3, z_1 = \lambda + 4$

$\therefore A = (2\lambda + 1, -\lambda + 3, \lambda + 4)$ lies on plane.

$\Rightarrow 2(2\lambda + 1) - (-\lambda + 3) + (\lambda + 4) = 0$

$6\lambda + 6 = 0$

$\lambda = -1$

$A = [(2(-1) + 1), (+1 + 3), (-1 + 4)]$

$A = (-1, 4, 3)$

137. **(c)** L: $\frac{x-5}{2} = \frac{y+1}{-1} = \frac{z+4}{1}$

Dr's of line: $2, -1, 1$

P: $3x - 4y - z + 5 = 0$

Dr's of normal to plane: $-3, 4, 1$

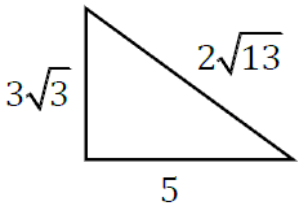
$\sin\theta = \left|\frac{-6 - 4 + 1}{\sqrt{4 + 1 + 1}\sqrt{9 + 16 + 1}}\right| = \left|\frac{-9}{\sqrt{156}}\right|$

$\sin\theta = \frac{9}{\sqrt{156}}$

$\theta = \sin^{-1}\left(\frac{9}{\sqrt{156}}\right)$

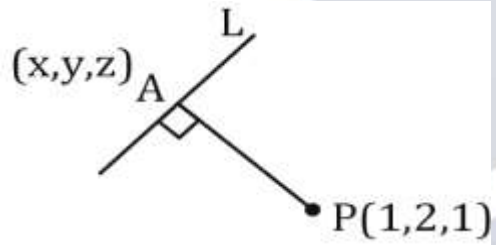
$\theta = \sin^{-1}\left(\frac{9}{2\sqrt{39}}\right)$

$\theta = \cos^{-1}\left(\frac{5}{2\sqrt{13}}\right)$



138. **(b)** Let

L: $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{2} = \lambda$



$A = [x = 2\lambda + 1, y = \lambda + 2, z = 2\lambda + 3]$

$\overset{uu}{PA}$ = Position vector of A − position of vector of P

$= [(2\lambda + 1)\hat{i} + (\lambda + 2)\hat{j} + (2\lambda + 3)\hat{k}] - [\hat{i} + 2\hat{j} + \hat{k}]$

$= (2\lambda)\hat{i} + (\lambda)\hat{j} + (2\lambda + 2)\hat{k}$

$\because \overset{uu}{PA} \perp L$

$\Rightarrow \overset{uu}{PA} \cdot L = 0$

$\Rightarrow [2\lambda\hat{i} + \lambda\hat{j} + (2\lambda + 2)\hat{k}] \cdot [2\hat{i} + \hat{j} + 2\hat{k}] = 0$

$\Rightarrow 4\lambda + \lambda + 4\lambda + 4 = 0$

$\lambda = -\frac{4}{9}$

$A = \left[2\left(\frac{-4}{9}\right) + 1, \frac{-4}{9} + 2, 2\left(\frac{-4}{9}\right) + 3\right] = \left[\frac{1}{9}, \frac{-14}{9}, \frac{19}{9}\right]$

Distance $= \sqrt{\left(1 - \frac{1}{9}\right)^2 + \left(2 - \frac{14}{9}\right)^2 + \left(1 - \frac{19}{9}\right)^2}$

$$= \sqrt{\frac{64}{81} + \frac{16}{81} + \frac{100}{81}} = \frac{2\sqrt{5}}{3}$$

139. **(d)** $A(2,3,-5),\ B(-1,-2,-3)$

The ratio that xy plane divide line joining the points $(x1, y1, z1)\&(x2, y2, z2) = -z1 : Z2$

If result is positive, it divides internally otherwise externally.

The ratio that xy plane divides the points $(2,3-5)\&(-1,-2,-3)$

$= -(-5):(-3)$

$= -5:3$

So, $5:3$ externally in the ratio.

140. **(a)** (1) Since region lies above x-axis

$\therefore\ y \geq 0$

(2) Shaded region is on right side of y-axis

$\therefore\ x \geq 0$

(3) Equation of line passing through $(5,0)\&(0,4)$ is

$$\Rightarrow\ (y-0) = \frac{4}{-5}(x-5)$$
$$\Rightarrow\ -5y = 4x - 20$$
$$\Rightarrow\ 4x + 5y = 20$$

(4) Equation of line passing through $(10,0)\&(0,3)$ is

$$\Rightarrow\ (y-0) = \frac{3}{-10}(x-10)$$
$$\Rightarrow\ -10y = 3x - 30$$
$$\Rightarrow\ 3x + 10y = 30$$

(5) Shaded region is on left of $x = 6$

$\therefore\ x \leq 6$

Consider the figure and observe the shaded region the inequalities can be written as

$x \geq 0$
$y \geq 0$
$x \leq 6$
$4x + 5y \geq 20$
$3x + 10y \leq 30$

141. **(d)**
142. **(a)**
143. **(c)**
144. **(c)**

145. **(d)**

146. **(a)**

Let $I = \int_{-3}^{3} \cot^{-1} x dx$

Using by parts property

$I = [\cot^{-1} x(x)]_{-3}^{3} - \int_{-3}^{3} \left(\frac{-1}{x^2+1}\right)(x)dx$

$I = [x\cot^{-1} x]_{-3}^{3} + \int_{-3}^{3} \frac{x}{x^2+1} dx$

$\left(\text{Let } x^2 + 1 = t \Rightarrow 2x = \frac{dt}{dx} \Rightarrow xdx = \frac{1}{2}dt\right\}$

