1. **(d)** $\mu_k = \mu_0 - \alpha x$

$\mu_0 - \alpha L = 0 \Rightarrow \alpha = \frac{\mu_0}{L}$

W.D. by kinetic friction $= \int f_k dx \cos 180^\circ$

$= \int_0^L \mu_k mg dx(-1)$

$= -\int_0^L (\mu_0 - \alpha x) mg dx$

$= -\left[\mu_0 mgL - \alpha mg \frac{L^2}{2}\right]$

$= -\left[\mu_0 mgL - \frac{\mu_0}{L} mg \frac{L^2}{2}\right]$

$= -\left[\frac{\mu_0 mgL}{2}\right]$

on comparing magnitude with $n\mu_0 MgL$

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

2. **(d)** $\lambda = \frac{1}{\sqrt{2}\pi d^2}\frac{1}{n}$

$n \propto \frac{1}{\lambda d^2}$

$\frac{n_A}{n_B} = \frac{\lambda_B}{\lambda_A} \times \left(\frac{d_B}{d_A}\right)^2$

$= 2 \times \left(\frac{1}{2}\right)^2 = \frac{1}{2}$

$n_A = \frac{n_B}{2}$

3. **(d)** $E_p = \frac{Ldi}{dt}$

$E_Q = L\frac{di/2}{dt}$

$E_Q = \frac{L}{2}\frac{di}{dt}$

$\frac{E_P}{E_Q} = \frac{\frac{Ldi}{dt}}{\frac{L}{2}\frac{di}{dt}} = 2$

4. **(c)** For COP and OOP → No. of nodes = m + 1 where m = No. of overtone

In OOP → 5^{th} Harmonic means 4^{th} OT

$m = 4$

so No. of nodes $n = 4 + 1 = 5$

In COP → 9^{th} Harmonic means 4^{th} OT

means $m = 4$

then no of nodes $= m + 1 = 4 + 1 = 5$

$m = 5$

So ratio $\frac{n}{m} = \frac{5}{5} = \frac{1}{1}$

5. **(a)** $L = n^2 \mu_0 Al$

$L = n^2 \mu_0 \pi r^2 1$

6. **(c)** $S = \alpha t^2 - \beta t + \gamma$

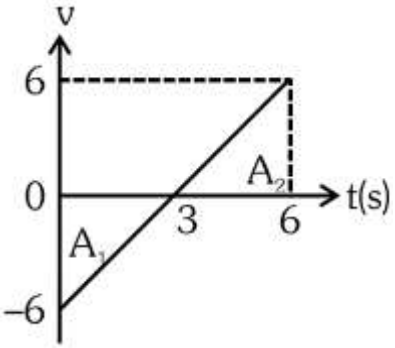
$S = t^2 - 6t + 5$

$\because v = \frac{ds}{dt} = (2t - 6) m/s$

distance travelled $= |A_1| + |A_2|$

distance $= 2\left[\frac{1}{2} \times 3 \times 6\right]$

distance = 18 m



$\therefore$ Average speed $\Rightarrow V_{avg} = \frac{\text{distance}}{\text{Time}}$

$V_{avg} = \frac{18}{6} = 3\ m/s$

7. **(a)** $Q = (m_1 - m_1)C^2$

$= [238.050 - (234.043 + 4.003)]uC^2$

$= 0.004 \times 931.5$

$= 3.726Mev$

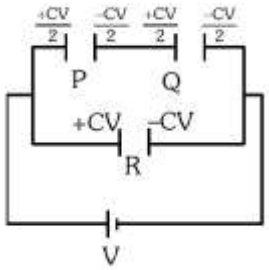
$= 3726Kev$

8. **(a)** $P = \frac{nhC}{\lambda} = nh\nu$

If power decreases then n decreases but frequency remain same as source is same.

$\therefore$ Photocurrent will decrease & stopping potential remain same.

