Physics

1. (c) Given: - $g = 10\ m/s^2$

$t = 10$ sec.

Initial velocity $(u) = 0\ m/s$

$$S = ut + \frac{1}{2}gt^2$$

$$S = 0 + \frac{1}{2} \times 10 \times 10^2$$

$$V_{avg.} \Rightarrow \frac{500}{10} = 50\ m/s$$

2. (d)

$$R_A = R_C < R_B$$

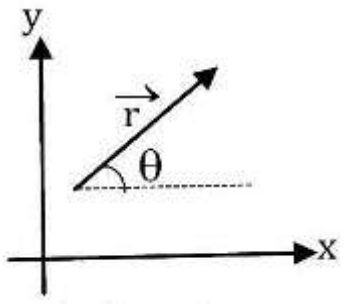
$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R_A = \frac{u^2 \sin 60^\circ}{g} = \frac{\sqrt{3}}{2}\frac{u^2}{g}, R_B = \frac{u^2 \sin 90^\circ}{g} = \frac{u^2}{g}$$

$$R_C = \frac{u^2 \sin 120^\circ}{g} = \frac{u^2}{g}\cos 30^\circ \Rightarrow \frac{u^2}{g} \times \frac{\sqrt{3}}{2}$$

$\therefore R_A = R_C < B_B$

3. (a)



$\vec{r}_x = |r|\cos\theta$

$(r_x) = |r|\cos\theta$ max

$r_x = |r|\cos\theta$

$\therefore \cos\theta$ is maximum of $\theta = 0$

$\theta = 0$

$\vec{r} = \parallel -x - axis$

4. (b) $\mu = 0.3$

$m = 50$ kg

$g = 10\ m/s^2$

$f = \mu mg$

The box kept on the floor of train remains stationary it the pseudo force acting on the box is balanced by frictional force

$\therefore ma = \mu mg$

$a = \mu g = 0.3 \times 10 \Rightarrow 3.0\ m/s^2$

5. (a) As initial momentum of the system is zero

According to the law of conservation of momentum

Initial momentum = final momentum

So, final momentum of the system must also be zero

Hence, Momentum of 8 kg piece must be equal, opposite to the momentum of 4 kg piece.

$\Rightarrow$ 8 kg. piece, $P = 20NS$

K.E. of 8 kg piece, $K = \frac{P^2}{2\ m}$

$\Rightarrow \frac{(20)^2}{2 \times 8} \Rightarrow 25\ J$

6. (b) The centre of mass lies towards the heavier mass, from the above diagram, the mass is more at the point D.

7. (c) Let the body start from rest

Using work-energy equation

$W = \Delta K.E$

$= K.Ef_f - K.E_i$

$= K.E.f\ [\because KE_i = 0]$

$mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

But $V = r\omega$

$I = kmr^2$

$\therefore mgh = \frac{1}{2}mv^2 + \frac{1}{2}kmv^2$

$mgh = \frac{1}{2}mv^2[1 + k]$

$v = \sqrt{\frac{2gh}{1+k}}$

As we know; $k_R = 1, k_C = 0.5, k_S = 0.4$

$\therefore K_S < K_C < K_R$

$\Rightarrow V_R < V_C < V_S$

8. **(d)** Acceleration due to gravity at a depth d

$g = g_0 = \left(1 - \frac{d}{R}\right)$

Distance from earth centre $x = R - d$

$d = R - x$

$\Rightarrow g = g_0 \frac{x}{R}$

Thus acceleration due to gravity increases linearly with the increase in distance from centre of earth

Acceleration due to gravity at a height h

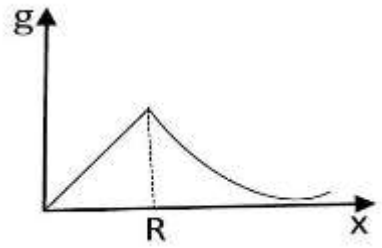
$g = g_0 \left(\frac{R}{R + h}\right)^2$

Distance from earth centre $x = R + h$

$h = x - R$

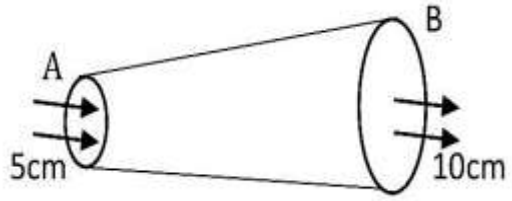
$g = g_0 \left(\frac{R}{x}\right)^2$

So acceleration due to gravity decreases as $\frac{1}{x^2}$ with the increase in distance from centre of earth.



9. **(c)** The length and shape of the spring changes and the weight of the load behaves as a deforming force. The change in length corresponds to longitudinal strain and change in shape corresponds to shearing strain.

10. **(a)**



$D_A = 5$ cm, $D_B = 10$ cm

From continuity equation

$A_1 V_1 = A_2 V_2$

Where,

$V_1 = V_A$

$V_2 = V_B$

$\therefore \frac{\pi D_A^2}{4} V_A = \frac{\pi D_B^2 V_B}{4}$

$\frac{V_A}{V_B} = \frac{D_B^2}{D_A^2} = \frac{(10)^2}{(5)^2}$

On solving

$\frac{V_A}{V_B} = \frac{4}{1}$

11. (b) Using newton's law of cooling with approximation

$\frac{dT}{dt} = \frac{-k}{ms}\left(T_{avg} - T_{surrounding}\right)$

Case I: - $dt = 2$ min, $T_s = 20°C$

$T_{avg} = \frac{94 + 86}{2} = 90°C$

$dT = 94 - 86 = 8°C$

$\frac{-k}{ms} = \frac{dT}{dt} \times \frac{1}{\left(T_{avg.} - T_s\right)} \Rightarrow \frac{8}{2} \times \frac{1}{(90 - 70)}$

$\underline{-k} = 0.05714$

ms

Case II: -

$T_s = 20°C$, $T_{avg} = \frac{74 + 66}{2} \Rightarrow 70°C$

$dT = 74 - 66 = 8°C$

Now value's putting in equation

$\frac{8}{dt} = 0.05714 \times (70 - 20)$

$\therefore dt = 2.8$ min

12. (d) Heat conducted by Rod

$Q = \frac{KAt\Delta T}{\ell}$

$A = \pi r^2$

So,

The rate of the flow of heat

$$\frac{d\theta}{dt} \propto \frac{A\Delta T}{\ell}$$

On considering above relation

The option $\Rightarrow r = 2\ cm, \ell = \frac{1}{2}\ m$

13. (b) Given: -

$T_M = 400k$

$T_L = 300k$

$W = 800\ J$

We know

Efficiency $(\eta) \Rightarrow 1 - \frac{T_L}{T_H} = \frac{W}{Q}$

$$1 - \frac{300}{400} = \frac{800}{Q}$$

On solving

$Q = 3200J$

14. (a) Maximum velocity, $V_{max} = \omega_A \Rightarrow 0.5\ m/s$

Maximum acceleration, $amax = \omega^2\ A \Rightarrow 1\ m/s^2$

Angular frequency $\omega = \frac{a_{max}}{v_{max}}$

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

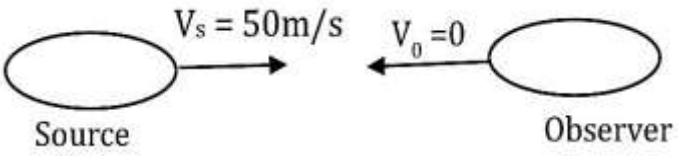
$\omega = 2rad/s$

15. (c) Speed of source, $V_s = 50\ m/s$

$V = 350\ m/s$ [speed of sound]

Using Doppler formula: -

$$f' = \left[\frac{v + v_0}{v - v_s}\right] f$$



Given:- Frequency Heard by observer (f'') $= 500$ Hz

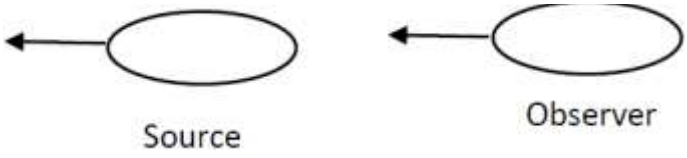
From equation (1)

$$500 = \left[\frac{350+0}{350-50}\right] f$$

$$500 = \left(\frac{35}{30}\right) f$$

$$f = \frac{15{,}000}{35}$$

$$f = 428.6$$



Frequency heard observer is $(f'') = \left[\frac{350+0}{350+50}\right] 428.6$

$$\Rightarrow \left[\frac{35}{40}\right] 428.6 = 375 \text{ Hz}$$

16. (d)

17. (a) Distance $S = h$

Electrostatic force $F = eE$

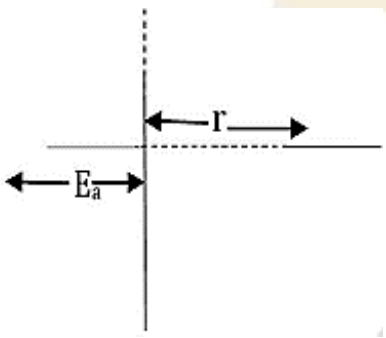
$$a = \frac{F}{m} = \frac{eE}{m}$$

$$S = ut + \frac{1}{2}at^2$$

$$\therefore h = 0 + \frac{1}{2} \times \frac{eE}{m} t^2$$

$$t = \sqrt{\frac{2hm}{eE}}$$

18. (c)



E.F. on axial line of dipole is

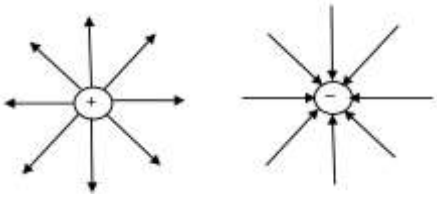
$$\vec{E}_{ax} = \frac{2\vec{p}}{4\pi\varepsilon_0 r^3}, r > a$$

E.F. on equatorial line of dipole is

$\vec{E}_{eq} = \frac{\vec{p}}{4\pi\varepsilon_0 r^3}, r > a$

So, $\vec{E}_{ax} = -2\vec{E}_q$

19. (b)



For a point charge, equipotential surface are concentric spherical shells with centre at the point charge.

20. (d) Given:-

$r_1 = 1\ m,\ r_2 = 10\ m$

$q_1 = 1\mu$

$q_2 = 2mc$

$U_i = \frac{kq_1q_2}{r_1} = \frac{9 \times 10^9 \times 10^{-6} \times 2 \times 10^{-3}}{1}$

On solving

$U_i = 18\ J$

$K_i = 0$

$U_f = \frac{9 \times 10^9 \times 10^{-6} \times 2 \times 10^{-3}}{10} \Rightarrow 1.8\ J$

$K_f = 0 + \frac{1}{2}mv^2$

$K_f = \frac{1}{2} \times (0.001) \times v^2$

$K_f = 0.0005 \times v^2$

Now Apply Energy Conservation

$\therefore K_f + U_f = K_i + U_i$

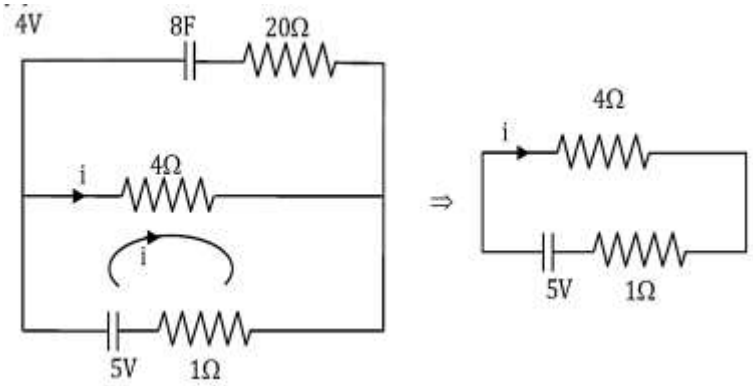
$0.0005v^2 + 1.8 = 0 + 18$

$0.0005v^2 = 16.2$

On solving

$v = 180\ m/s$

21. (a)



No current through 20Ω

$$v_{4\Omega} = 4\Omega \times 1\ A\ i = \frac{5v}{(4+1)} = 1\ A$$

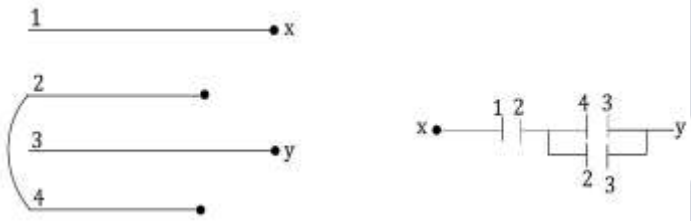
$$= 4\ V$$

$$V_C = 4V \Rightarrow Q = C \times VV$$

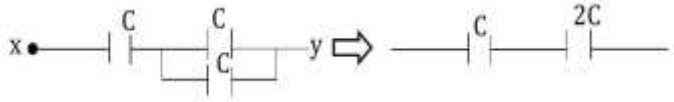
$$= 8F \times 4V$$

$$Q = 32C$$

22. (c)



Capacitance of each capacitor; $c = \frac{A\varepsilon_0}{d}$



Equation capacitance between x and y

$$C_{eq} = \frac{C \times 2C}{C + 2C} = \frac{2}{3}C$$

$$C_{eq} = \frac{2}{3}\frac{A\varepsilon_0}{d}$$

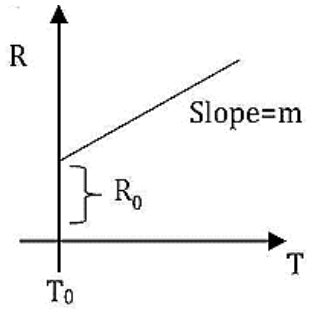
23. (b) Mobility of free $-e^-, \mu = \frac{q\tau}{m}$

$\mu = \tau$ [q & m are constant]

Hence,

Mobility of free $e^- \propto$ relation time

24. (d)



Resistance of conductor, $R = R_0(1 + \alpha\Delta T)$…… (1)

$\Delta T = T - T_0$

From graph

$R = R_0 + m(T - T_0)$

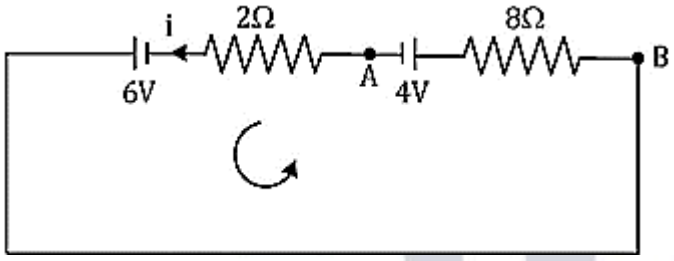
$= R_0 + m\Delta T$……. (2)

Equation (1) & (2)

$R_0 + \alpha(\Delta T) = m(\Delta T)$

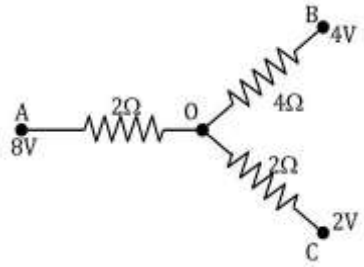
So, $\alpha = m/R_0$

25. (b)



Using kirchhoff's second law from A to B in direction of Anti-clock wise.