$I = [x\cot^{-1} x]_{-3}^{3} + \int_{-3}^{3} \frac{1}{t} dt$

$I = [x\cot^{-1} x]_{-3}^{3} + [\ln|x^2+1|]_{-3}^{3}$

$I = [3\cot^{-1} 3 + 3\cot^{-1}(-3)] + [\ln 10 - \ln 10]$

$I = [3\cot^{-1} 3 + 3(\pi - \cot^{-1} 3)] + 0$

$I = 3\pi$

147. **(d)** Let $I = \int \frac{1}{\sqrt{x}+x\sqrt{x}} dx$

$$I = \int \frac{1}{\sqrt{x}(x+1)} dx$$

Let $\sqrt{x} = t$

$x = t^2$

$dx = 2tdt$

So, $I = \int \frac{1}{t(1+t^2)} (2tdt)$

$$I = 2\int \frac{1}{1+t^2} dt$$

$I = 2\tan^{-1} t + C$

$I = 2\tan^{-1} \sqrt{x} + C$

148. **(d)** Let $I = \int \frac{2x-1}{(x-1)(x+2)(x-3)} dx$

Now,

$$\frac{2x-1}{(x-1)(x+2)(x-3)} = \frac{A}{(x-1)} + \frac{B}{(x+2)} + \frac{C}{(x-3)}$$

$\Rightarrow 2x - 1 = A(x+2)(x-3) + B(x-1)(x-3) + C(x-1)(x+2)$

Putting $x = 3$, we get

$6 - 1 = C(3-1)(3+2)$

$C = \frac{1}{2}$

Putting $x = 1$, we get

$$2 - 1 = A(1 + 2)(1 - 3)$$
$$A = -\frac{1}{6}$$

Putting $x = -2$, we get

$$-4 - 1 = B(-2 - 1)(-2 - 3)$$
$$B = -\frac{1}{3}$$
$$-\frac{1}{6}\int \frac{1}{x-1}dx - \frac{1}{3}\int \frac{1}{x+2}dx + \frac{1}{2}\int \frac{1}{x-3}dx$$
$$= -\frac{1}{6}\log|x-1| - \frac{1}{3}\log|x+2| + \frac{1}{2}\log|x-3| + C$$

A, B, C are $-\frac{1}{6}, -\frac{1}{3}, \frac{1}{2}$

149. **(a)** $I = \int_0^2 [x^2]dx$

$$I = \int_0^1 [x^2]dx + \int_1^{\sqrt{2}} [x^2]dx + \int_{\sqrt{2}}^{\sqrt{3}} [x^2]dx + \int_{\sqrt{3}}^2 [x^2]dx$$

$$I = 0 + \int_1^{\sqrt{2}} 1dx + \int_{\sqrt{2}}^{\sqrt{3}} 2dx + \int_{\sqrt{3}}^2 3dx$$

$$I = (\sqrt{2} - 1) + 2(\sqrt{3} - \sqrt{2}) + 3(2 - \sqrt{3})$$

$$I = \sqrt{2} - 1 + 2\sqrt{3} - 2\sqrt{2} + 6 - 3\sqrt{3}$$

$$I = 5 - \sqrt{2} - \sqrt{3}$$

150. **(b)**

$$I = \int_0^1 \sqrt{\frac{1+x}{1-x}}dx$$
$$= \int_0^1 \sqrt{\frac{1+x}{1-x} \times \frac{1+x}{1+x}}dx$$
$$= \int_0^1 \frac{1+x}{\sqrt{1-x^2}}dx$$
$$= \int_0^1 \frac{1}{\sqrt{1-x^2}}dx + \int_0^1 \frac{x}{\sqrt{1-x^2}}dx$$
$$= [\sin^{-1}x]_0^1 - \left[\sqrt{1-x^2}\right]_0^1 + C$$
$$= \frac{\pi}{2} - 0 - [0 - 1]$$
$$= \frac{\pi}{2} + 1$$

151. **(d)**

Q.E. $x^2 + x + 1$

$\alpha + \beta = -1$

$\alpha\beta = 1$

Now

$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$= (-1)^2 - 2(1)$

$= 1 - 2$

$= -1$

152. **(a)** Given digits are 1,2,3,4,5,6,7

Two even digits can be selected in ${}^3C_2$

Two odd digits can be selected in ${}^4C_2$ ways

These selected 4 digits can be arranged in 4 ! ways

$\therefore$ Total number of ways $= {}^4C_2 \cdot {}^3C_2 \cdot 4!$

$= 6 \times 3 \times 24$

$= 432$

153. **(b)**

$(x^2 + y^2)^{25} - (x^2 - y^2)^{25}$

$(a + b)^n - (a - b)^n$ if n is odd

On simplification we get $\frac{n+1}{2}$ terms

i.e. $\frac{25+1}{2} = \frac{26}{2} = 13$

154. **(c)**

The third terms of G.P. is 9

$ar^2 = 9$…… (1)

Now, product of five terms $= T_1\ T_2\ T_3\ T_4\ T_5$

$= (a)(ar)(ar^2)(ar^3)(ar^4)$

$= a^5r^{10}$

$= (r^2)^5$

$= (9)^5$

$= 3^{10}$

155. **(d)** We know that equation of a line in intercept form is

$\frac{x}{a} + \frac{y}{b} = 1$

$\because$ Here, both intercept are equal

$\Rightarrow \frac{x}{a} + \frac{y}{a} = 1$

$\Rightarrow y = -x + a$

Now comparing it with

$y = mx + c$

We get $m = -1 = \text{slope}$

We know that

$\text{Slope} = \tan\theta$
$\tan\theta = -1$
$\theta = 135°$

156. (c)

$I = \int x^3 \cdot \sin 3x dx$

Using by part property

$$I = x^3\left[\frac{-\cos 3x}{3}\right] + \int 3x^2 \cdot \frac{\cos 3x}{3} dx$$

$$I = \frac{-x^3\cos 3x}{3} + \left[x^2\int \cos 3x dx - \int 2x \cdot \frac{\sin 3x}{3} dx\right]$$

$$I = \frac{-x^3\cos 3x}{3} + \frac{x^2\sin 3x}{3} - \frac{2}{3}\int x \cdot \sin 3x dx$$

$$I = \frac{-x^3\cos 3x}{3} + \frac{x^2\sin 3x}{3} - \frac{2}{3}\left[x\int \sin 3x dx + \int (1) \cdot \frac{\cos 3x}{3} dx\right]$$

$$I = \frac{-x^3\cos 3x}{3} + \frac{x^2\sin 3x}{3} + \frac{2x\cos 3x}{9} - \frac{2}{27}\sin 3x + C$$

157. (d) $y^2 = x$

$x^2 + y^2 = 2x$……. (1)

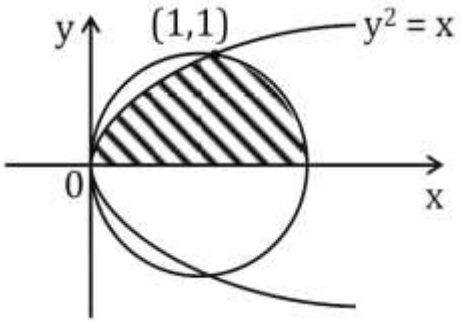
$\Rightarrow (x-1)^2 + (y-0)^2 = 1$…… (2)

Equation (2) is a circle with centre $(1,0)$ and radius 1.