9. **(d)**



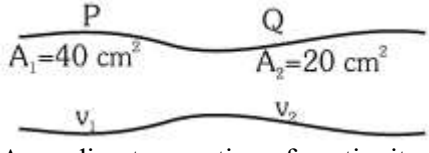
$U_p = \frac{1}{2}\frac{\left(\frac{CV}{2}\right)^2}{C} = \frac{1}{8}CV^2$

$U_T = \frac{1}{2}\frac{\left(\frac{CV}{2}\right)^2}{C} + \frac{1}{2}\frac{\left(\frac{CV}{2}\right)^2}{C} + \frac{1}{2}CV^2$

$U_T = \frac{3}{4}CV^2$

$\frac{U_P}{U_T} = \frac{\frac{1}{8}CV^2}{\frac{3}{4}CV^2} = \frac{1}{6}$

10. **(d)**



According to equation of continuity

$A_1v_1 = A_2v_2 \Rightarrow 40v_1 = 20v_2$

$v_2 = 2v_1$

Bernoulli's principle

$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$

$P_1 - P_2 = \frac{1}{2}\rho((2v_1)^2 - v_1^2)$

$\frac{15 \times 2}{10^3} = 3v_1^2$

$v_1 = 0.1\ m/s$

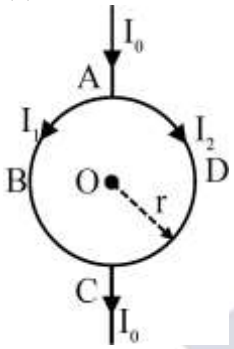
Now rate of flow $\frac{dV}{dt} = A_1 v_1 = A_2 v_2$

$\frac{dV}{dt} = 40 \times 10^{-4} \times 0.1 = 4 \times 10^{-4}\ m^3/s$

$= 4 \times 10^{-4} \times 10^6\ cm^3/s$

$= 400\ cm^3/s$

11. (a)



$R_1 : R_2 = 1 : 2$

From $V = IR$

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

$\frac{I_1}{I_2} = \frac{R_2}{R_1} = \frac{2}{1}$

$I_1 = \frac{2}{3}I_0$ and $I_2 = \frac{1}{3}I_0$

$(B_0)_{net} = B_1 - B_2$

$= \frac{\mu_0 I_1}{4r} - \frac{\mu_0 I_2}{4r}$

$= \frac{\mu_0}{4r}(I_1 - I_2) = \frac{\mu_0}{4r}\left(\frac{2I_0}{3} - \frac{I_0}{3}\right)$

$= \frac{\mu_0 I_0}{12r}$

12. (a) Given density of ball (solid) $\rightarrow \sigma$

Density of liquid $\rightarrow \rho$

So formula of terminal velocity

$v = \frac{2r^2}{9\eta}(\sigma - \rho)g$

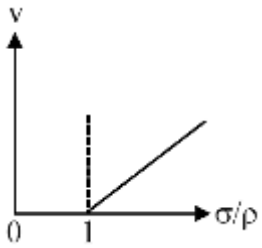
$v = \frac{2r^2}{9\eta}\rho\left[\frac{\sigma}{\rho} - 1\right]g$

$v = \frac{2r^2\rho g}{9\eta}\left(\frac{\sigma}{\rho}\right) - \frac{2r^2\rho g}{9\eta}$

It's equation of positive slope and negative straight line of intercept

If $\frac{\sigma}{\rho} = 1$ then $v = 0$

So, correct graph



13. **(c)** $V_{es} = \sqrt{\frac{2GM}{R}}$

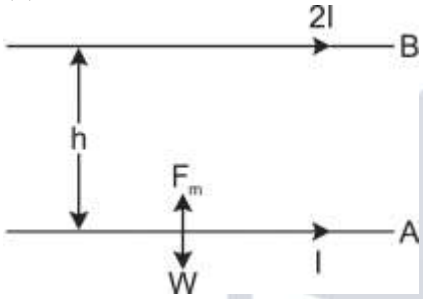
$\frac{V_2}{V_1} = \sqrt{\frac{R_1}{R_2}} = \sqrt{2}$

14. **(b)** By Kepler's III law-

$T^2 \propto R^3$

$T \propto R^{3/2}$

15. **(b)**



At equilibrium: $F_m = W$

$\frac{F_m}{\ell} = \frac{W}{\ell} = \frac{mg}{\ell} = \lambda g$

$\frac{\mu_0(2I)(I)}{2\pi(h)} = \lambda g$

$h = \frac{\mu_0 I^2}{\pi\lambda g}$

16. **(b)** Here Zener diode is in reverse biased, so voltage drop across Zener diode is 3V.