26. (d)



Apply K.V.L.

$$\frac{8 - v}{2} = \frac{v - 4}{4} + \frac{v - 2}{2}$$

$$\frac{8 - v}{2} = \frac{v - 4 + 2v - 4}{4}$$

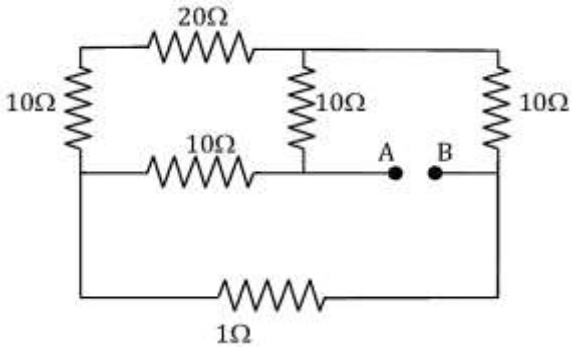
On solving

$16 - 2v = 3v - 8$

$5v = 24$

$v = \frac{24}{5} \Rightarrow 4.8v$

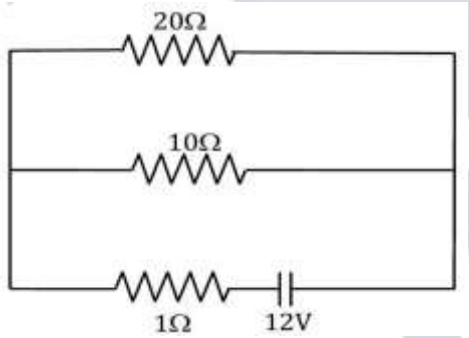
27. (a)



The given circuit represents a balanced wheat stone bridge and each resistance is equal to 10Ω

So, Reg $= 10\Omega$

28. (c)



Let, potential drop across 10Ω and 20Ω resistor is V

$p_1 = \frac{V^2}{R} = \frac{V^2}{10}$ watts

$p_2 = \frac{V^2}{R} = \frac{V^2}{20}$ watts

$\therefore p_1 : p_2 = \frac{V^2}{R} : \frac{V^2}{20}$

$p_1 : p_2 = 2 : 1$

29. (d) The magnetic field due to a solenoid at the axis is along the axis. Hence, if a proton projected with a velocity ' v ' along the axis, its velocity will be parallel to the magnetic field. If there is no component of velocity of proton $\perp$ to the magnetic field, net force on the proton will be zero and proton will continue to move along the axis with velocity ' v '

30. (c) $v = \frac{Bqr}{m}$

$V \propto r$

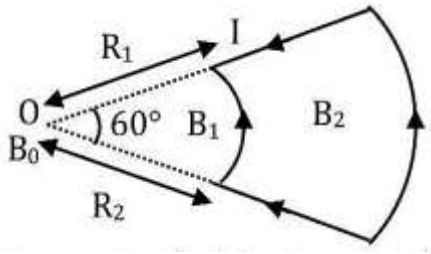
Angular velocity $\omega = \frac{Bq}{m}$

ω = constant

Hence,

v increases, ω remains constant.

31. (a)



Magnetic field at point ' O '

$$B = \frac{\mu_0}{4\pi}\frac{0_1}{r}(\alpha)$$

$$\alpha = 60^\circ = \frac{\pi}{3} \sim$$

$$B \propto \frac{1}{R}$$

$$B_1 = \frac{\mu_0 I}{4\pi R_1} \times \frac{\pi}{3} \Rightarrow \frac{\mu_0 I}{12R_1}$$

$$B_2 = \frac{\mu_0 I}{4\pi R_2} \times \frac{\pi}{3} \Rightarrow \frac{\mu_0 I}{12R_2}$$

So, magnetic field at point ' O ' $B = B_1 - B_2 = \frac{\mu_0}{12}\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

32. (b) Given: -

Current, $I = 20$ A

Time, $T = 1\text{hr}30$ min

$= 1.5 \times 3600$

$T = 5400$ sec.

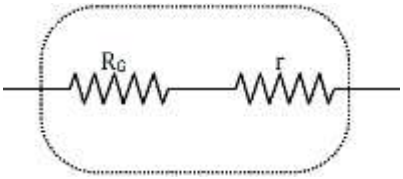
$q = I \times t$

$= 20 \times 5400$

On solving

$q = 10.8 \times 10^4 c$

33. (a)



$Ig_g = 5\ mA = 0.005\ A$

$V = 20volts$

$R_G = 50\Omega$

$\therefore V = Ig_g(R_G + r)$

$20 = 0.005(50 + r)$

$\frac{20}{0.005} = 50 + r$

$4000 = 50 + r$

$R = 4000 - 50 \Rightarrow 3950\Omega$

In series with galvanometer

34. (b) According to curie's law

$x \propto \frac{1}{T}$

$\therefore \frac{x_1}{x_2} = \frac{T_2}{T_1}$

$x_1\ T_1 = x_2\ T_2$

35. (c) Magnetic field of earth, $B = \frac{B_H}{\cos\theta}$

Given: -

Magnetic field of horizontal component of earth

$BH = 3.0G$

$\theta = 30°$

Now, value putting in equation (1)

$B = \frac{3.0}{\cos 30°}$

$B = 3.5G$

36. (d) The process of super imposing message signal on carrier wave is modulation. High frequency signals on the other hand can be sent over large distances with small dissipation in power.

37. (a) $I = 1\ A$

No. of turns, $n = 40$ turns per cm $\Rightarrow 4000$ per m.

Now,

Apply formula

Energy stored per unit volume, $(u) = \frac{\mu_0 n^2 I^2}{2}$

$$\therefore u = \frac{4\pi \times 10^{-7} \times (400)^2 (1)^2}{2}$$

On solving

$u = 3.2\pi J/m^3$

38. (b) Angular velocity is constant

$V = 0$, increase to $V = \omega L$

$$V_{avg.} = \frac{0 + \omega L}{2}$$

$$V_{avg.} = \frac{\omega L}{2}$$

We know that

$\varepsilon = BV_{avg} L$

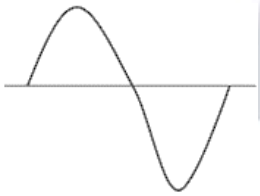
$$= B\left(\frac{\omega L}{2}\right)^2 \varepsilon = \frac{1}{2}\omega BL^2$$

39. (c) $F = 50$ Hz

$I_{rms} = 6$ A

Iavg. = ?

Iavg $= 0$



As, current is negative for same amount of time for which it is positive.

So, Average value of AC current over a cycle is zero.

40. (a)

Given: -

$C = 10\mu \Rightarrow 10^{-5}$ F

$V = 50\sqrt{2}\sin 100t$

On comparing

$V = V_0 \sin \omega t$

$V_0 = 50\sqrt{2}$

$\omega = 100$

Now,

$V_{rms} = \frac{50\sqrt{2}}{\sqrt{2}} = 50 volts$

$Irms = \frac{V_{rms}}{x_c}$

$\left[\because x_c = \frac{1}{\omega_c}\right]$

$I_{rms} = \frac{V_{rms}}{1/\omega c} \Rightarrow \omega_c V_{rms}$

$I_{rms} = 100 \times 10^{-5} \times 50$

$= 50 \times 10^{-3}\ A$

$= 50\ mA$

41. (d) Given: -

$V_L = 40\ V$

$V_C = 120$

$V_R = 60$

Source voltage, $(V_s) = \sqrt{(C_C - V_L)^2 + V_R^2}$

$V_s = \sqrt{(120-40)^2 + (60)^2}$

$= \sqrt{(80)^2 + (60)^2}$

$= \sqrt{6400 + 3600} = \sqrt{10{,}000}$

$V_s = 100\ V$

42. (b) Power dissipated in A.C. circuit is

$P = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \cos\phi$

$\theta = 60^\circ$

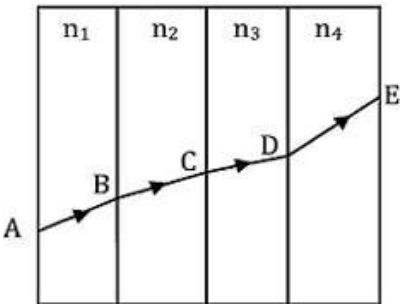
$P = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \cos 60^\circ$

$\Rightarrow \frac{V_0 i_0}{\sqrt{2}} \times \frac{1}{2}$

$\Rightarrow \frac{V_0 i_0}{4}$

43. (c) The electromagnetic radiation used to sterilise the milk in dairy is ultraviolet

44. (c)
45. (a)



Angle of incidence = Angle of refraction

$i = r$

Using snell's law of refraction

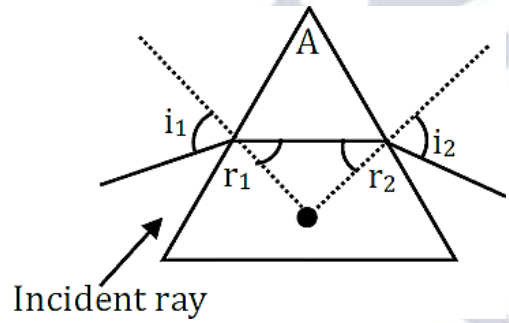
$n_1 \sin i = n_4 \sin i$

$\therefore n_1 = n_4$

46. (c) A convex lens forms an erect and enlarged image when the object is placed between focus and the lens. So, object distance must be less then the focal length of the lens.

Thus, object distance must be 15 cm.

47. (b)



$n_1 = 1$, $n_2 = \sqrt{2}$
$A = 60°$ (equilateral prism)
By geometry
$A = r_1 + r_2$ ……. (1)
For min. deviation
$A = r_1 = r_2$ …… (2)
From equation (1) & (2)

$$A = 2r_1$$
$$R_1 = \frac{60}{2} = 30°$$

Using snell's law

$n_1 = \sin i_1 = n_2 \sin(r_1)$

1. $\sin i_1 = \sqrt{2} \times \frac{1}{2}$

After solving

$i_1 = 45°$

48. (d) The light from two slits of young's double-slit experiment is of different colours, and having different wavelengths and frequencies. Hence, there shall be no interference fringes.

49. (a)

$\lambda = 600 \text{ nm} \Rightarrow 600 \times 10^{-9} \text{ m}$

Linear width of central maxima is $= \frac{2\lambda D}{a}$

Angular width $= \frac{2\lambda}{d}$

$d = 0.2 \text{ mm} = 0.2 \times 10^{-3} \text{ m}$

So,

Angular width $= \frac{2(600\times10^{-9})}{0.2\times10^{-3}}$

After solving

Angular width $= 6 \times 10^{-3}\text{rad}$

50. (b)

Aperture width $a = 4 \text{ mm} \Rightarrow 4 \times 10^{-3} \text{ m}$

Wavelength

$\lambda = 400 \text{ nm}$
$= 400 \times 10^{-9} \text{ m}$

So,

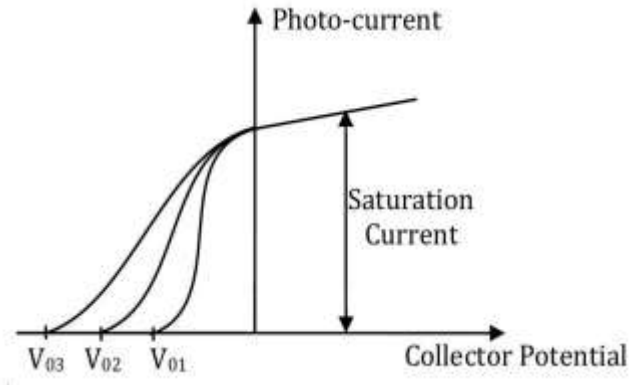
Fresnel distance: -

$D_f = \frac{a^2}{\lambda} \Rightarrow \frac{(4 \times 10^{-3})^2}{400 \times 10^{-9}}$

After solving

$D_f = 40\text{m}$

51. (c)



Retarding potential

$V_{03} > V_{02} > V_{01}$ [stopping potential]

Minimum Energy of photon required for emission ' α ' stopping potential

$E_3 > E_2 > E_1$

$E = h\nu$

So,

$V_3 > V_2 > V_1$

52. (d) Using de-Broglie wavelength

$$\lambda = \frac{123}{\sqrt{v}} \text{ Å}$$

Given: -

$V = 400v$

$$\lambda = \frac{12.3}{\sqrt{400}} \Rightarrow \frac{12.3}{20} \text{ A°}$$

$= 0.615\text{A°}$

$\lambda = 0.0615$ nm

53. (b) $-3.4ev = K.E + P.E.$ ..... (i) [Given]

The relation b/w P.E. & K.E

P.E. $= -2$ K.E……. (ii)

Use the relation in equation (i)

$-3.4ev = K.E. - 2K.E.$

K.E. $= 3.4ev$

From equation (ii)

P.E. $= -2(3.4ev)$

P.E. $= -6.8$ev

54. (c) From Bohr's postulate, the angular momentum is:-

$$mvr = \frac{nh}{2\pi}$$

For $n = 4$

$mvr = \frac{4\,h}{2\pi}$ .....(i)

For $n = 1$

$mvr = \frac{1\,h}{2\pi}$ .....(ii)

Thus, the change in angular momentum

$$\Delta mvr = \frac{4\,h}{2\pi} - \frac{h}{2\pi}$$

$$\Delta mvr = \frac{3\,h}{2\pi}$$

55. (a) Nuclei present after 5 days, $N = N_o \exp\left(\frac{-0.693}{T_{2/2}}t\right)$..... (1)

Given: -

$N_o = 1000x$

$T_{1/2} = 10$ days

$t = 5$ days

Substitute's values in equation (1)

$$N = 1000x \times \exp\left(\frac{-0.693 \times 5}{10}\right)$$

$N = 1000x \times \exp.(-0.346)$

$N = 1000x \times 0.707$

$N = 707x$

56. (d) A&Z = mass number

$${}^{A}_{z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$$

$${}^{A-4}_{z-2}Y \rightarrow {}^{A-4}_{z}Z \rightarrow +2e^{-}$$

x&z are isotopes.

57. (b) $E = 6Mev \Rightarrow 6 \times 1.6 \times 10^{-13}$ J

$m = 20u \Rightarrow 20 \times 1.6 \times 10^{-27}$ kg

Momentum of γ-photon, $P = E/C$

$P = P = E/C$ [momentum of Nucleus]

$$K = \frac{P^2}{2\,m} \Rightarrow \frac{E^2}{2mc^2}$$

$$K = \frac{(6 \times 1.6 \times 10^{-13})^2}{2 \times (20 \times 1.6 \times 10^{-27}) \times (3 \times 10^8)^2}$$

After solving

K.E. $= 1$Kev

58. (c) To convert AC to DC, a full wave rectifier is required the O/P of the full wave rectifier will be positive cycles of the applied input AC voltage. To convert the positive cycles to ripples a RC filter will be required.

59. (a) Current gain $\beta = \frac{\Delta I_C}{\Delta I_b}$

Given: -

$\Delta I_c = 0.49$ mA

$\Delta Ie = 0.50$ mA **[emitter current]**

Change in base current: -

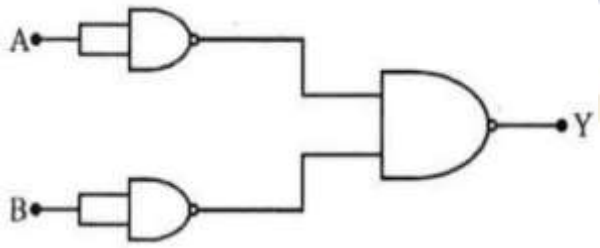
$\Delta Ib = \Delta Ie - \Delta I_c$

$= 0.50 - 0.49 \Rightarrow 0.01$ mA

Substitute value in equation (1)

$$\therefore \beta = \frac{0.49}{0.01} = 49$$

60. (d)



$C = \overline{A}\overline{B} = \overline{A}$

$D = \overline{B}$

$Y = \overline{C}\overline{D}$

$= \overline{A} + \overline{B}$

A	B	C	D	Y	
0	0	1	1	0	} OR Gate
0	1	1	0	1	
1	0	0	1	1	
1	1	0	0	1	

Chemistry

61. (a)

Given that:

Half life $(t_{1/2}) = 60$ min.

Percentage left after 240 min = ?