Solving eq. (1) and eq. (2)

$\Rightarrow (x-1)^2 + x = 1$
$x^2 - x = 0$
$x(x-1) = 0$
$x = 0,1$

We get the points of intersection $(0,0)$ and $(1,1)$



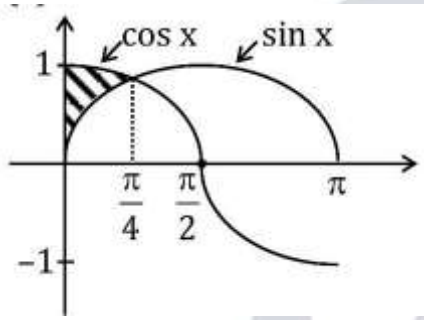
$$\text{Area} = \int_0^1 \left(\sqrt{1-(x-1)^2} - \sqrt{x}\right) dx$$

$$= \left[\frac{x-1}{2}\sqrt{1-(x-1)^2} + \frac{1}{2}\sin^{-1}(x-1)\right]_0^1 - \left[\frac{x^{3/2}}{3/2}\right]_0^1$$

$$= \left[0 + \frac{\pi}{4}\right] - \frac{2}{3}$$

$$= -\frac{2}{3} + \frac{\pi}{4}$$

158. (a)



$$\text{Required area} = \int_0^{\pi/4} (\cos x - \sin x) dx$$

$$= [\cos x - \sin x]_0^{\pi/4}$$

$$= \left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} - 1\right)$$

$$= (\sqrt{2} - 1) \text{ sq. units}$$

159. (d) $(2x + 3y^2)dy = ydx$

$$\Rightarrow \frac{2x + 3y^2}{y} = \frac{dx}{dy}$$

$$\Rightarrow \frac{dx}{dy} - \frac{2}{y} \cdot x = 3y$$

$$\text{I.F.} \Rightarrow e^{\int -\frac{2}{y} dy} = e^{-2\log y} = y^{-2} = \frac{1}{y^2}$$

160. (c) $\frac{dy}{dx} = xy$

$$\frac{1}{y} dy = x dx$$

Integrate

$\log y = \frac{x^2}{2} + C$ ……. (1)

Equation (1) passing through $(1,1)$

$\log(1) = \frac{1^2}{2} + C$

$C = -\frac{1}{2}$

Put in eq. (1)

$\Rightarrow \log y = \frac{x^2}{2} - \frac{1}{2} \Rightarrow 2\log y = x^2 - 1$

161. (a)

$9x^2 + 25y^2 = 225$

$\frac{x^2}{(5)^2} + \frac{y^2}{(3)^2} = 1$

Eccentricity $(e) = \frac{\sqrt{a^2-b^2}}{a}$

$= \frac{\sqrt{25-9}}{5} = \frac{4}{5}$

162. (b)

$\sum_{r=1}^{n} (2r-1) = x$

$\Rightarrow 2\sum_{r=1}^{n} r - \sum 1 = x$

$\Rightarrow n(n+1) - n = x$

$\Rightarrow n^2 = x$

Now,

$\Rightarrow \lim_{n\to\infty} \left[\frac{1^3 + 2^3 + 3^3 + \cdots + n^3}{x^2}\right]$

$\Rightarrow \lim_{n\to\infty} \left[\left(\frac{n(n+1)}{2}\right)^2 \times \frac{1}{n^4}\right]$

$\Rightarrow \lim_{n\to\infty} \frac{1}{4}\left[\frac{n^2(n+1)^2}{n^4}\right]$

$\Rightarrow \frac{1}{4} \times 1 = \frac{1}{4}$

163. (c) Always all differentiable functions are continuous. But all continuous functions are not differentiable. So, negation of the given statement is some continuous functions are not differentiable. Ex: $|x|$

164. **(a)** Here $n = 100, A = 50, \sigma = 4$

Now, $A = \frac{\Sigma x}{n} \Rightarrow \Sigma x = nA$

$\Rightarrow \Sigma x = 100 \times 50$

$\Rightarrow \Sigma x = 5000$

Again, from the formula

$\Rightarrow \sigma^2 + A^2 = \frac{\sum x^2}{n}$

$\Rightarrow \Sigma x^2 = n(\sigma^2 + A^2)$

$= 100(16 + 2500)$

$= 251600$

165. **(d)**

Vowel: E, A, U, I, O $\Rightarrow P(v) = {}^5C_1$

Consonant: Q, T, N, S $\Rightarrow P(c) = {}^4C_1$

Probability $= \frac{{}^5C_1 \times {}^4C_1}{{}^9C_2}$

$= \frac{5 \times 4}{36} = \frac{5}{9}$

166. **(d)**

$$\Delta = \begin{vmatrix} 3x+1 & 2x-1 & x+2 \\ 5x-1 & 3x+2 & x+1 \\ 7x-2 & 3x+1 & 4x-1 \end{vmatrix}$$

Put $x = 0$

$$\Delta = \begin{vmatrix} 1 & -1 & 2 \\ -1 & 2 & 1 \\ -2 & 1 & -1 \end{vmatrix}$$

$\Delta = 1(-3) + 1(3) + 2(-1 + 4)$

$\Delta = -3 + 3 + 6$

$\Delta = 6$

167. **(c)**

$f(x) = x - [x] - \cos x$

$f(x) = \{x\} - \cos x \{\because x = [x] + \{x\}\}$

$f'(x) = 1 + \sin x$

$f'\left(\frac{\pi}{2}\right) = 1 + \sin\frac{\pi}{2}$

$= 1 + 1 = 2$

168. **(d)**

169. (b)