Voltage difference across points B and A

$V_{BA} = 5 - 3 = 2V$

17. **(c)** $W = \frac{\mu R\Delta T}{1-\gamma}$

$= \frac{1 \times 8.3 \times (-10)}{1 - \frac{5}{3}}$

$= \frac{3 \times 8.3 \times 10}{2} = 124.5\ J$

18. **(a)** For photo-electric effect wavelength of incident light should be less than threshold wavelength.

(1) $\lambda_1 < \lambda$

∴ No photoelectric effect take place.

(2) $\lambda_2 > \lambda$, photoelectric effect take place.

(3) $\lambda_3 \gg \lambda$ photoelectric effect take place.

Frequency of 3 > frequency of 2

∴ $V_3 > V_2 \& V_1 = 0$

19. **(c)** $\frac{p_e}{p_{Ph}} = \frac{\sqrt{2mE_e}}{\frac{E_{Ph}}{C}} (E_e = E_{Ph} = E)$

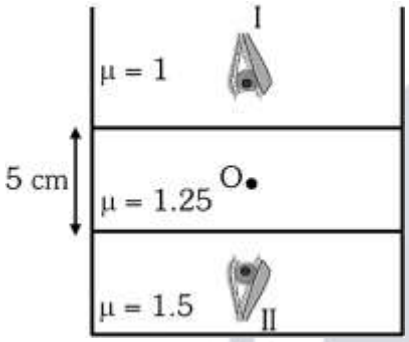
$\frac{p_e}{p_{Ph}} = \sqrt{\frac{2m}{E}} \times C$

$$= \sqrt{\frac{2 \times 9 \times 10^{-31}}{20 \times 1.6 \times 10^{-19}}} \times 3 \times 10^{8}$$
$$= \frac{3}{4} \times 10^{-6} \times 3 \times 10^{8}$$
$$= 225$$

20. (c) In an optical bench experiment, index correction also known as bench correction.
Optical bench experiment perform to calculate focal length of lenses.

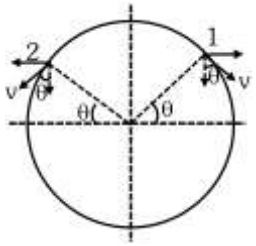
21. (d) $W = q\Delta V$
$= q(V_B - V_A)$
$= 1\frac{kQ}{3R} - \frac{kQ}{2R} = \frac{-kQ}{6R}$
$= \frac{1}{4\pi\varepsilon_0}\frac{\rho \times \frac{4}{3}\pi R^3}{6R} = \frac{\rho R^2}{18\epsilon_0}$
n = 18

22. (b)



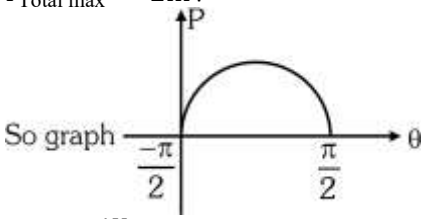
For observer I
$\frac{d'}{d} = \frac{\mu_2}{\mu_1}$
$\frac{d'}{2.5} = \frac{1}{1.25}$
$d' = 2\text{ cm} = h_1$
For observer II
$\frac{d'}{d} = \frac{\mu_2}{\mu_1}$
$\frac{d'}{2.5} = \frac{1.5}{1.25}$
$d' = 3\text{ cm} = h_2$
$|h_1 - h_2| = 1\text{ cm}$

23. (c)



$\vec{P}_1 + \vec{P}_2 = mv\sin\theta\hat{i} - mv\cos\theta\hat{j} + (-mv\sin\theta\hat{i} - mv\cos\theta\hat{j})$
$P_{Total} = |\vec{P}_1 + \vec{P}_2| = 2mv\cos\theta$
At $\theta = \frac{\pi}{2}$
At $\theta = -\frac{\pi}{2}$
$P_{Total} = 0$