From Ist order kinetic equation $t_{1/2} = \frac{2.303}{k}\log\frac{a}{a-\frac{a}{2}}$

$$t_{1/2} = \frac{2.303}{k}\log 2$$

$$k = \frac{2.303}{60}\log 2 min^{-1}$$

Again from Ist order kinetic equation $t = \frac{2.303}{k}\log\frac{a}{a-x}$

So, $\log\frac{a}{a-x} = \frac{t.k}{2.303}$

$$= \frac{240 \text{ min} \times 2.303 \times \log 2}{60 \times 2.303}$$

$$\log\frac{a}{a-x} = 4\log 2$$

$$\frac{a}{a-x} = 2^4$$

$$\frac{a}{a-x} = 16$$

If initial concerntationa taken as 100%

Then, % of the reactant left after 240 min $= \frac{100}{a-x} = 16$

$$a - x = \frac{100}{16}\%$$

$$a - x = 6.25\%$$

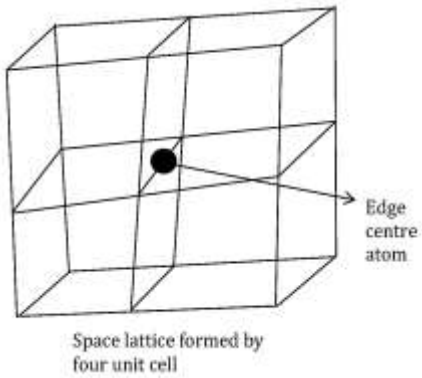
62. (b) Colligative properties of solutions are properties that depend upon the concentration of solute molecules or ions, but not upon the identity of the solute.

Colligative properties include vapour pressure lowering, boiling point elevation, freezing point depression and osmotic pressure.

Whereas optical activity is the ability of a chiral molecule to rotate the plane of plane

polarized light. So, optical activity is not a colligative property.

63. (b) An atom present at the edge centre of a unit cell is shared by four-unit cells.



The contribution from each edge centre atom is thus $1/4$.

64. (a) Van't Hoff factor is the ratio of the concentration of particles formed when a substance is dissolved to the concentration of the substance by mass.

$i = \frac{\text{measured value}}{\text{Calculated value}}$ Electrolytes are dissociated in the solutions, for dissociation in absence of association, the van't Hoff factor is i>1.

65. (d) Galvanic Cell also called as voltaic Cell. In Galvanic Cell at Cathode reduction will take place (gain of e^-will take place). So it is act as sink of electrons. On Cathode positive polarity developed. Anode is of negative polarity. On anode oxidation will take place. So it is act as source of electrons.

66. (c) A Secondary Cell is a type of electrical battery. In secondary Cells, the reaction can be reversed by passing current through it in the opposite direction. That is why these cells can be recharged by passing electric current and can be used again and again. These Cells also called storage Cells.

67. (a) Osmotic pressure (π) of a solution is affected by concentration of solute and temperature.

As we know $\pi = CRT$

Here π = atom $\begin{cases} C = mol/Lt \\ R = 0.082 Ltatm.mol^{-1}k^{-1} \\ T = \text{ Kelvin} \end{cases}$

So, $\pi \propto$ Concentration (molarity)

$\pi \propto T$

Thus osmotic pressure is directly proportion to temperature. So Osmotic pressure increased with the increase in temperature

68. (c)

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

Oxidation state of chromium consider as x,

$2x + 7(-2) = -2$

$x = \frac{14 - 2}{2} = +6$

Electrons required for reduction of two chromium ion will be:

$\Rightarrow 2(6 - 3) = 6e^-$

Charge required for 1 mole $e^- = 1$ F Charge

So, Charge required for 6 mole $e^- = 6$ F Charge

69. (b) From a chemical reaction

$mA \longrightarrow xB$

The rate law $(r) = k[A]^2$

When the concentration is doubled, then

$r = k[2]^2$

$\therefore r = 4k$

The rate of reaction will be quadrupled.

70. (b) Schottky defect is a type of point defect or imperfection in solid arises when equal number of Cations and anions are missing from the lattice. Where both Cations and anions are of the same size.

71. (b) For the given reaction: $3\ A \longrightarrow 2\ B$

Rate of disappearance of $A = -\frac{1}{3}\frac{d[A]}{dt}$

Rate of appearance of $B = +\frac{1}{2}\frac{d[B]}{dt}$

So, the overall rate of the reaction $\Rightarrow -\frac{1}{3}\frac{d[A]}{dt} = +\frac{1}{2}\frac{d[B]}{dt}$

$\therefore \frac{d[B]}{dt} = -\frac{2}{3}\frac{d[A]}{dt}$

72. (a) From the Arrhenius equation: $K = Ae^{-\frac{Ea}{RT}}$

K is the rate constant

Ea = activation energy

R = gas constant

T = Temperature (in Kelvin)

A = Arrhenius factor

The activation energy can also be calculated directly given two known temperatures and a rate constant at each temperature. Suppose that at two different temperatures T_1 and T_2, reaction rate constants k_1 and k_2.

$\ln\left(\frac{k_1}{k_2}\right) = \left(\frac{1}{T_2} - \frac{1}{T_1}\right)\frac{E_a}{R}$ ____ Arrhenius equation

73. (d) Physisorption: Adsorption is caused by van der waals forces. It is an exothermic process.

Enthalpy change for physical adsorption: -

$\Delta H = \Delta G + T\Delta S$

The entropy change of the adsorbate ΔS necessarily negative since the adsorbed state is more ordered than the unadsorbed state due to a loss of at least one degree of freedom. The ΔG is negative for spontaneity of adsorption process. Hence, enthalpy change ΔH accompanying physical adsorption is always negative (exothermic).

74. (c) Sulphur sols are colloidal solutions of elemental Sulphur or of Sulphur rich compounds. The particle in these-solution have diameters of $0.1 - 1.0\mu m$ and consist large aggregation of S8 molecules (Hydrophobic sols) or of chain - like Sulphur compounds with Hydrophilic end.

75. (d) The Characteristic feature of Zeolites is openness of the structures. Which permit cavities of different sizes. The reaction - selectivity of Zeolites depends upon the size of cavities (Cages), pores (apertures) and the distribution of pores in the structure. The pore size in Zeolites generally varies from $260pm$ to $740pm$.

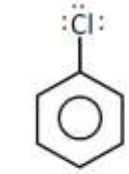
76. (a)

$$\overset{4}{C}H_3 - \overset{3}{C}H = \overset{2}{C}H - \overset{1}{C}H_2 - Br$$

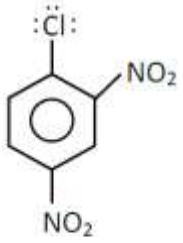
First select longest carbon chain (parent chain). Then parent chain numbed so that the multiple bond and substituent have lowest number. For double bond 'ene' suffix is use.

IUPAC name of this compound: 1-bromobut-2-ene.

77. (d) Replacement of Cl^- group by - OH group is a nucleophilic substitution reaction.



Chlorobenzene



2,4–dinitrochlorobenzene

In Chlorobenzene, lone pair of chlorine involves in resonance and develop partial double bond character, bond gets stronger. Hence, requires drastic conditions to form phenol. But in 2, 4-dinitrochlorobenzene, $-NO_2$ group is electron withdrawing group and deactivates ortho and para position as compared to meta position. Which decrease density of benzene ring. So, Chlorine can be easily replaced at normal condition.

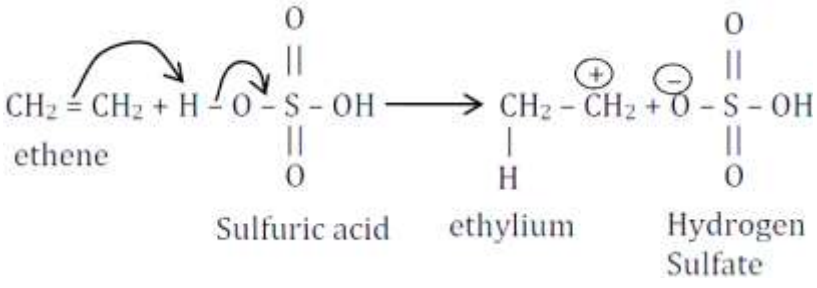
78. (d)

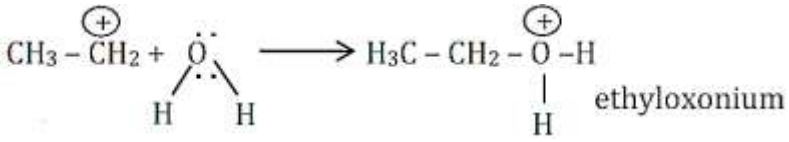
$$\underset{\text{ethanol}}{C_2H_5OH} + \underset{\text{phosphorus pentachloride}}{PCl_5} \longrightarrow \underset{\text{(X)}}{\underset{\text{ethyl Chloride}}{C_2H_5Cl}} + \underset{\text{Phosphoryl chloride}}{POCl_3}$$

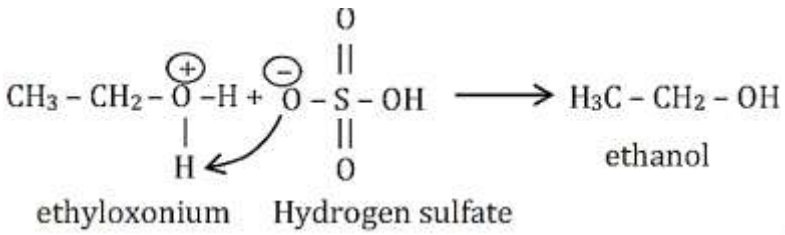
$$\underset{\text{(X)}}{C_2H_5Cl} + \underset{\text{alcoholic Potassium hydroxide}}{alc.KOH} \longrightarrow \underset{\text{(Y)}}{\underset{\text{ethene}}{CH_2 = CH_2}} + \underset{\text{Potassium Chloride}}{KCl} + \underset{\text{Water}}{H_2O}$$

$$\underset{\text{(Y)}}{CH_2 = CH_2} + \xrightarrow[H_2O.\Delta]{H_2SO_4.\text{Room temp.}} \underset{\text{(Z)}}{\underset{\text{ethylalcohol}}{CH_3 - CH_2 - OH}}$$

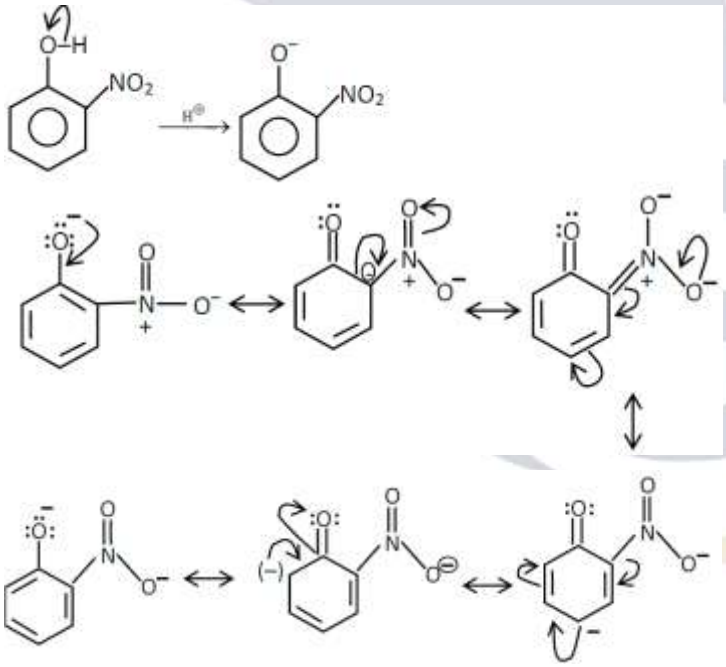
Mechanism for this reaction





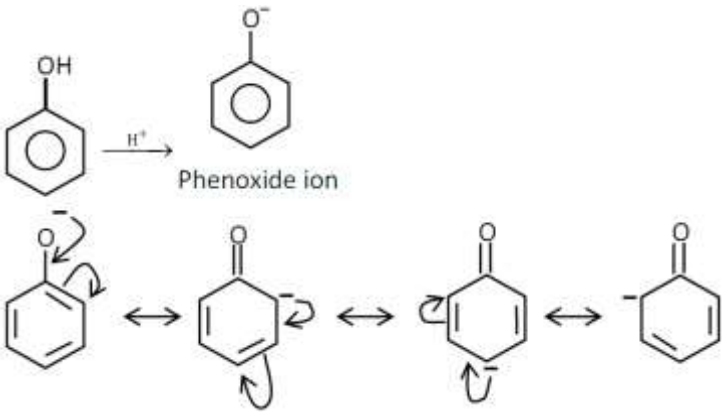


79. (c) The Nitro group is electron withdrawing in nature. In o-nitrobenzene after removal of Hydrogen atom, the structure is resonance stabilizes and being more acidic than other compounds.



Resonance delocalization of negative charge from the phenolate to the oxygen of onitro group.

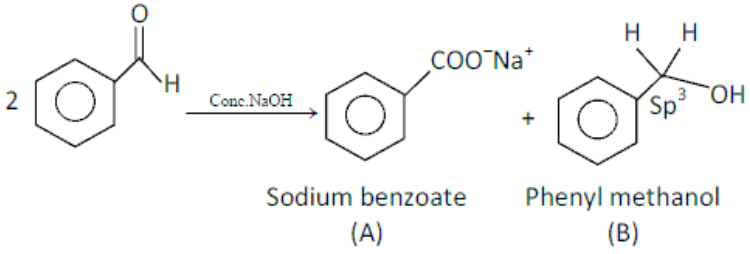
In Phenol, removal after H^+ions, phenoxide ion is formed, which resonance stabilized.



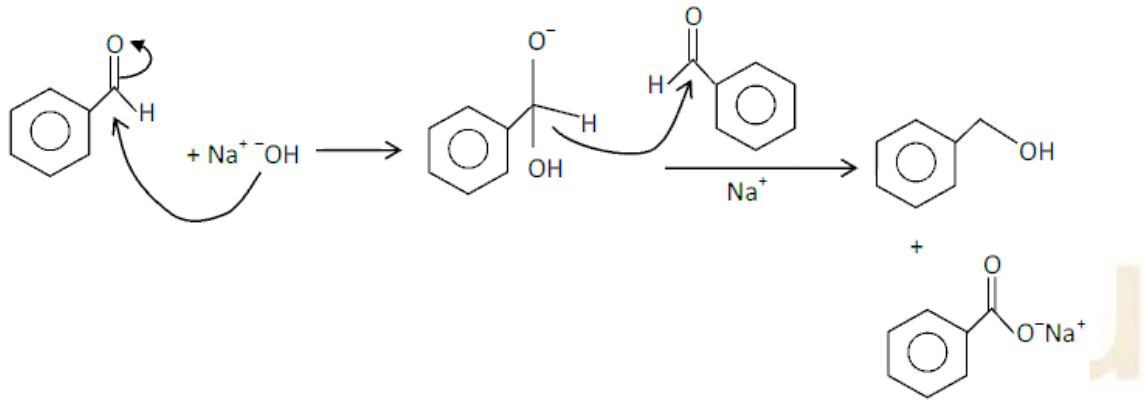
Resonating structures of phenoxide ion Number of resonating structure decides the stability of compounds. Phenol is more stable than alcohol and less acidic than o-nitro phenol. m-cresol, CH_3 group is e^-donating in nature so removal of H^+ion is less favourable as compared to other compound.

80. (a) Benzadehyde or an aldehyde without active hydrogen undergoes a redox reaction under the action of strong base, known as cannizaro reaction.

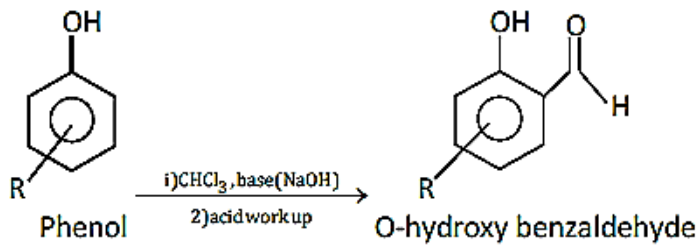
It undergoes disproportionation reaction under the action of a strong base (NaOH) to form molecule of alcohol and carboxylic acid or sodium benzoate which can be used as food preservative to extend shelf life. Chemical equation is:



Mechanism of cannizaro reaction



81. (a) Reimer - Tiemann reaction This reaction used to convert phenol to an o-hydroxy benzaldehyde using chloroform, a base and acid work up.