$f(x) = \sin^{-1}\left[\frac{2^{x+1}}{1+4^x}\right]$

$f(x) = \sin^{-1}\left[\frac{2 \cdot 2^x}{1+(2^x)^2}\right]$

$f(x) = 2\tan^{-1}(2^x)$

Differentiating both side w.r.t. x

$f'(x) = \frac{2}{1+4^x}(2^x \log 2)$

$f'(0) = \frac{2}{1+1}(\log 2)$

$f'(0) = \log 2$

170. (c) $x = a\sec^2\theta$

$y = a\tan^2\theta$

$y = a(\sec^2\theta - 1)$

$y = a(x-1)$

$\frac{dy}{dx} = a$

$\frac{d^2y}{dx^2} = 0$

171. (c)

Let $A = \begin{bmatrix} 2 & 5 & 0 \\ 0 & 1 & 1 \\ -1 & 0 & 3 \end{bmatrix}$

$|A| = 2(3-0) - 5(0+1) + 0$

$|A| = 1$

$A^{-1} = \frac{\text{adj } A}{|A|}$

$A^{-1} = \frac{1}{|A|}\begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}^T$

$A^{-1} = \frac{1}{1}\begin{bmatrix} 3 & -15 & 5 \\ -1 & 6 & -2 \\ 1 & -5 & 2 \end{bmatrix}$

$A^{-1} = \begin{bmatrix} 3 & -15 & 5 \\ -1 & 6 & -2 \\ 1 & -5 & 2 \end{bmatrix}$

172. (d)

Given $P = P'$ and $Q = Q'$

Now,

$$(PQ - QP)' = (PQ)' - (QP)'$$
$$= Q'P' - P'Q'$$
$$= QP - PQ$$
$$= -[PQ - QP]$$

$\therefore (PQ - QP)$ is skew symmetric.

173. (a)

$$3A + 4B' = \begin{bmatrix} 7 & -10 & 17 \\ 0 & 6 & 31 \end{bmatrix} \ldots\ldots(1)$$
$$2B - 3A' = \begin{bmatrix} -1 & 18 \\ 4 & 0 \\ -5 & -7 \end{bmatrix} \ldots\ldots\ldots(2)$$
$$\Rightarrow (2B - 3A')' = \begin{bmatrix} -1 & 18 \\ 4 & 0 \\ -5 & -7 \end{bmatrix}$$
$$\Rightarrow 2B' - 3A = \begin{bmatrix} -1 & 4 & -5 \\ 18 & 0 & -7 \end{bmatrix}$$

Adding equation (1) & (3), we get

$$\Rightarrow 6B' = \begin{bmatrix} 6 & -6 & 12 \\ 18 & 6 & 24 \end{bmatrix} \ldots\ldots(3)$$
$$\Rightarrow B' = \begin{bmatrix} 1 & -1 & 2 \\ 3 & 1 & 4 \end{bmatrix}$$
$$\therefore B = \begin{bmatrix} 1 & 3 \\ -1 & 1 \\ 2 & 4 \end{bmatrix}$$

174. (b)

$$A = \begin{bmatrix} 1 & 3 \\ 4 & 2 \end{bmatrix}, B = \begin{bmatrix} 2 & -1 \\ 1 & 2 \end{bmatrix}, B' = \begin{bmatrix} 2 & 1 \\ -1 & 2 \end{bmatrix}$$

Now,

$$|ABB'| = |A||B||B'|$$
$$= \begin{vmatrix} 1 & 3 \\ 4 & 2 \end{vmatrix} \begin{vmatrix} 2 & -1 \\ 1 & 2 \end{vmatrix} \begin{vmatrix} 2 & 1 \\ -1 & 2 \end{vmatrix}$$
$$= (2 - 12)(4 + 1)(4 + 1)$$
$$= -10 \times 5 \times 5$$
$$= -250$$

175. (c) Given that

$|A| = 16$

Order of determinant $A = 3$

Now,

$|\text{adj } A| = |A|^2$
$= (16)^2$
$= 256$

176. (b)

$f(x) = x^2$

$g(x) = \sqrt{x}$

Now,

$fog(x) = f[g(x)]$
$= f[\sqrt{x}]$
$= x$
$fog(2) = 2$
$fog(-4) = -4$

And

$gof(x) = g[f(x)]$
$gof(x) = g[x^2]$
$gof(-2) = g(4)$
$= \sqrt{4} = 2$

177. (c)

$A = \{x \mid x \in N, x \leq 5\}$

$A = \{1,2,3,4,5\}$

$B = \{x \mid x \in Z, x^2 - 5x + 6 = 0\}$

$B = \{2,3\}$

Total number of onto function $5 \begin{cases} 4 \\ 1 \end{cases} + 5 \begin{cases} 3 \\ 2 \end{cases}$

$= \left(\frac{5!}{4!\,1!} + \frac{5!}{3!\,2!}\right) \times 2!$
$= (5 + 10) \times 2$
$= 30$

178. (d)

$a * e = a = e * a$

where, $e =$ identity element and a^{-1} =inverese of element a

$\therefore a * e = a \Rightarrow \frac{2ae}{5} = a \Rightarrow e = \frac{5}{2}$
$\because a * a^{-1} = e = a^{-1} * a$
$3 * 3^{-1} = e = \frac{2 * 3 * 3^{-1}}{5} \Rightarrow 3^{-1} = \frac{5}{2} \times \frac{5}{2} \times \frac{1}{3} = \frac{25}{12}$

Now, $2 * x = 3^{-1} \Rightarrow \frac{2\times2\times x}{5} = \frac{25}{12} \Rightarrow x = \frac{125}{48}$

179. (a)

$$\cos\left[2\sin^{-1}\frac{3}{4} + \cos^{-1}\frac{3}{4}\right]$$

$$\Rightarrow \cos\left[\sin^{-1}\frac{3}{4} + \sin^{-1}\frac{3}{4} + \cos^{-1}\frac{3}{4}\right]$$

$$\Rightarrow \cos\left[\frac{\pi}{2} + \sin^{-1}\frac{3}{4}\right]$$

$$\Rightarrow -\sin\left(\sin^{-1}\frac{3}{4}\right)$$

$$\Rightarrow -\frac{3}{4}$$

180. (b)