$P_{Total} = 0$
At $\theta = 0$
$P_{Total\ max} = 2mV$



24. (c) $\gamma = \frac{\Delta V}{V} \times \frac{1}{\Delta T}$
$3\alpha\Delta T \times V = \Delta V$
$\Delta V = \frac{4}{3}\pi R^3 \times 3\alpha\Delta T$
$= 4\pi R^3 \alpha\Delta T$

25. (d) Force on cork when cross section area is A
$F = -\rho g A x$
Compare with $F = -kx$
$k = \rho A g$

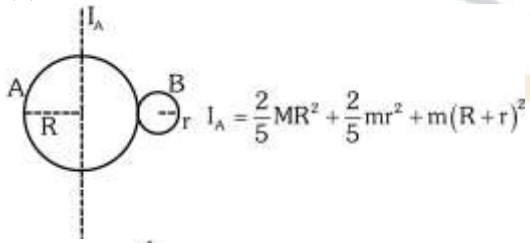
$$T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow T = 2\pi\sqrt{\frac{m}{\rho A g}} \Rightarrow T \propto \frac{1}{\sqrt{\rho}}$$

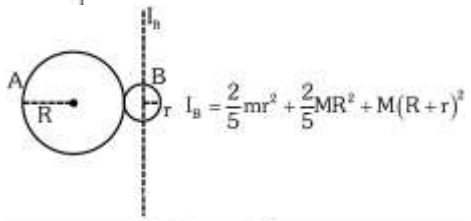
Now $\frac{T_1}{T_2} = \sqrt{\frac{\rho_2}{\rho_1}}$

$$\frac{T}{2T} = \sqrt{\frac{\rho_2}{\rho_1}} \Rightarrow \frac{\rho_2}{\rho_1} = \frac{1}{4}$$

26. (d) MSD = 1 mm
VSD = 0.9 mm
LC = 0.1 mm = 0.01 cm
ZE = −(Total − coinciding VSD)LC
$= -(10-4)(0.01)$
$= -0.06$ cm
Actual reading = Measured reading – ZE
$= 1\text{ cm} - (-0.06)\text{cm}$
$= 1.06$ cm

27. (b)





$I_A - I_B = m(R+r)^2 - M(R+r)^2$
$= (R+r)^2(m-M)$

28. (b) In a spring mass system, the total energy is

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

or $\frac{mv^2}{2E} + \frac{kx^2}{2E} = 1$

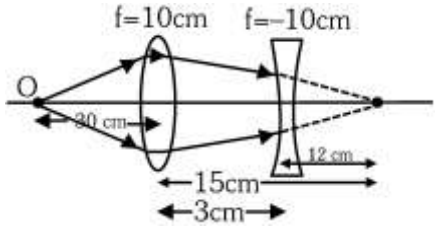
or $\frac{v^2}{\frac{2E}{m}} + \frac{x^2}{\frac{2E}{k}} = 1$

Compare with $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

For circle $a^2 = b^2 \Rightarrow \frac{2E}{m} = \frac{2E}{k}$

$\Rightarrow m = k$

29. (b)



1st lens $u = -30$ cm

$f = 10$ cm

$v = \frac{uf}{u+f} = \frac{-30 \times 10}{-30+10} = 15$ cm

Image of first lens act as a virtual object for second lens.

2nd lens $u = 12$ cm

$f = -10$ cm

$v = \frac{12 \times (-10)}{12-10} = -60$ cm(Virtual image)

negative sign indicates left of the concave lens.

30. (a) Here $X_L = \omega L = 2 \times 10^3 \times 10 \times 10^{-3} = 20\Omega$

$X_c = \frac{1}{\omega C} = \frac{10^6}{2 \times 10^3 \times 25} = 20\Omega$

$\therefore X_L = X_C$; hence LCR circuit is in resonance

So $Z = R; I_0 = \frac{V_0}{Z} = \frac{V_0}{R} = \frac{220}{100} = 2.2$Amp

31. (c) $L_{\text{of pure rotaten body}} = L_{\text{adout which tody rodethg}}\ \omega$