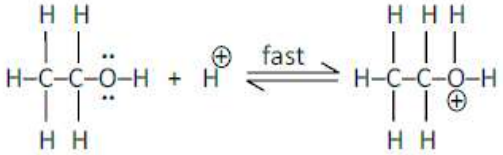
In this reaction mechanism dichlorocarbene free radical is used as electrophile.

$$Na^+\bar{O}H + CHCl_3 \xrightarrow{-HCl} \underset{\text{dichlorocarbene free redicals}}{:CCl_2}$$

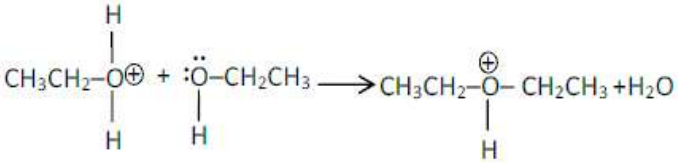
82. (a)

$$\underset{\text{ethanol}}{2CH_3CH_2OH} \xrightarrow[140^\circ C]{\text{Conc } H_2SO_4} CH_3CH_2-O-CH_2CH_3 + H_2O$$
ethoxy ethane

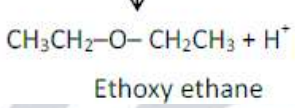
Due to the presence of lone pairs of electron in oxygen, ethanol act as weak base, it reacts with strong mineral acids. Convention of ethanol to ethoxy ethane follows SN^2 mechanism.



ethanol Protonated alcohol



Ethyl oxonium ion

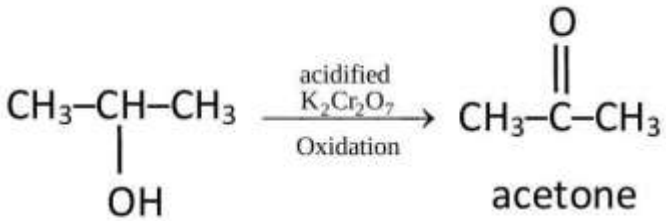


Ethoxy ethane

83. (a) On oxidation of compound (x) in presence of strong oxidizing agent oxidation product is formed, this oxidation production react with phenyl hydrazine that means it is a carbonyl group (aldehyde or ketone) containing compound.

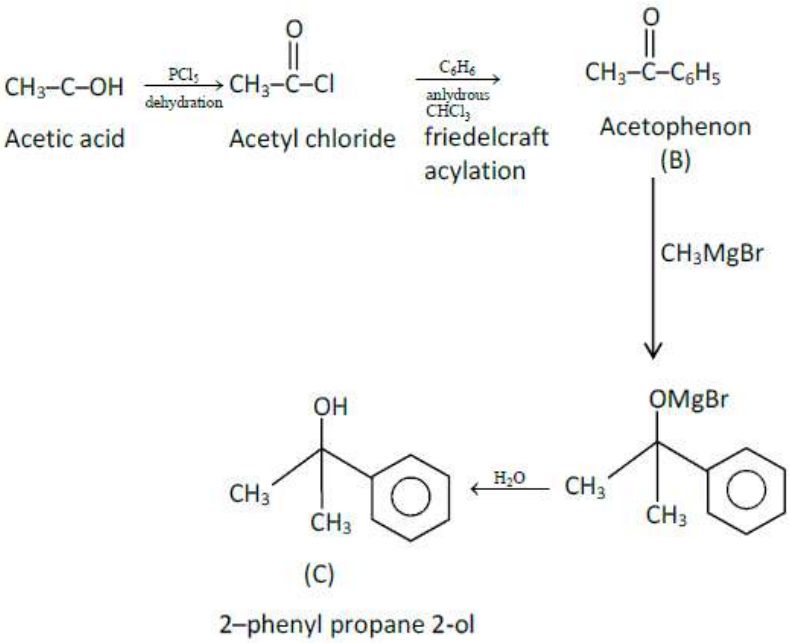
Silver mirror test only given by aldehydes not by Ketones. Thus product must be ketone.

As we know primary alcohol oxidized to give aldehyde whenever secondary alcohol oxidised to give ketone.



2-propanol acetone

84. (d)



85. (a) Molar mass of $CO_2(M_{wt}) = 44\ g/mol$

Given mass of $CO_2(w) = 4.4\ g$

Moles of $CO_2(n) = \frac{\text{given mass}}{\text{molecular mass}} = \frac{4.4}{44} = 0.1\ mol$

One CO_2 molecule having two oxygen atoms

So, total number of oxygen - atom $= 2 \times$ number of moles $\times N_A$

$= 2 \times 0.1 \times 6.023 \times 10^{23}$ atoms
$= 1.2 \times 10^{23}$ atoms

86. (d)

Given that:
Bond energies of $H - H = 433 KJmol^{-1}$
Bond energies of $Br - Br = 192 KJmol^{-1}$
Bond energies of $H - Br = 364 KJmol^{-1}$

$H - H + Br - Br \longrightarrow 2H - Br$
$\Delta H^0 = \Sigma$ bond energy (reactant) $-$ -bond energy (products)
$= 433 + 192 - 2 \times 364$
$= +625 - 728$
$= -103 KJ$

87. (c) For the reaction:

$Fe(OH)_{3(s)} \longrightarrow Fe^{+3}(aq.) + 3\ \bar{O}H$

Equilibrium constant $(k) = [Fe^{+3}][-OH]^3$

If concentration of ^-OH ion is decreased by $1/4$ times

Now, $K = [Fe^{+3}]\left[\frac{-OH}{4}\right]^3$

$$K = \left[Fe^{+3}\right]\left[\frac{^{-}OH}{64}\right]$$

So, at equilibrium concentration of Fe^{+3} is increased by 64 times. So that equilibrium constant does not change.

88. (a) The third law of thermodynamics tells us that all molecular movement stops at a temperature we call absolute zero or zero (0) Kelvin (-2730 C) Since temperature is a measure of molecule movement, there can be no temperature lower than absolute zero. At this temp., a perfect crystal has no disorder. The entropy (s) of a pure perfectly crystalline compound at $T = 0$ K is zero (no disorder).

$S_{T=0} = 0$

89. (d)

$$K_1 = \frac{[NO_2]}{[NO][O_2]^{1/2}} \; ; \; K_2 = \frac{[NO^2[O_2]}{[NO_2]^2}$$

If we reverse and multiply equation (a) by two then the equilibrium constant:

$$K_2 = \frac{1}{(K_1)^2}$$

90. (a) Van - Arkel method (vapour phase refining).

By this method we obtain ultrapure metal from crude metal. In this method impurities as oxygen and nitrogen present in zirconium or titanium are removed by thermal decomposition of metal. The metal once converted into unstable metal iodides which is unstable and easily decomposes to form pure metals.

91. (a) Copper matte is mixture of copper sulphide (Cu2 S) and some iron sulphide (FeS). Before final reduction process, copper is extracted from matte. When a hot blast of air is blown through a molten matte placed in a silica lined converter, FeS of the matte oxidized to FeO.

92. (a) Leaching: It is chemical method of concentration. In this process metallic ore dissolves in a suitable reagent in which metallic ore is soluble and impurities are insoluble.

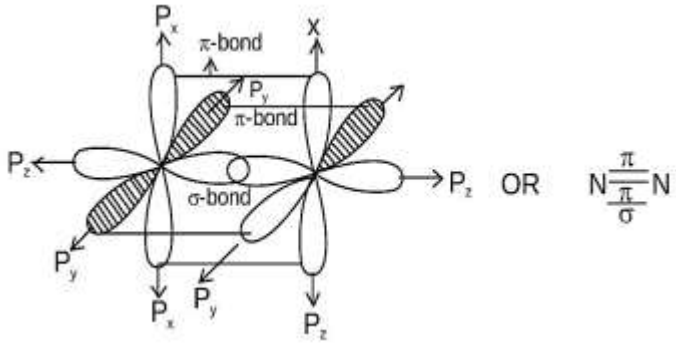
Leaching of alumina from bauxite.

$$Al_2O_{3(s)} + 2NaOH_{(aq.)} + 3H_2O_{(f} \longrightarrow 2Na[Al(OH)_4](aq.$$

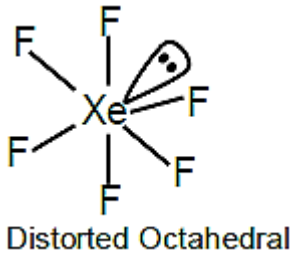
(complex)

93. (d) Bond dissociation enthalpy depends on bond strength. Bond strength depends on the attractive and repulsive force present in a molecule. The bond dissociation energy of $F - F$ is minimum as the repulsion between the bond pair and lone pairs of F is strong.

94. (d) Nitrogen can form $P\pi - P\pi$ bond with itself due to small size of N-atom. Its valence electrons are close enough to form π bond with another N-atom.



95. (b) XeF_6 molecule is $Sp^3\ d^3$ hybridized. After hybridization, XeF_6 molecular geometry will be distorted octahedral or square bipyramidal due to the lone pair of electron.

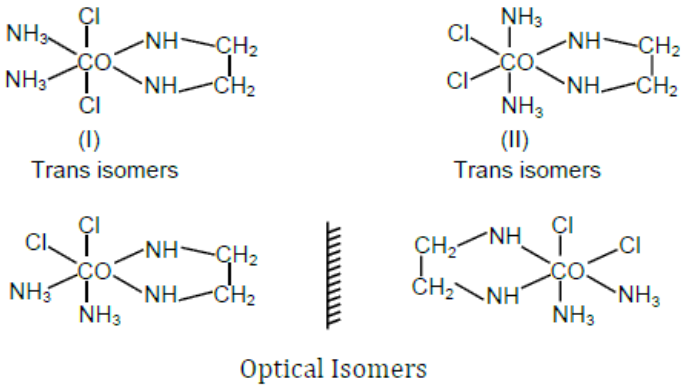


Distorted Octahedral

96. (d) Octahedral complex $[CoCl_2(en)(NH_3)_2]^4$

For this complex, there are two geometrical isomers possible i.e. cis and trans isomer.

Cis isomer has two optical isomers i.e. d-cis isomer and ℓ-cis isomer.



Cis isomer show optical isomerism due to absence of plane of symmetry.

97. (d) The lower HOMO energy means that Co is a poorer σ donor orbital towards the metal than Cl^-. Likewise, the lower LUMO makes it a better π acceptor. These two factors are conflicting stronger π acceptor are stronger field ligands. But poorer σ donors are weaker field ligands.

98. (a) Paramagnetic character of metal ion depends on number of unpaired electrons. Maximum the number of unpaired electrons maximum is the paramagnetic behavior of the element.

Electronic configuration:

Mn^{+2}: $[Ar]3\ d^5 45°\ n = 5$

Cu^{+2}: $[Ar]3\ d^9 45°\ n = 1$ {∵ n = number of unpaired electrons }

Sc^{+2}: $[Ar]3\ d^1 45°\ n = 1$

Cu^{+}: [Ar]3 $d^{10}45^{1}$ n = 1

Among these transition metals Mn^{+2} has five unpaired electron. Having maximum paramagnetic character.

99. (a)

100. **(a)** Mn^{+2} outer most electronic configurations are 3 $d^{5}4$ s°. So, Mn^{+2} gain extra stability due to half field sub shells. Removal of one more electron decreases the stability of this compound that is why it has higher 3rd ionization energy. While Fe^{+2} has 3 $d^{6}4$ s° electronic configuration by lose of one more electron from d orbital, it acquires stable half- filled configuration i.e. 3 $d^{5}4$ s°. So, Mn^{+2} stable with half filled configuration rather than Mn^{+3} and Fe^{+3} more stable than the Fe^{+2} ion.

101. **(a)** A spectrochemical series is a series of ligands ordered on ligand Strength. Ligand arranged on the left end of this spectrochemical series are generally regarded as weaker ligands and cannot cause forcible pairing of electrons within the 3 d level. On the other hand, stronger ligand lies at the right end and form inner orbital after forcible pairing of electrons hence, are called low spin ligands. Correct order of field strength of ligand as per spectrochemical series.

$SCN^{-} < F^{-} < CN^{-} < CO$

102. **(a)**

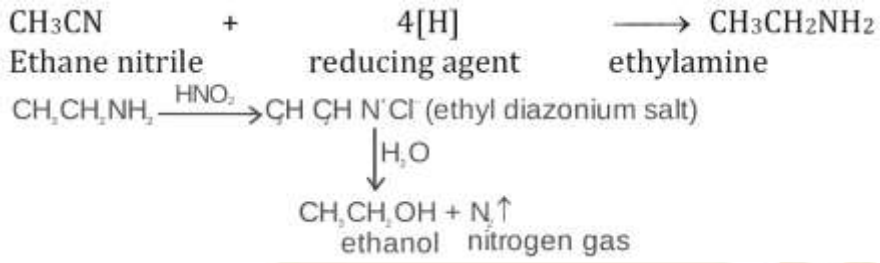
[Co (en) 2 (ONO)Cl]Cl

Oxidation state of Co. $x + 2(0) + (-1) + (-1) = +1$

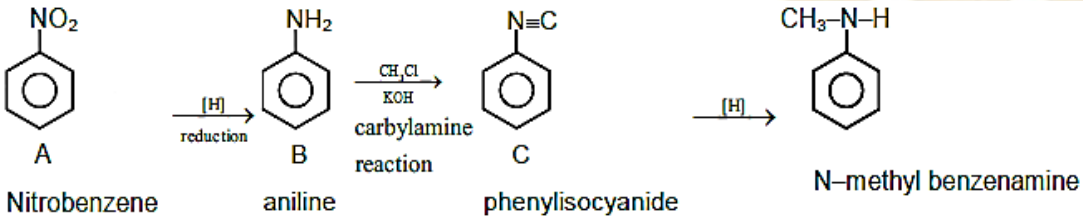
$$X = +1 + 1 + 1 = +3$$

First we write cationic part and then anionic part. Then, we place ligands according to their alphabetical order. For bidentate ligand we use prefix bis. After that, place metal and oxidation state of metal atom in roman number and anionic part. IUPAC name of [Co (en) 2(ONO)Cl] is chlorobis (ethylene diamine) nitrito-o-cobalt (III) chloride.

103. **(b)** Reduction of ethane nitrile gives ethyl amine overall CN triple bond is reduced to give a primary amine. Primary amine contains the $-NH_2$ group.



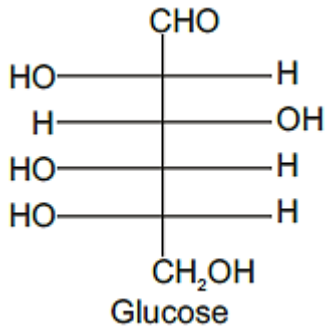
104. **(a)**



In carbylamines reaction 1° amine reacts with trichloromethane and caustic potash (KOH) to form isocyanide compound. On behalf of 10 amine we can take aniline as reduction product of nitrobenzene. So the compound A is Nitrobenzene.

105. **(b)** Fehling's solution is a chemical reagent used to differentiate between water soluble carbohydrate and ketone functional groups and as a test for reducing sugar and non reducing sugar, supplementary to the tollen's

reagent test. Glucose is a reducing sugar and contain aldehyde group give positive test with Fehling's solution. Sucrose is non reducing sugar does not give test.



Glucose

106. **(d)** The critical point is the highest temperature and pressure at which a pure material can exist in vapour/liquid equilibrium. At temperature higher than the critical temperature, the substance cannot exist as a liquid, no matter what the pressure. Since, the triple point is a point there is only one temperature and one pressure where the three phases will exist.