We know that

$$\Rightarrow 0 < \cot^{-1} x < \pi$$

$$\Rightarrow \pi + 0 < 2\left(\frac{\pi}{2}\right) + \cot^{-1} x < \pi + \pi$$

$$\Rightarrow \pi < 2(\tan^{-1} x + \cot^{-1} x) + \cot^{-1} x < 2\pi$$

$$\Rightarrow \pi < 2\tan^{-1} x + 3\cot^{-1} x < 2\pi \quad \ldots\ldots (1)$$

Equation (1) compare to $a + \frac{\pi}{2} < 2\tan^{-1} x + 3\cot^{-1} x < b$

$$a = \frac{\pi}{2}$$

$$b = 2\pi$$

Biology

181. (b) GLUT4 is an insulin-responsive glucose transporter that is found in the adipose tissue, and brain. It is present in the cytoplasm of cells in vesicles from which it is translocated to the plasma membrane under the influence of insulin.

182. (d) In G_0, some cells in the adult animals do not appear to exhibit division (e.g., heart cells) and many other cells divide only occasionally. These cells that do not divide further exist G_1 phase to enter an inactive stage called quiescent stage (G_0) of the cell cycle. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism.

183. (a) The criteria for essentiality of an element are given below:

(a) The element must be absolutely necessary for supporting normal growth and reproduction. In the absence of the element the plants do not complete their life cycle or set the seeds.

(b) The requirement of the element must be specific and not replaceable by another element. In other words, deficiency of any one element cannot be met by supplying some other element.

(c) The element must be directly involved in the metabolism of the plant.

184. (c) During chemiosmotic synthesis, ATP synthesis is linked to development of a proton gradient across a membrane. This time these are membranes of the thylakoid There is one difference though, here the proton accumulation is towards the inside of the membrane, i.e., in the lumen. In respiration, protons accumulate in the inter membrane space of the mitochondria when electrons move through the ETS.

185. **(b)** Respiratory quotient (RQ) or respiratory ratio can be defined as the ratio of the volume of CO_2 evolved to the volume of O_2 consumed during respiration. The value of respiratory quotient depends on the type of respiratory substrate. Its value is one for carbohydrates. However, it is always less than one for fats as fats consume more oxygen for respiration than carbohydrates. It can be illustrated through the example of tripalmitin fatty acid, which consumes 145 molecules of O_2 for respiration while 102 molecules of CO_2 are evolve(d) The RQ value for tripalmitin is 0.7 .

186. **(a)** Biocontrol refers to the use of biological methods for controlling plant diseases and pests. In modern society, these problems have been tackled increasingly by the use of chemicals - by use of insecticides and pesticides. These chemicals are toxic and extremely harmful, to human beings and animals alike, and have been polluting our environment (soil, ground water), fruits, vegetables and crop plants.

187. **(b)** Blue green algae such as nostoc are very good at fixing nitrogen in the soil. They grow in symbiotic association with the roots of plant forming a legume where nitrogen fixation for the plant takes place. It provides the plant and the soil with nitrogen. It is an effective way of increasing production of plant along with soil fertility.

188. **(b)** Antibiotic resistance gene present in the vector is mainly used for the selection of transformed bacterial cell. This transformed bacterial cell contains a recombinant vector with antibiotic resistance gene so that it can resist from the antibiotic (tetracycline) containing media the non- transformed cell failed to survive in the antibiotic containing media during the selection process.

189. **(d)** In order to use the DNA for genetic engineering processes, it must be in pure form, free from other macromolecules. This is termed DNA isolation and is the pioneer step. Since the DNA is enclosed within the membranes, it is required to break open the cell to release DNA along with other macromolecules such as RNA, proteins, polysaccharides, lipids, etc and from this mixture, DNA is purified A release of DNA from a cell is achieved by treating the cells or tissues with enzymes such as chitinase (fungus), etc These enzymes degrade cell wall; plasma membrane degrading enzymes like lipase, et(c), are also needed Since, yeast is a fungus and fungal cell wall is made of chitin (fungal cellulose), isolation of DNA necessarily requires the use of enzyme chitinase.

190. **(d)** In the laboratory, restriction enzymes are used to cut DNA into smaller fragments. The cuts are always made at specific nucleotide sequences. Different restriction enzymes recognize and cut different DNA sequences. EcoRI is a restriction enzyme that cleaves DNA double helices into fragments at specific sites. It is also a part of the restriction modification system. The DNA sequence can be cut using EcoRI is 3'ACGAATTCAT5', 5'TGCTTAAGTA3'.

191. **(d)**

- Valine is code for GTC, GTA and GTG.
- The codons UUU and UUC codes for phenylalanine only. This feature of the genetic code is called degenerate.
- Tyrosine is code for ATA, ATG.
- Tryptophan, encoded by a single codon UGG.

192. **(c)** Sigma factor proteins promote binding of RNA polymerase to promoter sites within DNA sequences to allow for initiation of transcription. Sigma factors are specific for the gene and are affected by the cellular environment. Sigma factorscan regulate at both the transcriptional and the translational level.

193. **(c)** According to salient features of human genome project, the total number of genes in human genome is estimated at 30,000, Chromosome 1 has most genes (2968), and the Y has the fewest (231).

194. **(b)** Erythrocytes contain the pigment hemoglobin, which imparts the red colour to blood, and transport oxygen and carbon dioxide to and from the tissues. In a crime investigation, the investigating officer collects different biological samples from the crime spot for DNA finger printing analysis. Skin shreds, semen sample and hair follicle are helpful in the DNA finger printing.

195. **(c)** 3 bases contain 1 codon

900 bases contain 300 codons

The number of amino acids coded by this mRNA during translation 300 codes contains 300 amino acids.