$L_A = \frac{MR^2}{2}\omega \Rightarrow L_B = \frac{MR^2}{2}\omega$

$\frac{L_A}{L_B} = 1$

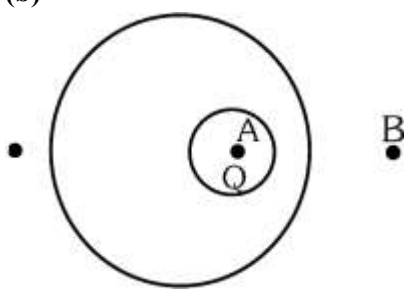
32. (b) $\phi = BA$

$\phi = BA_0(1 + \sin t)$

$e = \frac{-d_\phi}{dt} = -BA_0 \cos t \Rightarrow P = \frac{e^2}{R} = \frac{B^2 A_0^2 \cos^2 t}{R}$

$P \propto \cos^2 t$

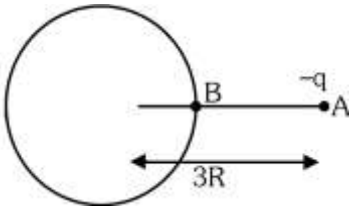
33. (b)



$E_A = \frac{kQ}{r^2}$

$E_B = \frac{kQ}{r_B^2} = \frac{kQ}{r_C^2} = E_C$

34. (c)



$K_A + U_A = K_B + U_B$

$-qV_A = \frac{1}{2}mv^2 + (-qV_B) \Rightarrow -\frac{KQq}{3R} = \frac{1}{2}mv^2 - q\frac{KQ}{R}$

$\frac{2}{3}\frac{KQq}{R} = \frac{1}{2}mv^2 \Rightarrow \sqrt{\frac{Qq}{3\pi\epsilon_0 R}} = v$

35. (c) $N \propto \frac{1}{\sin^4(\theta/2)}$

36. (a) $RA = R_1 + R_2$

$= R_0(1 + \alpha\Delta T) + R_d(1 - \alpha\Delta T) = 2R_0$

$I_A = \frac{V}{R_A} = \frac{V}{2R_0}$

does not depends on temperature

$R_B = \frac{R_1R_2}{R_1 + R_2} = \frac{R_0^2(1 + \alpha\Delta t)(1 - \alpha\Delta t)}{R_0(1 + \alpha\Delta t) + R_0(1 - \alpha\Delta t)}$

$= \frac{R_0^2(1 - \alpha^2\Delta t^2)}{2R_0}$

$R_B = \frac{R_0}{2}(1 - \alpha^2\Delta t^2)$

as $\Delta t \uparrow R_B \downarrow I_B \uparrow$

37. (a) $[\sigma_S][k_B^{-1}][b] = \left[\frac{\text{Intensity}}{(\text{Temp})^4}\right]\left[\frac{\text{Energy}}{\text{Temp}}\right]^{-1}[\lambda_{max}\ \text{Temp}]$

$= \left[\frac{MT^{-3}}{K^4}\right]\left[\frac{ML^2T^{-2}}{K}\right]^{-1}[LK]$

$= [M^0L^{-1}T^{-1}K^{-2}]$

38. (b, c) (a) Speed of EMW in a medium

$C_m = \frac{C}{\sqrt{\mu_r\varepsilon_r}}$

Here, $\mu_r \simeq 1, \varepsilon_r = 9$

$C_m = \frac{C}{\sqrt{1\times9}} = \frac{3\times10^8}{3} = 10^8$ m/sec. (Correct)

(b) $v = f\lambda \Rightarrow \lambda_m = \frac{C_m}{f}$

Here $2\pi f = \omega = 2\pi \times 10^6 \Rightarrow f = 10^6$

$\lambda_m = \frac{C_m}{f} = \frac{10^8}{10^6} = 100$ m (Incorrect)

(c) $\frac{E_0}{B_0} = v \Rightarrow B_0 = \frac{E_0}{v}$

$By = \frac{E_0}{v}\sin(kz - 2\pi \times 10^6 t)$ (Incorrect)

(d) Here EMW is propagating in $+z$ (from eq.) (correct)