107. **(a)** Energy of electron in n^{th} Bohr- orbit of H-atom

Total energy ⇒ K.E + P.E.

$$E \Rightarrow \frac{Kze^2}{2r} - \frac{Kze^2}{r}$$

$$\Rightarrow \frac{-Kze^2}{r}$$

$$\Rightarrow -\frac{Kzz^2}{2\left(\frac{n^2\,h^2}{4\pi^2 mKzee^2}\right)} \Rightarrow -\frac{2\pi^2 mK^2Z^2e^4}{n^2\,h^2}$$

$$\Rightarrow \left[\frac{2\pi^2 \times 9.1 \times 10^{-31} \times (9 \times 10^9)^2 \times z^2 \times (1.6 \times 10^{-19})^4}{n^2 \times (6.624 \times 10^{-34})^2}\right] \times \frac{1}{1.6 \times 10^{-19}} ev$$

$$E \Rightarrow \frac{-13.6z^2}{n^2} ev$$

108. **(d)** The magnetic Quantum number (m_ℓ) determines the number of orbitals and their orientation. Consequently, its value depends on the orbital angular quantum number (ℓ.

If $n = 3, \ell = 2, m = -3, s = +\frac{1}{2}$

For this arrangement m_ℓ must be in range from $-\ell$ to $+\ell$,

Then m_ℓ can be varies from $-2, -1, 0, +1, +2$

109. **(d)** Bond order formula

Bond order $= \frac{1}{2} \times$ [number of an electron in anti-bonding molecular orbitals

[number of electrons in bonding molecular orbitals]

(i) B. 0 of $O_2 = \frac{1}{2} \times [10 - 6] = 2$

(ii) B. 0 of $O_2^{+} = \frac{1}{2} \times [10 - 5] = 2.5$

(iii) B. 0 of $O_2^{-} = \frac{1}{2} \times [10 - 7] = 1.5$

(iv) B.O of $O_2^{-2} = \frac{1}{2} \times [10 - 8] = 1$

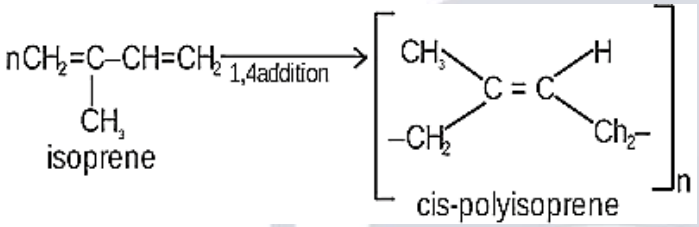
Increasing bond order is: $O_2^{2-} < O_2^{-} < O_2 < O_2^{+}$

110. **(d)** Electro negativity difference between atoms helps to determine compound's ionic or covalent character. If the Electro negativity is large, the more negative and positive the atoms became. NaCl (sodium chloride) is ionically bonded. Because Sodium has E.N of 1.0 and chlorine has an E.N of 3.0

$\Delta EN = 3.0 - 1.0 = 2.0$

Large difference in Electro negativity, make the bond between the two atoms highly polar. In Hydrogen chloride(HCl). Hydrogen has an Electro negativity of 2.1 and chlorine has 3.0. The electron pair that is bonding HCl together, shifts towards the chlorine atom because it has a large Electro negativity value. So, HCl gas is covalent.

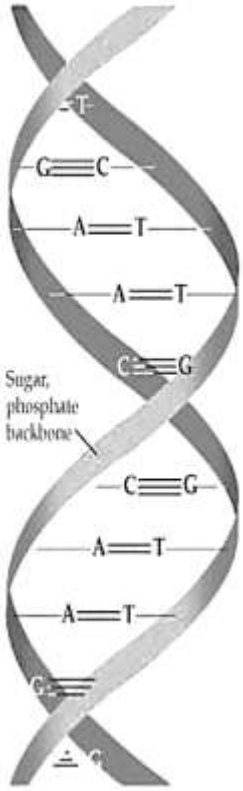
111. **(b)** Natural rubber is linear polymer of isoprene called as cis -1,4-polyisoprene.



Buna -S: It is also known as styrene butadiene rubber (SBR). It is obtained by the polymerization of butadiene and styrene in the ratio of 3: 1 in presence of sodium.

112. **(a)**

113. **(a)** DNA is double helix structure in which two nucleic acid chains are wound about each other and hold together by Hydrogen bond between pairs of bases. Adenine forms Hydrogen bond with thymine where as cytosine Hydrogen bonds with guanine.



114. **(a)** Tranquilizers (antidepressant drugs):

The chemical which are used to reduce mental tension relieves anxiety and mental stress.

i.e. Equanil

⇒ Anti-inflammatory drugs used to treat such as headache, muscle aches etc. i.e Naproxen

⇒ Tetracycline is important class of antibiotics. It is used as treatment of typhoid and treatment of eyes.

⇒ Dettol is commonly used antiseptic, the chemical which either kill or prevents the growth of microorganisms.

115. **(b)** F has smallest size among the group. I has largest size. As the size of the atom increases bond length also increases which makes bond easily to break. Bond length order of halides:

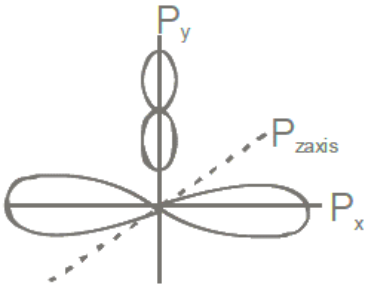
$R - I > R - Br > R - Cl > R - F$

As the bond length becomes large, compound becomes less stable readily breaks.

Reactivity order of dehydrohalogenation of alkyl halides:

$R - I > R - Br > R - Cl > R - F$

116. **(d)** Z axis is internuclear axis. There is no effective overlapping in labs. So, No bond formation between these labs



117. **(b)** Hybridization of C in diamond: -

The electronic configuration of carbon is $1\ S^2, 2\ S^2 2P^2$, i.e. with four valence electrons spread in the S and P orbitals. In order to create covalent bond in diamond, the S orbital mixes with the three P orbitals to form SP^3 hybridisation.

Hybridization of graphite: -

Graphite has a SP^2 type of hybridization. Carbon has four outer most valance electrons spread in S and P orbitals. During hybridization, the S-orbital with two Porbitals to Additionaly, each carbon atom will also consist of one non-bonded outer electrons, which becomes delocalized.

Hybridization of ethyne : -

The carbon atom consists of four outer most electron and hydrogen has only one.

Ground state $_6C$: $1\ S^2, 2\ S^2 2P_x\ ^1 2P_y\ ^1 2P_z$

Exited state $_6C$: $1\ S^2, 2\ S^2, 2Px^1, 2P_y\ ^1, P_z$

So, here one S and two P orbitals participate in hybridization. The hybridization of ethyne is SP. The hybridization of C in diamond, Graphite and Ethyne is in the order: SP^3, SP^2, SP

118. **(b)** Distillation process refers to the selective boiling and subsequent condensation of a component in a liquid mixture. A miscible mixture of $C_6H_6 + CHCl_3$ can be separated by simple distillation method according to their boiling points. Boiling point of chloroform is ($61.2\ ^\circ C$) is lower than the boiling point of benzene ($80.1\ ^\circ C$). Chloroform short boil first, vaporize and collect before benzene starts vaporize.

119. **(c)** Given that

$\%$ of $C = 40\%$

$\%$ of $H = 13.33\%$

$\%$ of $N = 46.61\%$

Assume a 100 g sample, convert the same % values to grams

40 g carbon
13.33g Hydrogen
46.67 g Nitrogen

$$\text{Moles of Carbon} = \frac{\text{given mass}}{\text{atomic mass}} = \frac{40\ \text{g}}{12\ \text{g/mol}} = 3.33\ \text{mol}$$

$$\text{Moles of Hydrogen} = \frac{13.33\ \text{g}}{1\ \text{g/mol}} = 13.33\ \text{mol}$$

$$\text{Moles of Nitrogen} = \frac{46.67\ \text{g}}{14\ \text{g/mol}} = 3.33\ \text{mol}$$

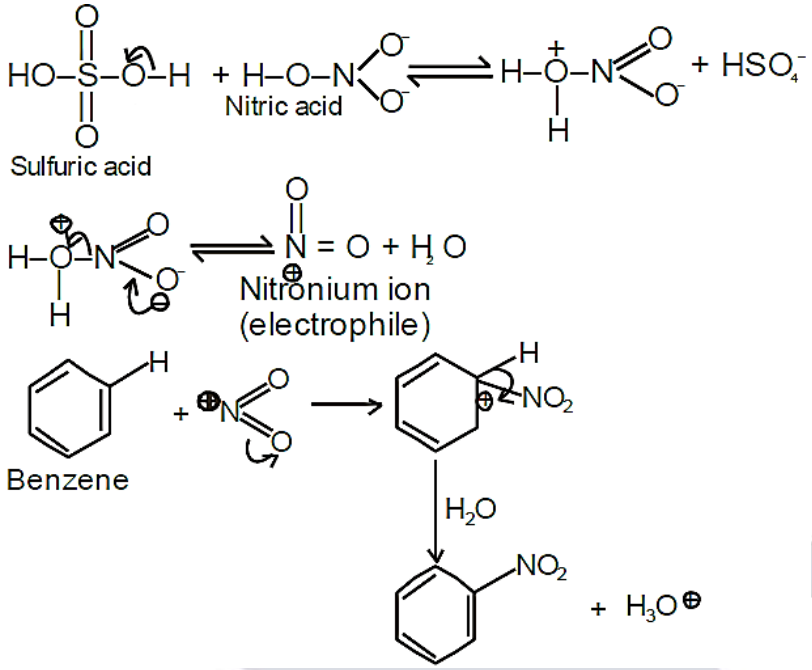
$$C = \frac{3.33}{3.33} = 1;\ H = \frac{13.33}{3.33} = 4; N = \frac{3.33}{3.33} = 1$$

The formula of the compound is $C_1H_4\ N_1$ or $CH_4\ N$

120. **(b)** Nitration of Benzene:

Benzene reacts with concentrated nitric acid in the presence of concentrated sulphuric acid to form nitrobenzene.

Mechanism:



Mathematics

121. **(d)** No. of elements in set A = 4

No. of elements in set B = 5

No. of injective mapping = $^{5}P_{4} = \frac{5!}{1!} = 120$

122. **(a)**

$f(x) = 2x + 6$

$y = 2x + 6$

$y - 6 = 2x$

$\frac{y-6}{2} = x$ (put $y = x \& x = f^{-1}(x)$}

$f^{-1}(x) = \frac{x}{2} - 3$

123. **(b)**

$a * b = \frac{a+b}{2}$ (given)

Commutative property

$\Rightarrow a * b = b * a$

$\frac{a+b}{4} = \frac{b+a}{4}$

The given operation is commutative.

Associative property $\Rightarrow a * (b * c) = (a * b) * c$

$$\Rightarrow \frac{a + \frac{b+c}{4}}{4} = \frac{\frac{a+b}{4} + c}{4}$$

$$\Rightarrow \frac{4a + b + c}{16} = \frac{a + b + 4c}{16}$$

$\Rightarrow$ L.H.S. $\neq$ R.H.S.

The given operation is not associative.

124. (d)

$$\sin^{-1}\left(\cos\frac{53\pi}{5}\right)$$

$$\Rightarrow \sin^{-1}\left[\cos\left(10\pi + \frac{3\pi}{5}\right)\right]$$

$$\Rightarrow \sin^{-1}\left[\cos\left(\frac{3\pi}{5}\right)\right]$$

$$\Rightarrow \sin^{-1}\left[\sin\left(\frac{\pi}{2} - \frac{3\pi}{5}\right)\right]$$

$$\Rightarrow \frac{\pi}{2} - \frac{3\pi}{5} = \frac{-\pi}{10}$$

125. (b)

$$3\tan^{-1} x + \cot^{-1} x = \pi$$

$$\Rightarrow 2\tan^{-1} x + \frac{\pi}{2} = \pi$$

$$\Rightarrow 2\tan^{-1} x = \frac{\pi}{2}$$

$$\Rightarrow \tan^{-1} x = \frac{\pi}{4}$$

$$\Rightarrow x = \tan\left(\frac{\pi}{4}\right) = 1$$

126. (b)

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) - \tan^{-1}\left(\frac{x-y}{x+y}\right)$$

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) - \tan^{-1}\left(\frac{1 - \frac{y}{x}}{1 + \frac{y}{x}}\right)$$

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) - \left[\tan^{-1} 1 - \tan^{-1}\frac{y}{x}\right]$$

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right) - \tan^{-1} 1$$

$$\Rightarrow \tan^{-1}\left(\frac{x}{y}\right) + \cot^{-1}\left(\frac{x}{y}\right) - \frac{\pi}{4}$$

$$\Rightarrow \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$$

127. (d)

$$\begin{vmatrix} 1+x & 1 & 1 \\ 1 & 1+y & 1 \\ 1 & 1 & 1+z \end{vmatrix} = 0$$

$\Rightarrow (1+x)[(1+y)(1+z)-1]-[1+z-1]+[1-1-y]=0$

$\Rightarrow (1+x)(1+y)(1+z)-(1+x)-z-y=0$

$\Rightarrow 1+x+y+z+xy+xz+yz+xyz=x+y+z+1$

$\Rightarrow xy+yz+zx=-xyz$

$\Rightarrow \frac{1}{x}+\frac{1}{y}+\frac{1}{z}=-1$

$\Rightarrow x^{-1}+y^{-1}+z^{-1}=-1$

128. **(c)** Use property $|KA| = K^n|A|$ {here n = order of matrix }

$\Rightarrow |3A| = 3^3|A| = 27|A|$

129. **(b)**

$y = e^{\sin^{-1}(t^2-1)}; x = e^{\sec^{-1}\left(\frac{1}{t^2-1}\right)}$

$y = e^{\sin^{-1}(t^2-1)}; x = e^{\cos^{-1}(t^2-1)}$

$\Rightarrow xy = e^{\sin^{-1}(t^2-1)} \cdot e^{\cos^{-1}(t^2-1)}$

$\Rightarrow xy = e^{\sin^{-1}(t^2-1)+\cos^{-1}(t^2-1)}$

$\Rightarrow xy = e^{\frac{\pi}{2}}$

On differentiating both side with respect to x

$\Rightarrow y + x\frac{dy}{dx} = 0$

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

130. **(d)**

$$\Rightarrow A-B = \frac{1}{\pi}\begin{bmatrix} \sin^{-1}(\pi x) & \tan^{-1}\left(\frac{x}{\pi}\right) \\ \sin^{-1}\left(\frac{x}{\pi}\right) & \cot^{-1}(\pi x) \end{bmatrix} - \frac{1}{\pi}\begin{bmatrix} -\cos^{-1}(\pi x) & \tan^{-1}\left(\frac{x}{\pi}\right) \\ \sin^{-1}\left(\frac{x}{\pi}\right) & -\tan^{-1}(\pi x) \end{bmatrix}$$

$$\Rightarrow A-B = \frac{1}{\pi}\begin{bmatrix} \sin^{-1}(\pi x)+\cos^{-1}(\pi x) & \tan^{-1}\left(\frac{x}{\pi}\right)-\tan^{-1}\left(\frac{x}{\pi}\right) \\ \sin^{-1}\left(\frac{x}{\pi}\right)-\sin^{-1}\left(\frac{x}{\pi}\right) & \cot^{-1}(\pi x)+\tan^{-1}(\pi x) \end{bmatrix}$$

$$\Rightarrow A-B = \frac{1}{\pi}\begin{bmatrix} \frac{\pi}{2} & 0 \\ 0 & \frac{\pi}{2} \end{bmatrix} \Rightarrow A-B = \frac{1}{\pi}\cdot\frac{\pi}{2}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\Rightarrow A-B = \frac{I}{2}$$

131. **(c)**

$x^y = e^{x-y}$

on taking log both sides

$\Rightarrow y\log x = x-y \Rightarrow y = \frac{x}{1+\log x}$..... (1)