196. **(c)** The tropical rain forest is a hot, moist biome found near Earth's equator. Tropical rainforests receive from 60 to 160 inches of precipitation that is fairly evenly distributed throughout the year. The tropical rain forest has highest annual net primary productivity (9000 $Kcal/m^2/yr$). Net primary productivity is the rate at which all the plants in an ecosystem produce net useful chemical energy.

197. **(b)** Source of energy in an ecosystem is solar energy. 50 per cent of the solar energy incident over Earth is present in PAR (photo synthetically active radiation). Almost 1 to 5 percent of incident solar energy or 2 to 10 percent of PAR is captured by photosynthetic organisms in synthesis of organic matter.

198. **(a)** The United Nations Conference on Environment and Development (UNCED), also known as the Rio de Janeiro Earth Summit, the Rio Summit, the Rio Conference, and the Earth Summit was a major United Nations conference held in Rio de Janeiro from 3 to 14 June 1992. More than 100 heads of states met in Rio de Janeiro in Brazil. Earth Summit was created as a response for Member States to cooperate together internationally on development issues after the Cold War.

199. **(d)** Slash and burn agriculture, commonly called as Jhum cultivation in the north-eastern states of India, has also contributed to deforestation. In slash and burn agriculture, the farmers cut down the trees of the forest and burn the plant remains. The ash is used as a fertilizer and the land is then used for farming or cattle grazing. After cultivation, the area is left for several years so as to allow its recovery. The farmers then move on to other areas and repeat this process.

200. **(c)** DDT was commonly used as a pesticide. On the prolonged use of the pesticide, there were many side effects observed the plants were accumulated with these chemicals and the pesticide entered the food chain. The birds were affected due to the presence of the pesticide. The birds lay the eggs but due to the effect of this chemical, the egg shells were very thin. The shell break and the embryos did not develop. So, there was a failure in the hatching of the birds from the eggs.

201. **(b)** Homo-habilis were first human like being with $650 - 800$ cc cranial capacity

202. **(b)** Divergent evolution is the process whereby groups from the same common ancestor evolve and accumulate differences, resulting in the formation of new species. Divergent evolution creates homologous organs. Homologous organs are the organs which have similar structure and different function and have the same developmental origin. For example, the thorn of Bougainvillea and tendril of Cucurbita Thorns and tendrils both are axillary in position and are the modifications of axillary buds. But they both perform different functions as thorns are for protection and tendrils are for support.

203. **(a)** HIV can't be transmitted through saliva, so it can't be transmitted through a mosquito's bite.

Bacterial pneumonia is an infection of your lungs caused by certain bacteria the most common one is Streptococcus (pneumococcus).

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. It is a major cause of death in developed countries. Most cancers are non-infectious diseases caused by a combination of genetic and environmental factors.

Ringworm is a common infection of the skin and nails that is caused by fungus.

204. **(b)** Immunoglobulin E (IgE) is antibodies produced by the immune system. If you have an allergy, your immune system over reacts to an allergen by producing antibodies called Immunoglobulin E (IgE). These antibodies travel to cells that release chemicals, causing an allergic reaction. This can cause wheezing, itching, running nose, watery or itchy eyes, and other symptoms.

205. **(b)** Drugs like barbiturates, amphetamines, benzodiazepines, lysergic acid diethyl amides (LSD), and other similar drugs, that are normally used as medicines to help patients cope with mental illnesses like depression and insomnia, are often abused

206. **(b)**

• Liverworts usually grow in moist and shady habitats. The plant body is haploi(d) Thallus is dorsiventral and closely appressed to the substrate. Some members have tiny leaf-like appendages in two rows on the stem-like structures. For example: marchantia

• Gametophyte is the predominant stage of the life cycle of moss. The leafy stage develops from the protonema as a lateral bud The leafy stage consists of upright, slender axes bearing spirally arranged leaves. It is attached to the soil through multicellular and branched rhizoids. The leafy stage bears the sex organs. Vegetative reproduction takes place by fragmentation and budding in the secondary protonema

207. **(b)** A single individual (parent) is capable of producing offspring. As a result, the offspring that are produced are not only identical to one another but are also exact copies of their parent is known as asexual reproduction.

The small bulb-like projection coming out from the yeast cell is called a bud

208. **(b)** In dichogamy, the anther and stigma mature at different times. Either anthers dehisce before the stigma becomes receptive (called protandry) or stigma becomes receptive before anthers dehisce (called protogyny). During this time, if pollen grains of another plant of the same species fall on the stigma of the dichogamy flower then, the type of pollination that will occur is cross pollination.

209. **(c)** Conventional plant breeding is the development or improvement of cultivars using conservative tools for manipulating plant genome within the natural genetic boundaries of the species. The general strategy is to breed a cultivar whose genetic purity and productivity can be sustained by its natural mating system. Conventional plant breeding is used to overcome the problem of purchasing hybrid seeds.

210. **(c)** Artificial hybridization is one of the major approaches of crop improvement programme. In such crossing experiments it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen). This is achieved by emasculation and bagging techniques.

The process of hybridization involves following steps:

- Emasculation
- Bagging
- Artificial Pollination
- Rebagging

211. **(d)** In flagellated protozoans, the members of this group are either free-living or parasitic They have flagella The parasitic forms cause diseases such as sleeping sickness. Example: Trypanosoma

212. **(c)**

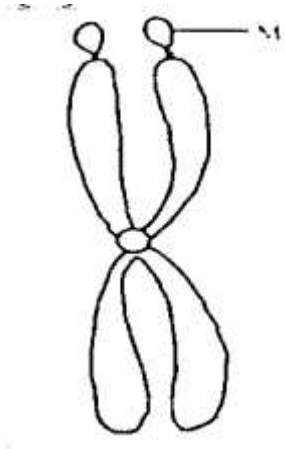
In some animals, the body cavity is not lined by mesoderm; instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom and the animals possessing them are called pseudocoelomates, e.g., aschelminthes.

213. **(a)** The ovule maturation leads to the developmental changes in integuments in form of reduction and disorganization of the thickening. The ovules are covered with two layers of integuments. The outer integument is called as testa while inner integument is called as tegmen. The seeds are developmentally matured ovules

containing two integument layers. The seed coat is developed from integuments which protect the embryo from mechanical injuries and desiccation. Testa and tegmen of the seeds coat represent two layers of dried integuments.