39. (c) $W = Q =$ Area of rectangle

$Q = (300 - 100)(5 - 2)$

$= 200 \times 3 = 600$ J

40. (d) $\frac{mv^2}{r} = \frac{1}{4\pi\epsilon_0}\frac{e^2}{r^2}$

$$\frac{9\times10^{-31}\times25.6\times10^{5}\times10^{5}}{r}=9\times10^{9}\times\frac{1.6\times10^{-19}\times1.6\times10^{-19}}{r^2}$$

$$r=\frac{256\times10^{-40}}{256\times10^{4}\times10^{5}}\times\frac{10^{9}}{10^{-31}}$$

$r = 1\times1^{-9}\ m = x\times10^{-9}\ m$

$x = 1$

41. (a) $\tan\theta=\frac{v^2}{Rg}$

$$\tan\theta=\frac{(10)^2}{50\times10}=\frac{1}{5}$$

$$\theta=\tan^{-1}\left(\frac{1}{5}\right)$$

42. (c) Here diode D_1 is F.B. diode D_2 is unbias and diode D_3 is R.B.

In F.B width of depletion region decreases and in R.B width of depletion region increases so order of width of depletion region is

$W_3 > W_2 > W_1$

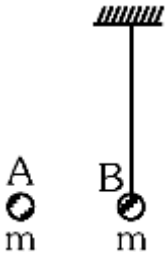
43. (c) • Microwaves are used for warming the food (P-II)

• UV rays are used for purifying the water (Q-I)

• Gamma rays are used for treating the cancer cells. (R-IV)

• Radio wave are used for AM and FM communication system (S-III)

44. (c)



• Mass same

• Collision → Head on elastic

• Velocity will interchange

• After that by COME

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

$$h=\frac{v^2}{2g}$$

$$h=\frac{100}{20}$$

• $h = 5m$

45. (a) Total degree of freedom $=\frac{2}{\gamma-1}$

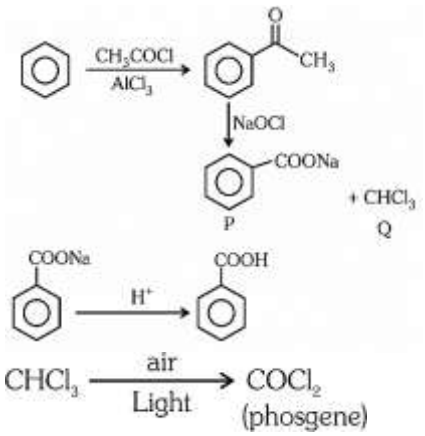
$$6+2f=\frac{2}{\frac{8}{7}-1}$$

$6 + 2f = 14$

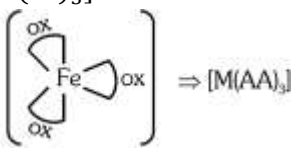
$2f = 8$

$f = 4$

46. (c)

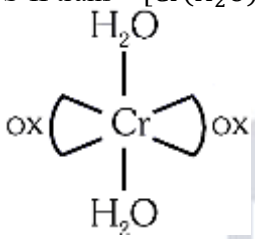


47. (c) $[Fe(ox)_3]^{3-}$

S-I  $\Rightarrow [M(AA)_3]$

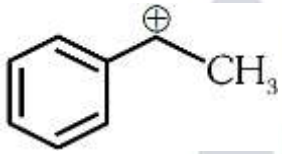
$\Rightarrow$ optically active so chiral

S-II trans $-[Cr(H_2O)_2(ox)_2]^-$



Plane of symmetry is present, so it is not optically active i.e. not chiral

48. (a)



Filled σ and filled π orbitals.

49. (a) Potash Alum: $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

$K^+ : SO_4^{-2}$

$2:4 \Rightarrow (1:2)$

50. (c) In β-pleated sheet structures, peptide chains are held together by intermolecular hydrogen bonds.