On differentiating both side

$$\Rightarrow \frac{y}{x} + \log x \frac{dy}{dx} = 1 - \frac{dy}{dx}$$

$$\Rightarrow \frac{dy}{dx}(\log x + 1) = 1 - \frac{y}{x}$$

Put value of y from eq. (1)

$$\Rightarrow \frac{dy}{dx}(1 + \log x) = 1 - \frac{x}{(1 + \log x)}$$

$$\Rightarrow \frac{dy}{dx}(1 + \log x) = \frac{1 + \log x - 1}{(1 + \log x)}$$

$$\Rightarrow \frac{dy}{dx} = \frac{\log x}{(1 + \log x)2}$$

132. **(d)** Given order of A is $= m \times n$

Let the order of B is $= v \times u$

If AB' is defined $= A_{m\times n} \times B'_{u\times v}$

This is possible when $n = u$

If $B'A$ is defined $= B_{u\times v} \times A_{m\times n}$

This is possible when $v = m$

The order of $B = v \times u = m \times n$

133. **(b)** $\int \frac{e^x(1+x)}{\cos^2(e^x x)} dx$

$\because e^x x = t$

$e^x(1 + x)dx = dt$

$$\Rightarrow \int \frac{dt}{\cos^2 t}$$

$$\Rightarrow \int \sec^2 t dt = \tan t + x \Rightarrow \tan(e^x \cdot x) + c$$

134. **(c)**

$$\Rightarrow \begin{vmatrix} \log x & \log y & \log z \\ \log 2x & \log 2y & \log 2z \\ \log 3x & \log 3y & \log 3z \end{vmatrix}$$

$R_2 \to R_2 - R_1; R_3 \to R_3 - R_1$

$$\Rightarrow \begin{vmatrix} \log x & \log y & \log z \\ \log 2 & \log 2 & \log 2 \\ \log 3 & \log 3 & \log 3 \end{vmatrix}$$

$\Rightarrow \log 2 \log 3 \begin{vmatrix} \log x & \log y & \log z \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{vmatrix}$

$\Rightarrow 0$ {because two row's are same}

135. (a)

$f(x) = [x]$

As we know Greatest Integer Functions are discontinuous at all integers

$LHL = \lim_{x \to 1.5^-} [x] = 1$

$RHL = \lim_{x \to 1.5^+} [x] = 1$

$F(1.5) = [1.5] = 1$

$LHL = RHL = f(1.5)$

Function $f(x)$ is continuous at $x = 1.5$

136. (a)

$$\int \frac{e^x(x^2 \tan^{-1} x + \tan^{-1} x + 1)}{x^2 + 1} dx$$

$$\Rightarrow \int e^x \left[\tan^{-1} x + \frac{1}{1 + x^2}\right] dx$$

$$\Rightarrow e^x \tan^{-1} x + c$$

137. (d)

$$\Rightarrow 2\vec{a} \cdot \vec{b} = |\vec{a}| \cdot |\vec{b}| \Rightarrow 2|\vec{a}||\vec{b}| \cos\theta = |\vec{a}||\vec{b}|$$

$$\Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{3}$$

138. (d)

$x^m y^n = (x + y)^{m+n}$

On taking log both sides

$\Rightarrow \log(x^m y^n) = \log(x + y)^{m+n} \Rightarrow m \log x + n \log y = (m + n) \log(x + y)$

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

$$\Rightarrow \frac{dy}{dx} = \frac{[m(x + y) - (m + n)x]/x}{[(m + n)y - n(x + y)]/y} \Rightarrow \frac{dy}{dx} = \frac{[my - nx]/x}{[my - nx]/y} = \frac{y}{x}$$

139. (b) $\Rightarrow \cot\theta + \tan\theta = 2$

$$\Rightarrow \frac{\cos\theta}{\sin\theta} + \frac{\sin\theta}{\cos\theta} = 2$$

$\Rightarrow \frac{\cos^2\theta + \sin^2\theta}{2\sin\theta\cos\theta} = 1$

$\Rightarrow 1 = \sin 2\theta$

$\Rightarrow 2\theta = n\pi + (-1)^n \frac{\pi}{2}$

$\Rightarrow \theta = \frac{n\pi}{2} + (-1)^n \frac{\pi}{4}$

140. (d)

$I = \int_{-\pi/4}^{\pi/4} \sin^{103} x \cdot \cos^{101} x dx$ ……..(1)
put $x = -x$
$I = -\int_{-\pi/4}^{\pi/4} \sin^{103} x \cdot \cos^{101} x dx$ ……(2)
We can say that the given function is an add function
Add equation (1) and (2)

$\Rightarrow 2I = 0$
$\Rightarrow I = 0$

141. (d)

$\Rightarrow 4y^2 + 3y = -3x - 1$

$\Rightarrow 4\left(y^2 + \frac{3}{4}y\right) = -3x - 1$

$\Rightarrow 4\left(y^2 + \frac{3}{4}y + \frac{9}{64} - \frac{9}{64}\right) = -3x - 1$

$\Rightarrow 4\left(\left(y + \frac{3}{8}\right)^2 - \frac{9}{64}\right) = -3x - 1$

$\Rightarrow \left(y + \frac{3}{8}\right)^2 = \frac{-3x - 1}{4} + \frac{9}{64}$

$\Rightarrow \left(y + \frac{3}{8}\right)^2 = \frac{-3x}{4} - \frac{7}{64} = \frac{-3}{4}\left[x + \frac{7}{48}\right]$

$\Rightarrow \text{LLR} = 4a = \left|4 \times \left(\frac{-3}{4 \times 4}\right)\right| = \left|\frac{-3}{4}\right| = \frac{3}{4}$

142. (b)

$\Rightarrow \int \frac{e^{6\log x} - e^{5\log x}}{e^{4\log x} - e^{3\log x}} dx$

$\Rightarrow \int \frac{x^6 - x^5}{x^4 - x^3} dx$

$\Rightarrow \int \frac{x^5(x-1)}{x^3(x-1)} dx \Rightarrow \int x^2 dx \Rightarrow \frac{x^3}{3} + c$

143. **(b)** let $u = \log_{10} x$

$v = \log_x 10 = \frac{1}{\log_{10} x} = \frac{1}{u}$

$\Rightarrow vu = 1$

On differentiating both side with respect to v.

$\Rightarrow u + v\frac{du}{dv} = 0$

$\Rightarrow \frac{du}{dv} = \frac{-u}{v}$ (from eq. (1) $v = \frac{1}{u}$)

$\Rightarrow \frac{du}{dv} = -u^2 = -(\log_{10} x)^2$

144. **(b)**

given $x = t^2 + 3t - 8$

$y = 2t^2 - 2t - 5$

Substitute $x = 2$ in given eq.

$\Rightarrow 2 = t^2 + 3t - 8$

$\Rightarrow t = -5,2$

Now substitute $y = -1$

$\Rightarrow -1 = 2t^2 - 2t - 5$

$\Rightarrow t = 2, -1$

Common value of t is 2 .

$\frac{dy}{dx} = \frac{dy/dt}{dx/dt}\Big|_{t=2} = \frac{4t-2}{2t+3}\Big|_{t=2} = \frac{6}{7}$

145. **(a)**

$\Rightarrow (1 - \cos\theta + i\sin\theta)^{-1}$

$\Rightarrow \frac{1}{(1-\cos\theta+i\sin\theta)} \times \frac{(1-\cos\theta-i\sin\theta)}{(1-\cos\theta-i\sin\theta)} \Rightarrow \frac{(1-\cos\theta)-i\sin\theta}{(1-\cos\theta)^2+\sin^2\theta}$

$\Rightarrow \frac{(1-\cos\theta)-i\sin\theta}{4\sin^4\frac{\theta}{2}+4\sin^2\frac{\theta}{2}\cos^2\frac{\theta}{2}} \Rightarrow \frac{2\sin^2\frac{\theta}{2} - i\left[2\sin\frac{\theta}{2}\cos\frac{\theta}{2}\right]}{4\sin^2\frac{\theta}{2}\left[\sin^2\frac{\theta}{2}+\cos^2\frac{\theta}{2}\right]}$

$\Rightarrow \frac{\sin\frac{\theta}{2} - i\cos\frac{\theta}{2}}{2\sin\frac{\theta}{2}} \Rightarrow R\left(\frac{1}{2} - \frac{1}{2}i\cot\frac{\theta}{2}\right) \Rightarrow \frac{1}{2}$

146. **(d)**

$I = \int_0^{\pi/2} \frac{\sin^{1000} x dx}{\sin^{1000} x + \cos^{1000} x} \ldots\ldots(1)$

Apply king property

$I = \int_0^{\pi/2} \frac{\cos^{1000} x dx}{\cos^{1000} x + \sin^{1000} x}$ .....(2)

On adding eq. (1) and eq. (2)

$2I = \int_0^{\pi/2} 1.dx$

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

147. **(c)** $\Rightarrow \frac{1}{1-\sin\theta} = 2\sqrt{3} + 4$

$\Rightarrow \frac{1}{2\sqrt{3}+4} \times \frac{2\sqrt{3}-4}{2\sqrt{3}-4} = 1 - \sin\theta$

$\Rightarrow 1 - \sin\theta = \frac{2\sqrt{3}-4}{-4}$

$\Rightarrow \sin\theta = 1 + \frac{\sqrt{3}-2}{2} = \frac{\sqrt{3}}{2}$

$\Rightarrow \theta = \frac{\pi}{3}$

148. **(c)**

$\lim_{x\to 0} \frac{xe^x - \sin x}{x} \left(\frac{0}{0}\right)$

L-Hospital Rule

$\Rightarrow \lim_{x\to 0} \frac{xe^x + e^x - \cos x}{1} = 0 + 1 - 1 = 0$

149. **(a)**

$\Rightarrow \tan^{-1}(x^2 + y^2) = \alpha$
$\Rightarrow x^2 + y^2 = \tan\alpha$
$\Rightarrow 2x + 2y\frac{dy}{dx} = 0$
$\Rightarrow \frac{dy}{dx} = \frac{-x}{y}$

150. **(a)**

$\Rightarrow i^n + i^{n+1} + i^{n+2} + i^{n+3}$
$\Rightarrow (i)^n + i(i)^n - (i)^n - i(i)^n$
$\Rightarrow 0$

151. **(b)**

$x^3 - 3xy^2 + 2 = 0$

$\Rightarrow 3x^2 - 6xy\frac{dy}{dx} - 3y^2 = 0$

$\Rightarrow \frac{dy}{dx} = \frac{3(x^2-y^2)}{6xy} = m_1 \ldots\ldots\ldots (1)$

$\Rightarrow 3yx^2 - y^3 = 2$

$\Rightarrow \frac{dy}{dx} = \frac{-6xy}{3(x^2-y^2)} = m_2 \ldots\ldots (2)$

$\because m_1 \times m_2 = -1$

$\therefore$ Both curves cut each other at right angle

152. (a)

$\because$ Tangent crosses x-axis.

Put $y = 0 \Rightarrow x = 2$

$\left.\frac{dy}{dx}\right|_{(2,0)} = \frac{-1-2xy}{(1+x^2)}$

$\left.\frac{dy}{dx}\right|_{(2,0)} = \frac{-1}{5} = m_T$

$m_N = 5$

Eq. of normal at $(2,0)$ is $y - 0 = 5(x-2) \Rightarrow 5x - y = 10$

153. (c)

$\Rightarrow y = \frac{1}{x^x}$

$\Rightarrow \log y = -x\log x$

$\Rightarrow \frac{1}{y}\frac{dy}{dx} = \frac{-x}{x} + (-\log x)$

$\frac{dy}{dx} = -x^{-x}(1+\log x) = 0$

$\Rightarrow 1 + \log x = 0$

$\Rightarrow x = \frac{1}{e}$ (Point of maxima)

$\max(y) = (e)^{1/e}$

154. (c)

$\frac{dy}{y} + \frac{dx}{x} = 0$

On integrating both sides

$\Rightarrow \log y + \log x = \log c$

$\Rightarrow xy = c$

155. (d) $1 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) = \left(\frac{d^2y}{dx^2}\right)^{4/3}$

Order $= 2$

Degree = not defined (because of $\sin\frac{dy}{dx}$)

156. (a)

$|\sqrt{3}\vec{a} - \vec{b}| = 1$

On squaring both sides

$\Rightarrow 3|\vec{a}|^2 + |\vec{b}|^2 - 2\sqrt{3}\vec{a}\cdot\vec{b} = 1$

$\Rightarrow 4 - 2\sqrt{3}|\vec{a}||\vec{b}|\cos\theta = 1$

$\Rightarrow \cos\alpha = \frac{3}{2\sqrt{3}} = \frac{\sqrt{3}}{2}$

$\Rightarrow \theta = \frac{\pi}{6}$

157. (b)

$$T_n = \frac{1^2 + 2^2 + 3^2 + \cdots \ldots \ldots + n^2}{1 + 2 + 3 + \cdots \ldots \ldots + n}$$

$$T_n = \frac{\frac{n(n+1)(2n+1)}{6}}{\frac{n(n+1)}{2}} = \frac{2n+1}{3}$$

$$S_n = \sum T_n = \frac{1}{3}\sum (2n+1)$$

$$= \frac{1}{3}\left(\frac{2n(n+1)}{2} + n\right)$$

$$= \frac{1}{3}(n^2 + 2n)$$

158. (b)

$$T_{11} = {}^{14}C_{10}(x)^{14-10}\left(\frac{1}{\sqrt{x}}\right)^{10}$$

$$= {}^{14}C_{10}x^4 \cdot \frac{1}{x^5}$$

$$= \frac{1001}{x}$$

159. (c)

$\Rightarrow \vec{a} + \vec{b} + \vec{c} = 0$

$\Rightarrow |\vec{a} + \vec{b}|^2 = |-\vec{c}|^2$

$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 + 2|\vec{a}||\vec{b}|\cos\theta = |\vec{c}|^2$

$\Rightarrow 9 + 25 + 2 \times 15\cos\theta = 49$

$\Rightarrow 30\cos\theta = 15$

$\Rightarrow \cos\theta = 1/2$

$\Rightarrow \theta = \pi/3$

160. **(c)**

Given

$$\vec{a} \cdot (\vec{b} + \vec{c}) = 0$$
$$\vec{b} \cdot (\vec{a} + \vec{c}) = 0$$
$$\vec{c} \cdot (\vec{a} + \vec{b}) = 0$$
$$\Rightarrow \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a} = 0$$
$$\Rightarrow |\vec{a} + \vec{b} + \vec{c}|^2 = |\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2(\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a})$$
$$= 9 + 16 + 25 + 0$$
$$\Rightarrow |\vec{a} + \vec{b} + \vec{c}| = 5\sqrt{2}$$

161. **(c)** $m_1 = \frac{-2}{3}$

$m_2 = \frac{-1}{K}$

$\Rightarrow m_1 m_2 = -1$

$\Rightarrow \frac{2}{3K} = -1 \Rightarrow K = \frac{-2}{3}$

162. **(d)**

$A = \pi r^2$

$\Rightarrow \left.\frac{dA}{dr}\right|_{r=2} = 2\pi r = 2\pi \times 2 = 4\pi$

163. **(c)** $\Rightarrow \tan\frac{\pi}{8}$

$\Rightarrow \frac{\sin 2(\pi/8)}{1 + \cos 2(\pi/8)}$

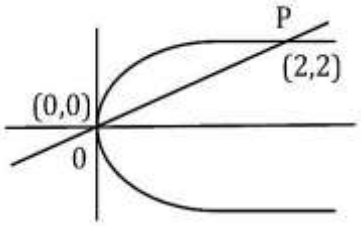
$\Rightarrow \frac{\sin \pi/4}{1 + \cos \pi/4} \Rightarrow \frac{1}{1 + \sqrt{2}}$

164. **(a)** Point of contact of both curves is

$\Rightarrow x^2 = 2x$
$\Rightarrow x = 0, x = 2$
$y = 0, y = 2$

$\Rightarrow \int_0^2 (\sqrt{2}\sqrt{x} - x)dx$

$\Rightarrow \sqrt{2}\left[\frac{2x^{3/2}}{3}\right]_0^2 - \left[\frac{x^2}{2}\right]_0^2$



$\Rightarrow 8/3 - 2 = 2/3$ sq. units

165. (c)

$$P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{7/10}{17/20}$$

$$= \frac{14}{17}$$

166. (a, d)

Coefficient of variation $Cv_1 = \frac{\sigma_1}{\bar{x}_1} \times 100$

$\Rightarrow 60 = \frac{21}{\bar{x}_1} \times 100$ …… (1)