214. **(a)** In plants of temperate regions, cambium is more active in spring and less active in autumn seasons. In temperate regions, climatic conditions are not uniform throughout the year. However, in tropics, climatic conditions are uniform throughout the year.

215. **(d)**



A few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of a small fragment called the satellite i.e. M is represented as satellite.

216. **(d)** Genetically Modified or GM Crops are that type of plants whose DNA has been modified through genetic engineering for imbedding a new trait to the plant which does not occur naturally in the species. GM plants have been useful in many ways. Genetic modification has:

- Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
- Reduced reliance on chemical pesticides (pest-resistant crops).
- Helped to reduce post-harvest losses.
- Increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).
- Enhanced nutritional value of food, e.g., Vitamin 'A' enriched rice

217. **(c)** Biopiracy is the term used to refer to the use of bio-resources by multinational companies and other organizations without proper authorization from the countries and people concerned without compensatory payment.

218. **(b)** In regulator organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc All birds and mammals, and a very few lower vertebrate and invertebrate species are indeed capable of such regulation (thermoregulation and osmoregulation).

219. **(b)** The butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body.

220. **(c)**

Species A	Species B	Name of Interaction
+	+	Mutualism
-	-	Competition
+	-	Predation

+	-	Parasitism
+	0	Commensalism
-	0	Amensalism

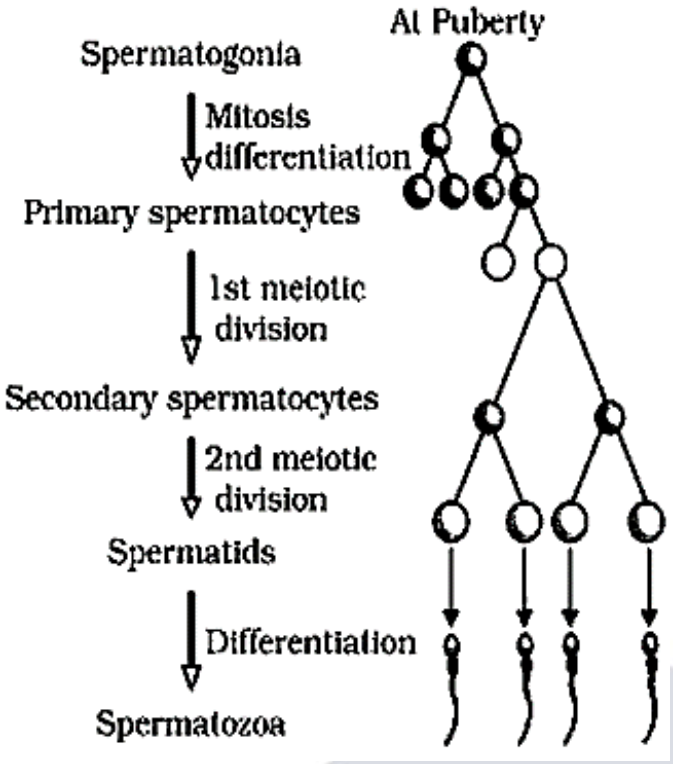
Both the species benefit in mutualism and both lose in competition in their interactions with each other. In both parasitism and Predation, only one species benefits (parasite and predator, respectively) and the interaction is detrimental to the other species (host and prey, respectively). The interaction where one species is benefitted and the other is neither benefitted nor harmed is called commensalism.

221. **(c)** The large sustentacular cells that extend from the capsule to the lumen of the seminiferous tubule are called sertoli cells. They serve to support, nourish, and regulate the maturation of sperm cells during spermatogenesis.

222. **(b)**

Normal menstruating woman, menses occur on 5th April. The expected date of ovulation is 18th April.

223. **(b)**



Spermatogenesis is the process of the production of sperms from the immature germ cells in males. The correct sequence is P-Primary Spermatocyte, Q-Secondary Spermatocyte, R- Spermatid and S-Spermatozoa

224. **(a)** Natural methods work on the principle of avoiding chances of ovum and sperms meeting. Periodic abstinence is one such method in which the couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected As chances of fertilization are very high during this period, it is called the fertile period Therefore, by abstaining from coitus during this period, conception could be prevented

225. **(b)** Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by artificial insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus of the female.

226. **(a)** In the figure, the zygote undergoes mitotic division. In the initial stage or the M stage every progeny cell retains its capacity to divide and form progeny cells. Here no cells are undergoing differentiation. So, here the division occurs in 2n manner, growth in unicellular organisms and certain higher plants. The graph plotted here is exponential gradually moving to sigmoid

In stage N, not all the progeny cells retain their capacity to divide; some stop division and undergo differentiation. So, here the division occurs as 2,4,6,8 i.e. in an arithmetic progression. Example: growth in root and stem. The graph plotted here is linear.

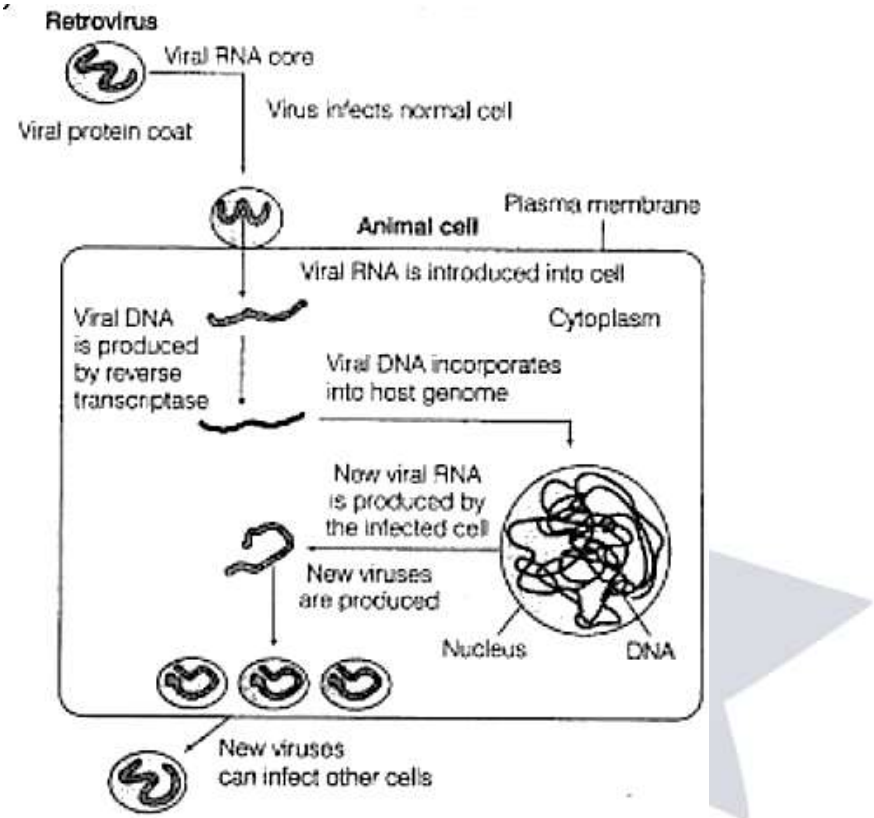
227. **(b)** Indigestion is often a sign of an underlying problem, such as ulcers, or gallbladder disease i.e. indigestion of fats in human may be an indication of inflammation of liver.

228. **(b)** Erythroblastosis fetalis classically results from incompatibility, which may develop when a woman with Rh-negative blood is impregnated by a man with Rhpositive blood and conceives a foetus with Rh-positive blood, sometimes resulting in haemolysis. Mast cells are a type of granular basophil cells in the connective tissue that releases heparin, histamine and serotonin during inflammation and allergic reactions. Coronary Artery Disease, often referred to as atherosclerosis, affects the vessels that supply blood to the heart muscle. It is caused by deposits of calcium, fat, cholesterol and fibrous tissues, which makes the lumen of arteries narrower. Angina is also called 'angina pectoris'. A symptom of acute chest pain appears when no enough oxygen is reaching the heart muscle. Angina can occur in men and women of any age but it is more common among the middle-aged and elderly. It occurs due to the conditions that affect the blood flow. Donors with blood type AB can donate to recipients with blood type AB only.

229. **(a)** Photoreceptor cells (rods and cones) are not present in that region and hence, it is called the blind spot.

230. **(b)** Testosterone is linked to many of the changes seen in boys during puberty (including an increase in height, body and pubic hair growth, and changes in sexual and aggressiveness and low pitch of voice).

231. **(a)**



Retroviruses infect the host cell and inject their genetic material, RNA, into the host cell. Inside the host cell, viral DNA is produced from the viral RNA is produced by the enzyme reverse transcriptase which used RNA as a template to synthesis DN(A) The viral DNA gets incorporated into the host genome and is replicated as the host genome replicates. Viral RNA is the produced from the replicated viral DNA by transcription which then forms new virus particles. The viruses are then released which infect other cells.

232. **(c)** When breeding is between animals of the same breed it is called inbreeding,

Out-crossing: This is the practice of mating of animals within the same breed, but having no common ancestors on either side of their pedigree up to 4-6 generations. Interspecific hybridization: In this method, male and female animals of two different species are mated The maximum genetic variations are present in it. In some cases, the progeny may combine desirable features of both the parents, and may be of considerable economic value, e.g., the mule Cross-breeding: In this method, superior males of one breed are mated with superior females of another breed

233. **(d)** Biofortification refers, breeding crops with higher levels of vitamins and minerals, or higher protein and healthier fats - is the most practical means to improve public health.

Breeding for improved nutritional quality is undertaken with the objectives of improving -

- Protein content and quality;
- Oil content and quality;
- Vitamin content; and

Micronutrient and mineral content

234. **(b)** Microbes like spirulina can be grown easily on materials like waste water from potato processing plants (containing starch), straw, molasses, animal manure and even sewage, to produce large quantities and can serve as food rich in protein, minerals, nutrition because of high rate of biomass production and growth in less time.

235. **(c)** Insect resistance in host crop is due to morphological, biochemical or physiological characteristics. Some characters which make the plants resistance to insects are:

- High aspartic acids
- Presence of hairy leaves
- Low nitrogen and sugar content in maize make them resistant to stem borers.
- Production of less nectar in flower.

236. **(a)** Most common and prevalent Mendelian disorders are Haemophilia, Cystic fibrosis, Sicklecell anaemia, Colour blindness, Phenylketonuria, Thalassemia, etc. It is important to mention here that such Mendelian disorders may be dominant or recessive. Haemophilia is sex linked recessive disease, which shows it's transmission from unaffected carrier female to some of the male progeny and other disease is autosomal recessive disorder.

237. **(d)** Birds show different mechanism of sex determination. In this case, the total number of chromosome is same in both males and females. But two different types of gametes in terms of the sex chromosomes are produced by females, i.e., female heterogamety. In order to have a distinction with the mechanism of sex determination described earlier, the two different sex chromosomes of a female bird has been designated to be the Z and W chromosomes. In these organisms the females have one Z and one W chromosome, whereas males have a pair of Z-chromosomes besides the autosomes.

238. **(c)** Morgan hybridized yellow-bodied, white-eyed females to brown-bodied, red-eyed males and intercrossed their F1 progeny. He observed that the two genes did not segregate independently of each other and the F2 ratio deviated very significantly from the 9:3:3:1. Morgan and his group also found that even when genes were grouped on the same chromosome, some genes were very tightly linked (showed very low recombination) while others were loosely linked (showed higher recombination). For example, he found that the genes white and yellow were very tightly linked and showed only 1.3 per cent recombination while white and miniature wing showed 37.2 per cent recombination.

239. **(b)**

Consanguineous marriages are those between related individuals, defined simply as those that share a common ancestor.

240. **(c)** DNA is a polymer of deoxyribonucleotides. The deoxyribonucleotides are made up of phosphoric acid and deoxyribonucleosides. The deoxyribonucleosides are made up of deoxyribose sugars and nitrogenous bases. The nitrogenous bases present in DNA are purine (adenine or guanine) and pyrimidine (cytosine or thymine).

- Thymine is specifically found in DNA
- Uracil is found in RNA
- Guanine and cytosine is found in DNA as well as in RNA