$\Rightarrow Cv_2 = \frac{\sigma_2}{\bar{x}_2} \times 100 \Rightarrow 70 = \frac{16}{\bar{x}_2} \times 100$……. (2)

From Eq. (1) & (2)

$\bar{x}_1 = 35 \& \bar{x}_2 = 22.85$

167. (b) Probability of two cards being aces is $= \frac{{}^4C_2}{{}^{52}C_2} = \frac{1}{221}$

168. (a)

$$\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$$

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

$$\Rightarrow \sin^{-1} x = \cos^{-1} y$$

$$\Rightarrow \sin^{-1} x = \sin^{-1} \sqrt{1 - y^2}$$

$$\Rightarrow x^2 = 1 - y^2$$

169. (d)

$I = \int_2^8 \frac{\sqrt{10-x}}{\sqrt{x}+\sqrt{10-x}} dx$…… (1)

Apply king

$I = \int_2^8 \frac{\sqrt{x}}{\sqrt{10-x}+\sqrt{x}} dx$……. (2)

On adding eq. (1) and eq. (2)

$\Rightarrow 2I = \int_2^8 1.dx = 6 \Rightarrow I = 3$

170. (d) The converse of the given statement $p \rightarrow q$ is $q \rightarrow p$

The contra positive of the given statement is $q \rightarrow p$ is $\sqcup p \rightarrow \sqcup q$

Hence, the contra positive of the converse of the given statement is " If x is not a prime number, then x is not odd"

171. **(c)** Total ways of obtaining score of 5 is $\{(1,4),(2,3),(3,2),(4,1)\}$

Required probability is $= \frac{4}{6^2} = \frac{4}{36} = \frac{1}{9}$

172. **(a)**

$A + A^T = I$

$\Rightarrow \begin{bmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{bmatrix} + \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ -\sin 2\theta & \cos 2\theta \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow \begin{bmatrix} 2\cos 2\theta & 0 \\ 0 & 2\cos 2\theta \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow 2\cos 2\theta = 1 \Rightarrow \cos 2\theta = \frac{1}{2}$

$\Rightarrow 2\theta = \frac{\pi}{3} \Rightarrow \theta = \frac{\pi}{6}$

173. **(d)**

$|A - \lambda I| = 0$

$\Rightarrow \begin{vmatrix} 3-\lambda & 1 \\ -1 & 2-\lambda \end{vmatrix} = 0$

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

$\Rightarrow \lambda^2 - 5\lambda + 6 + 1 = 0$

$\Rightarrow$ Put $\lambda = A$

$\Rightarrow A^2 - 5A + 7I = 0$

$\Rightarrow A^2 - 5A = -7I$

174. **(a)**

$|x(\hat{i} + \hat{j} + \hat{k})| = 1$

$\Rightarrow \sqrt{x^2 + x^2 + x^2} = 1$

$\Rightarrow 3x^2 = 1$

$\Rightarrow x = \pm\frac{1}{\sqrt{3}}$

175. **(b)**

$x = 2 + 3\cos\theta \Rightarrow \left(\frac{x-2}{3}\right) = \cos\theta$..... (1)

$y = 1 - 3\sin\theta \Rightarrow \left(\frac{y-1}{-3}\right) = \sin\theta$..... (2)

$\Rightarrow$ Equation $(1)^2$ + Equation $(2)^2$

$\Rightarrow \text{Sin}^2\theta + \cos^2\theta = \left(\frac{x-2}{3}\right)^2 + \left(\frac{y-1}{-3}\right)^2$

$\Rightarrow (x-2)^2 + (y-1)^2 = 9$

Centre $\equiv (2,1)$; radius $= 3$

176. **(a)** Vector equation of a plane is $\vec{r} \cdot \hat{n} = d$

$$\Rightarrow \vec{r} \cdot \frac{(2\hat{i} - 3\hat{j} + \hat{k})}{\sqrt{14}} = \frac{3}{\sqrt{14}}$$
$$\Rightarrow \vec{r} \cdot (2\hat{i} - 3j + \hat{k}) = 3$$

177. **(d)** Let foot of perpendicular drawn from origin is (x_1, y_1, z_1)

$$\Rightarrow \frac{x_1 - 0}{0} = \frac{y_1 - 0}{5} = \frac{z_1 - 0}{0} = \frac{-(0+0+0+8)}{0^2 + 5^2 + 0^2}$$

$$\Rightarrow \frac{x_1}{0} = \frac{y_1}{5} = \frac{z_1}{0} = \frac{-8}{25}$$

$$\Rightarrow x_1 = 0, y_1 = \frac{-8}{5}, z_1 = 0$$

Co-ordinate is $= \left(0, \frac{-8}{5}, 0\right)$

178. **(c)** As we know that

$$\Rightarrow \cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$
$$\Rightarrow \frac{1 + \cos 2\alpha}{2} + \frac{1 + \cos 2\beta}{2} + \frac{1 + \cos 2\beta}{2} = 1$$
$$\Rightarrow \cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$$

179. **(a)**

$$\sin 1^\circ + \sin 2^\circ + \cdots + \sin 359^\circ$$
$$\Rightarrow (\sin 1^\circ + \sin 359^\circ) + (\sin 2^\circ + \sin 358^\circ) + \cdots + \sin 180^\circ$$
$$\Rightarrow (\sin 1^\circ - \sin 1^\circ) + (\sin 2^\circ - \sin 2^\circ) + \cdots + \sin 180^\circ$$
$$\Rightarrow 0 + 0 + \cdots + 0 = 0$$

180. **(c)**

$$x\frac{dy}{dx} - y = x^4 - 3x$$
$$\Rightarrow \frac{dy}{dx} - \frac{y}{x} = x^3 - 3$$
$$\text{I. F} = e^{-\int \frac{1}{x} dx} = e^{-\ln x} = \frac{1}{x}$$

Biology

181. **(b)** As we go higher from species to kingdom, the number of common characteristics goes on decreasing or vice versa. Lower the taxa more are the characteristics that the members within the taxon share. Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

182. **(b)** Cleistogamous flowers do not open at all. In such flowers, the anther and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grain comes in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross pollen landing on the stigma. Whereas chasmogamous flowers (with exposed anthers and stigma) can exhibit autogamy, geitonogamy or xenogamy.

183. **(d)** Stahl showed the semi-conservative mechanism of DNA replication. They cultured E. coli cells initially in a medium containing ammonium salts prepared with heavy nitrogen $^{15}N_{15}$ to label, using all cellular DNA. Then cells were transferred to a medium containing the normal light isotope $^{14}N_{14}$. DNA was analyzed by equilibrium density-gradient centrifugation in the periodically collected sample to separate heavy-heavy, light-light, and

heavy-light duplexes into distinct bands. The sample was placed on a preformed gradient of cesium chloride. Centrifugation separates the macromolecules in different bands of density gradient which can be collected as a pure fraction. After the first generation, the density gradient contained only one band having H-L nitrogen. After the second generation, the density gradient contained 2 bands- one will have hybrid DNA and the other will have light DNA.

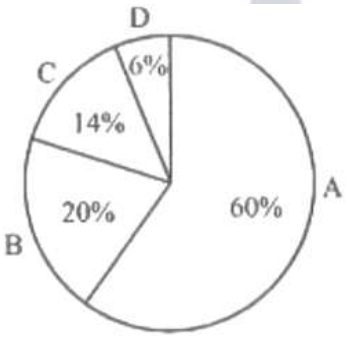
184. **(d)** Predation is the consumption of one species (the prey) by another (the predator). Parasitism is a host parasite relationship in which one (parasite) is benefited while other (host) is adversely affected, although not necessarily killed. Competition is the injurious effect of one organism on another because of the removal of some resources of the environment. This phenomenon can result in major fluctuations in the composition of the microbial population in the soil.

185. **(c)** Vasopressin, also known as antidiuretic hormone (ADH), is a neurohypophysial hormone found in most mammals. It plays an important role in the water balance (osmoregulation) of the body. When the fluid contents of the body become highly concentrated, ADH is secreted. This reaches the kidney via blood capillaries where it increases the permeability of the tubules thereby most of the water is reabsorbed and the urine gets concentrated with the reduction in volume. This hormone maintains the proper osmotic concentration of the blood plasma.

186. **(c)** Total pollen sacs or microsporangia in bilobed, dithecous anther are four. Each pollen sac has 1000 microspore mother cells. So, total microspore mother cell in 4 pollen sacs is $4 \times 1000 = 4000$. Meiosis produces 4 pollen grains or male gametophytes. Meiosis in 400 microspore mother cell will produce $= 400 \times 4 = 1600$ pollen grains or male gametophytes.

187. **(a c)** It state that allele frequencies in a population are stable and is constant from generation to generation. The gene pool remains constant known as genetic equilibrium. Sum total of all the allele frequencies is 1.individual frequencies, for example, can be named p, q, etc. In a diploid, p and q represent the frequency of allele and allele a. The frequency of AA individual in a population is simply p^2. This is simply stated in another ways, i.e. the probability that an allele A with a frequency of p appears on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e. p^2. Similarly of aa is q2 and of Aa is 2pq. Hence, $(p+q)2 = 1$ and when p^2 represents the frequency of the homozygous genotype AA, q^2 represents the frequency of the homozygous genotype aa, and $2pq$ represents the frequency of the heterozygous genotype Aa. In addition, the sum of the allele frequencies for all the alleles at the locus must be 1 , so $p + q = 1$.

188. **(a)**



The greenhouse effect is a naturally occurring phenomenon i.e. responsible for heating of earth surface and atmosphere. Greenhouse gases are gases that absorb and emit radiation within the thermal infrared range. Carbon dioxide contributes mostly to global warming which is followed by methane, nitrous oxide and CFC

189. **(d)** The pericycle lies just inside the endodermis and is the outer most part of the stele of plants. Although, it is composed of non-vascular parenchyma cells, it is still considered part of the vascular cylinder because it arises from the procambium as do the vascular tissues it surrounds. In dicots, it also has the capacity to produce lateral roots. Branch roots arise from this primary meristem tissue. In plants undergoing secondary growth, the pericycle contributes to the vascular cambium often diverging into a cork cambium. Cortex, pith and endodermis do not give rise to lateral roots.

190. **(b)** The codon of the template strands of the DNA is transcribed into m-RNA by RNA polymerase. The transcribed m-RNA has complimentary bases with respect to its DNA template which is further assessed by the anticodon loop of t-RNA for base pairing during translation. If the DNA template has the codon with base sequence 3'TACATGGGTCCG5' the m-RNA codon will be AUGUACCCAGGC The sequence of t-RNA codon will be UACAUGGGUCCG.

191. **(d)** The prothallus is the gametophyte of ferns i.e. present in pteridophytes. In most gymnosperms, the male pollen cones, called microstrobili, contain reduced leaves called microsporophylls. When a moss (bryophytes) first grows from the spore, it grows as a protonema which develops into a leafy gametophore. PEN, primary endosperm nucleus is present in angiosperm.

192. **(a)** When ozone depletion is occurring widely in the stratosphere, the depletion is particularly marked over the Antarctica region. This has resulted in formation of a large area of thinned ozone layer, known as ozone hole. Snow blindness is the condition of loss of vision due to overexposure of UV light.

193. **(c)** Immunoglobulin A (IgA), as the principal antibody class in the secretions that bathe these mucosal surfaces, acts as an important first line of defence. IgG is the main type of antibody found in blood and extracellular fluid, allowing it to control infection of body tissues. Immunoglobulin E (IgE) is antibodies produced by the immune system in response to the allergy. The immune system overreacted to the allergens and releases IgE. These antibodies travel to cells that release chemicals, causing an allergic reaction. This reaction usually causes symptoms in the nose, lungs, throat, or on the skin. IgM is the first antibody secreted by the adaptive immune system in response to a foreign antigen.

194. **(b)** The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece is known as elution.

195. **(a)** False fruit or pseudocarp is derived from the accessory floral parts other than ovary. Apple is actually a false fruit. The main edible part of an apple is actually juicy receptacle of a flower i.e., thalamus. The other examples are peduncle in cashew nut, jackfruit, and pineapple. The pericarp develops from a plant's ovary. It forms around the seeds. Depending on the fruit, only some layers of the pericarp are consumed Guava and grapes are examples of fruits with edible pericarp. Not the pericarp but the fleshy thalamus is edible in pear because pear is a false fruit like apple. Endocarp is the innermost layer of the fruit which often develops into the pith. Involucre is whorl or rosette of bracts surrounding an inflorescence (especially a capitulum) or at the base of an umbel.

196. **(c)** Monascus purpureus have been commercialized as blood cholesterol lowering agents. Aspergillus Niger is a fungal microbe of great industrial importance. This mold is used extensively in the production of citric acid and in the production of several enzymes. Many species of bacteria have been investigated for use in single cell protein production. Methylophilus methylotrophus has a generation time of about 2 hours and is usually and mainly used in animal feed as bacteria, in general produces a more favourable protein composition than yeast or fungi. Therefore, the large quantities of single cell proteins animal feed can be produced using bacteria CyclosporinA that is used as immunosuppressive agents in organ transplantation patients is produced by the fungus Trichoderma polysporum.

197. **(b)** The synaptonemal complex begins to form during the zygotene phase of Prophase I in the first division in Meiosis. Recombinases are genetic recombination enzymes. These enzymes catalyze directionally sensitive DNA exchange reactions between short (30-40 nucleotides) target site sequences that are specific to each recombinase. Recombinase in meiosis helps in crossing over between non- sister chromatids in pachytene stage. Condensation of chromatin occurs during the prophase stage. In meiotic cell division, the mother cell divides twice after one round of replication. In meiosis, condensation occurs during prophase I which is long and complex stage. Condensation also occurs in prophase II, even though prophase II is not elaborate as prophase I. In Metaphase I bivalent chromosomes align on the equatorial plate. The microtubules from the opposite poles of the spindle attach to the kinetochore of homologous chromosomes.

198. **(a)** Oestrous cycle is a reproductive cycle of females of non-primate vertebrates. The gap between two oestrus periods is known as estrous cycle. The females are highly receptive during oestrus period It is an indication of breeding period because one or more periods of estrus may occur during the breeding season of a species. Some animals like dogs are monoestrous as they have only one estrous phase in their breeding cycle. Males can recognize a female in heat by smell of pheromones. Lion, deer, dog and cow are nonprimates which exhibit oestrus cycle.

199. **(c)**

200. **(a)** Primary succession takes place in a newly formed area like new ponds and bare rocks and the areas where the soil is unable to develop sustainable lives like newly cooled lava and retreated glacier areas. Secondary succession occurs in the areas where there occurred some natural disasters like hurricane, forest fire which reduces the ecosystem. It includes abandoned farm lands.

201. **(b)** Adenoviruses are a group of viruses that can infect the membranes of the respiratory tract, eyes, intestines, urinary tract, and nervous system. Rhinoviruses cause upper respiratory tract infections, but may also infect the

lower respiratory tract. RVs are the most common cause of the common cold Malaria is caused by Plasmodium parasites. Salmonella infection is a common bacterial disease that affects the intestinal tract.

202. **(b)** When the bread is prepared yeast is added to it for porosity. The puffed-up appearance of dough is due to fermentation by bacteria During this process carbon dioxide is released

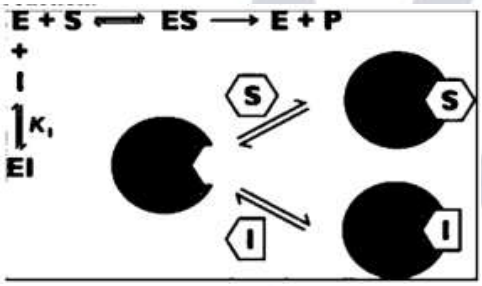
203. **(a)** Biolistics is a method for the delivery of nucleic acid to cells by high-speed particle bombardment. Microinjection is a technique of delivering foreign DNA into a living cell. Lipofection is a technique used to inject genetic material into a cell by means of liposomes, which are vesicles that can easily merge with the cell membrane since they are both made of a phospholipid bilayer. E.coli using the heat shock method is a basic technique of molecular biology. It consists of inserting a foreign plasmid or ligation product into bacteria

204. **(d)** Prostate gland, seminal vesicle and Cowper gland are accessory glands. Bartholin's gland is not an accessory gland in male reproductive system. It is present in females. It is located slightly posterior and to the left and right of the opening of the vagina Bartholin's glands secrete mucus to provide vaginal lubrication. Male accessory glands in humans are the seminal vesicles, prostate gland, and the Cowper's gland (also called as bulbourethral glands). These glands secrete fluid for the nourishment of sperms.

205. **(d)** In divergent evolution, two or more distinct species share a common ancestor from which they diverged They share a common ancestor and yet evolved into two different species. A common example is thorn of bougainvillea and tendril of cucurbita Adaptive radiation is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches. A number of marsupials (pouched mammals) each evolved differently from an ancestral stock but all within the Australian continent. Industrial melanism is a natural adaptation where the moths living in the industrial areas developed melanin pigment to hide themselves from their predators.

Genetic drift describes random fluctuations in the numbers of gene variants in a population. It takes place when the occurrence of variant forms of a gene, called alleles, increases and decreases by chance over time. So, the gene frequency keeps on changing and is not constant.

206. **(b)** In competitive inhibition, a molecule similar to substrate competes with the substrate for the active site. Such molecules are known as an inhibitor. The presence of the inhibitor decreases availability of the active site for the substrate and further decreases the rate of reaction.



207. **(b)**Plasmodium infection in humans begins when an infected Anopheles sp. mosquito takes a blood meal and injects infective sporozoites into the peripheral circulation. Within minutes, these sporozoites invade hepatocytes in the liver and, over approximately one week, undergo asexual multiplication, producing tens of thousands of merozoite forms of the parasite and released into the peripheral circulation. The merozoites invade red blood cells (RBCs) and complete another round of multiplication within $48 - 72$ h, with the production of $16 - 20$ additional merozoites per RBC, which devour the RBC hemoglobin in the process. Merozoites differentiate into male and female sexual forms. These sexual forms are taken from the bloodstream by a feeding Anopheles sp. mosquito and fertilize in the mosquito midgut to form zygotes. These zygotes further differentiate into motile forms, called ookinetes, migrate through the mosquito gut wall and divide within oocysts on the external gut wall to form thousands of sporozoites.

208. **(d)** Transcription is the process of formation of RNA from the DNA In this process, only one strand of DNA is used called as template strand which has polarity 3' to 5'. The segment of DNA that takes part in transcription is called as transcription unit in which have promoters at the 5' end of coding or 3' end of template strand, structural gene and then terminator sequence. The promoter provides the binding site to the RNA polymerase enzyme for transcription. The single base DNA difference in the human genome is called as single nucleotide polymorphism.

209. **(c)** Amniocentesis is a medical term used when doctors remove fluid from the uterus of a pregnant woman for testing. The fluid withdrawn is called amniotic fluid which contains foetal cells and different chemicals from the baby. MTP is the medical termination of pregnancy, which is an abortion of the fetus through sex determination by amniocentesis, but not permitted by law because of its misuse.

210. **(b)** Connel's experiment explained that two species of barnacles live in a stratified distribution in the intertidal region along the Scottish coast. Balanus is observed to be most concentrated in the lower intertidal area whereas Chthamalus is observed to be most concentrated in the upper intertidal area In experiment 1, Connell removed Chthamalus from the upper area, and no balanus replaced it. This showed that balanus could not survive in an area with low tides. In experiment 2, Connell removed Balanus from the lower area and Chthamalus replaced it. This showed that balanus was a more successful competitor in the lower intertidal zone. This showed that competition is occurring between Chthamalus and Balanus.

211. **(c)** Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another. In ciliated epithelium, columnar epithelial tissues have cilia, then they are ciliated epithelium. They are present in the lining of the trachea, kidney tubules, etc The rhythmic movement of the cilia helps in the movement of material in one direction. Adipose tissue is a specialized connective tissue consisting of lipid-rich cells called adipocytes. Cartilage is composed of specialized cells called chondrocytes that produce a large amount of collagenous extracellular matrix, abundant ground substance that is rich in proteoglycan and elastin fibers.

212. **(b)** Hybridoma technology is the production of monoclonal antibodies. Monoclonal antibodies are made outside the body by hybrid cells culture known as hybridomas. Molecular farming is an application of genetic engineering in which desired genes from human or animal origin are introduced into plants or animals for getting cost effective production of therapeutic products such as hormones, recombinant vaccines, antibodies etc Gene therapy means altering the genotype of a cell or tissue or even whole organism to correct a genetic disorder, by placing normal gene in place of defective or malfunctioned gene. Downstream processing is the stages of separation and purification of products obtained after fermentation or any other biotechnological process.

213. **(d)**

Oxygen will not be labelled and is normal as the supplied oxygen is normal as well.

Glucose will be labelled as the carbon than forms it will be derived from the carbon dioxide supplied which is the supplied isotope.

Glucose will be labelled

Glucose will be labelled as the carbon that forms it will be derived from the carbon dioxide supplied which is the supplied isotope. Oxygen will not be labelled and is normal as the supplied oxygen is normal as well

214. **(a)** During pre-fertilization events of sexual reproduction prior to the fusion of gametes. The two main pre-fertilization events are gametogenesis and gamete transfer. Gametogenesis is the process of formation of gametes for fertilization. Post fertilization is the events occurred after the process of fertilization such as Embryogenesis, seed formation and fruit formation. Embryogenesis refers to the process of developments of embryo from the zygote. During seed formation the female and the male gamete merge to produce a diploid zygote. A series of post fertilization events take place in the zygote, and a seed develops. Flower acts as a carrier of seeds. The formation of the seed occurs in the ovule, a fruit develops inside an ovary that forms in flowers.

215. **(a)** In the centre of each 'I' band is an elastic fibre called 'Z' line which bisects it. The thin filaments are firmly attached to the ' Z ' line. The thick filaments in the ' A ' band are also held together in the middle of this band by a thin fibrous membrane called ' M ' line. The ' A ' and ' I ' bands are arranged alternately throughout the length of the myofibrils. The portion of the myofibril between two successive 'Z' lines is considered as the functional unit of contraction and is called a sarcomere.

216. **(c, d)**

Metabolic water is created by oxidizing the energy-containing substances in their food during metabolic activity. Some animals living in the desert are exclusively on metabolic water. They absorb this metabolic water from the air along with the respiratory oxygen. Metabolic water refers to water created inside a living organism through their metabolism, by oxidizing energy-containing substances in their food

During respiration, glucose is respiratory substrate and in the presence of oxygen the breakdown of substrate into carbon dioxide, water and ATP. So, some desert beetles can survive on metabolic water without ever drinking liquid water because it is a breakdown product from glycolysis in the cytoplasm.

217. (b)

Polygenic inheritance occurs when one characteristic is controlled by two or more genes. Often the genes are large in quantity but small in effect. Examples of human polygenic inheritance are height, skin color, eye color and weight.

Pleiotropy is a condition when one gene controls two or more unrelated traits. Phenylketonuria (PKU) is an inborn error of metabolism that results in decreased metabolism of the amino acid phenylalanine. So, the gene disorder phenylketonuria is an example of pleiotropy.

Multiple allelism is the condition where in three or more alleles of a gene are present. Thus, the term multiple alleles pertain to the presence of three or more alleles for a particular gene. It is best illustrated by the ABO blood group system in humans.

A multiple is a number that can be divided by another number a certain number of times without a remainder. A factor is one of two or more numbers that divides a given number without a remainder.

218. (a) A population is defined as the number of organisms of the same species that live in a particular geographic area at the same time, with the capability of interbreeding.

219. (c)

Gametogenesis is a process of formation of gametes by the germ cells of the reproductive organs. They undergo mitotic and meiotic division to form a functional gamete.

Insemination is the introduction of sperm into a female animal or plant for the purpose of impregnating or fertilizing the female for sexual reproduction.

Fertilization is the union of a human egg and sperm, usually occurring in the ampulla of the fallopian tube. The result of this union is the production of a zygote cell, or fertilized egg, initiating prenatal development.

Implantation is the very early stage of pregnancy at which the developing embryo adheres to the wall of the uterus.

Gestation is the process or period of developing inside the womb between conception and birth.

Parturition is the action of giving birth to young ones.

220. (c) Peptide bonds are formed between amino acids by linking them into long chains called proteins. The bond formed between the sugar and the phosphate group is a phosphoester bond

Glycosidic bonds are formed between simple monosaccharides and join them to make large polysaccharides. Polysaccharides are polymers of simple sugars. In polysaccharides, many units of simple sugars are joined together by glycosidic bond Polysaccharides can be storage polysaccharides, e.g., starch and glycogen or structural polysaccharides, e.g., cellulose depending on their function.

Tiny forces called hydrogen bonds hold the glucose molecules together and the chains in close proximity.

221. (b)

CELL 'A'	CELL 'B'
Solute potential $= -9$ bars	Solute potential $= -8$ bars
Pressure potential $= 4$ bars	Pressure potential $= 5$ bars

Water potential (Ψ) is actually determined by taking into account two factors - osmotic (or solute) potential (Ψ_S) and pressure potential (Ψ_P). The formula for calculating water potential is $\Psi = \Psi_S + \Psi_P$. So, $\Psi_A = -9 + 4 = -5$ and $\Psi_B = -8 + 5 = -3$. The direction of water movements between these cells is "Cells B to Cell A".

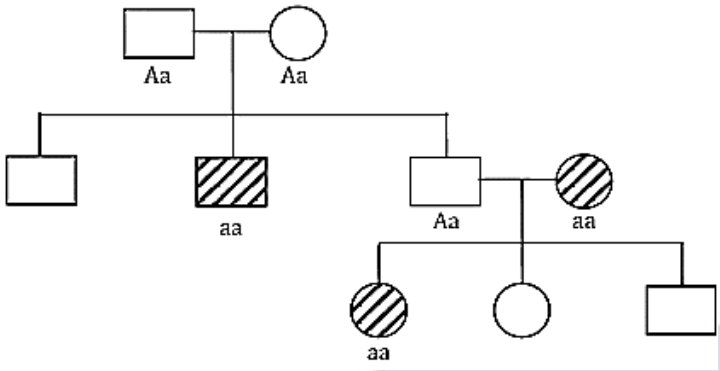
222. (d)

223. (b) Primary productivity is the rate at which energy is converted by photosynthetic and chemosynthetic autotrophs to organic substances. The rate at which the consumers convert the chemical energy of their food into their own biomass is called secondary productivity. A standing crop is the total dried biomass of the living organisms present in a given environment. Net primary production is the rate at which all the plants in an ecosystem produce net useful chemical energy.

224. **(c)** Enterokinase is an enzyme secreted by duodenum of the small intestine and involves in the digestion of food It converts trypsinogen to active trypsin which digests protein into amino acids and completes the digestion of protein. But in the absence of enterokinase trypsinogen is not converted into the trypsin and thus the digestion of protein will be incomplete.

225. **(d)** Primary treatment of sewage basically involves the physical removal of large and small particles, through filtration and sedimentation. This is done in many stages. Initially, floating debris is removed by sequential filtration and then the grit i.e. soil and small pebbles, is removed by sedimentation. All the solids that settle down forms the primary sludge and the supernatant form the effluent. The effluent from the primary settling tank is further taken for secondary treatment.

226. **(b)**



When neither parent is affected but producing affected offspring then they must be heterozygous and hence this disorder will be autosomal recessive. Such disorder appears more frequently among the children of marriage between closely related individual.

227. **(a)** Offspring produced from sexual reproduction shows more variation because sexual reproduction takes place between male and female of the same species and the genetic material comes from both the individuals in the form of male and female gametes and there is a genetic recombination.

228. **(c)** Prolactin is a hormone secreted in mammals (lactotrophs), usually females and stimulates the mammary gland to produce milk. This hormone is also called luteotropin or luteotropic hormone. The major source of prolactin is the anterior pituitary regulated by the hypothalamus; however, several other tissues synthesize and secrete this hormone. All the other hormones such as hCG, hPL, and estrogen are secreted by the human placenta

229. **(a)** Apical dominance is a phenomenon of the inhibition of the growth of lateral buds occurs due to the terminal bud of a shoot. Removal of shoot tips (decapitation) usually results in the growth of lateral buds. This technique is widely applied in tea plantations, hedge-making. Phytohormone auxins are believed to be responsible for apical dominance in plants.

230. **(a)** The genetically identical plants obtained through tissues culture or micro propagation are called as somaclones because it is produced by the culture of somatic cells.

Monoclone is the group of cells produced by single cell asexually. Somatic hybrid is the genetic modification of plants by the fusion of somatic cells of two different species. Cross hybrid is produced by the crossing between two true breeding organisms.

231. **(d)**

232. **(d)** A lichen is not a single organism; it is a stable symbiotic association between a fungus and algae and/or cyanobacteria, Mycorrhizae, known as root fungi, form symbiotic associations with plant roots Mycorrhizae help increase the surface area of the plant root system because hyphae, which are narrow, can spread beyond the nutrient depletion zone and Mutualism is the positive interaction in which two organisms live close together and benefit each other equally such as mycorrhiza, plant and animal relation for pollination and Cattle's egret and grazing cattle exhibits commensalism interaction.

233. **(c)** Thyroid stimulating hormone is produced and released into the bloodstream by the pituitary gland It controls production of the thyroid hormones. The adrenal glands are small glands located on top of each kidney. Melatonin is a peptide hormone secreted by the pineal gland, a small endocrine gland in the brain. It regulates the internal clocks i.e., sleep and wake cycles. Thus, it is also used as a medicine to treat insomnia The pituitary gland

secretes multiple hormones, including melanocyte-stimulating hormone (MSH), adrenocorticotropic hormone (ACTH) and thyrotropin (thyroid-stimulating hormone, or TSH).

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235. (a) Lactational Amenorrhea (absence of menstruation) method is based on the fact that ovulation and therefore the cycle do not occur during the period of intense lactation following parturition. Therefore, as long as the mother breast feeds the child fully, and prevent chances of conception are almost nil.

236. (d) Haemophilia is an X-linked recessive disorder in which person do not produce clotting factor. Female have XX chromosome in which one X is affected and one X is normal. When she inherits affected *X* chromosome she has second normal chromosome which compensates the haemophilic gene and thus, called as a carrier. But haemophilic father (XY) inherit haemophilia to all his daughter because she carries one X from father and one from mother whereas none of his sons will be affected because he carries only Y chromosome from his father.

237. (b) B - Cell is activated by antigen it proliferates and differentiates into an antibody-secreting effector cell. Virus infected cells secretes proteins called interferon which protect noninfected cells from further viral infection. Response of T- cells is called cell mediated immunity. Macrophage is a type of white blood cell which is a phagocyte. They are scavengers which constantly move around to remove dead cells and foreign bodies such as pathogenic microbes.

238. (d) Streptokinase produced by the bacterium streptococcus and modified by genetic engineering is used as a clot buster for removing clots from the blood vessels of patients, have undergone myocardial infarction leading to heart attack.

239. (d) In artificial insemination, 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. Out-crossing or out-breeding is the technique of crossing between different breeds with no common ancestors. Inbreeding is the process of breeding animals is closely related to each other for 4-6 generation. It helps to accumulate the desired gene and eliminate undesired recessive gene because in this process superior animals are used to breed MOET is Multiple Ovulation Embryo Transfer. It is the most common method of cattle breeding. The cow is inseminated and embryos are obtained from its uterus the following week using a catheter. These results in release of numerous eggs as compared to a single egg released during natural heat period Hence, the reproductive rate of cow increases due to this hybridization technique.

240. (d) The plasmid is a single circular extrachromosomal DNA which carries antibiotic-resistant gene and origin of replication i.e., the ability of autonomous replication and its size is smaller than chromosomal DNA These characters of plasmid make it an ideal vector for recombinant DNA technology.