51. (c) 17.0145 → Right most digit to be removed is 5 and preceding number is even

$\therefore$ it remains unchanged

17.014

21.0235 → Right most digit to be removed is 5 and preceding number is odd

$\therefore$ it is increased by 1

21.024

52. (d) Salt $\Rightarrow AgBr(s) \rightarrow Ag^+(aq.) + Br(aq.)$

$K_{sp} = S^2 \Rightarrow S_1 = \sqrt{K_{sp}} = \sqrt{5 \times 10^{-13}} = \sqrt{50 \times 10^{-14}} = 7.1 \times 10^{-7} M$

Salt $\Rightarrow Zn(OH)_2(s) \rightarrow Zn^{+2}(aq.) + 2OH(aq.)$

$K_{sp} = 4S^3 \Rightarrow S_2 = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{1.0 \times 10^{-15}}{4}\right)^{1/3}$

$S_2 = (250 \times 10^{-18})^{1/3} = 6.3 \times 10^{-6} M$

Salt $\Rightarrow Hg_2Cl_2(s) \rightarrow Hg_2^{+2}(aq.) + 2Cl^-(aq.)$

$K_{sp} = 4S^3 \Rightarrow S_3 = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{1.3 \times 10^{-18}}{4}\right)^{1/3}$

$S_3 = (325 \times 10^{-21})^{1/3} = 6.9 \times 10^{-7} M$

$\therefore$ Order of solubility $\Rightarrow Zn(OH)_2 > AgBr > Hg_2Cl_2$

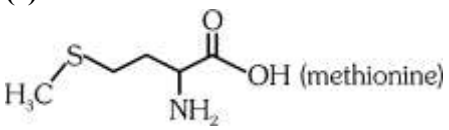
53. (c) Electron Gain Enthalpy order of Halogen

$Cl > F > Br > I$

54. (c) If the intermolecular attractive forces between the $P - P$ and $Q - Q$ are nearly equal to those between $P - Q$, this leads to the formation of ideal solution.

As interactions remains nearly same, therefore $\Delta H_{mix} = 0$ and $\Delta V_{mix} = 0$. Hence, Assertion is correct, and Reason is incorrect.

55. (c)



Contains both sulphur and nitrogen

$\therefore$ Its sodium fusion extract gives red blood colour with sodium nitroprusside.

56. (b) $Fe^{+3} + 3e^- \rightarrow Fe$ .... (1)

$Fe^{+2} + 2e^- \rightarrow Fe$ .... (2)

$Fe^{+3} + e^- \rightarrow Fe^{+2}$ .... (3)

Eq. (3) = Eq. (1) − Eq. (2)

$\Delta G_3^0 = \Delta G_1^0 - \Delta G_2^0$

$-nFE_3^0 = -nFE_1^0 - (-nFE_2^0)$

$-(1)FE_3^0 = -3FE_1^0 - (-2FE_2^0)$

$E_3^0 = 3E_1^0 - 2E_2^0$

$= 3(-0.04) - 2(-0.44)$

$= -0.12 + 0.88$

$= +0.76\ V$

57. (a) Equivalents of oxalic acid = Equivalents of $KMnO_4$

Normalilty × volume = Normality × volume

$N_1\ V_1 = N_2\ V_2$

$M_1 \times v.f \times V_1 = M_2 \times v.f \times V_2$

$0.25 \times 2 \times 10 = M_2 \times 5 \times 10$

$M_2 = 0.10M$

58. (a) Spectrochemical series for strength of ligands.

$CO > NH_3 > H_2O > Cl^-$

59. (d) It is isothermal free expansion from 10 Lt to 100 Lt at 300 K , 2 mole gas is taken.

$\Delta S_{Sys} = nR\ell n\frac{V_2}{V_1}$

$= 2R\ell n\frac{100}{10}$

$= 2R\ell n10$

$= 2R \times 2.303$

$= +4.606R$

as $dT = 0, \Delta U = 0$

$P_{ext} = 0$ (as free expansion)

$W_{PV} = 0$

First law $\Delta U = Q + W$

$0 = Q + 0$

$Q = 0$

As no heat is exchanged between system and surrounding

$\Delta S_{surr..} = -\frac{Q_{sys}}{T}$

$\Delta\ S_{surr.} = 0$

60. (b) $2A \xrightarrow{k} B$

Rate $= K[A]^0$

$\frac{1}{2}\left[-\frac{d[A]}{dt}\right] = K$

$\frac{-d[A]}{dt} = 2K$

$\therefore [A]_0 - [A]_t = 2Kt$

$[2] - [0.025(2)] = 2(1)t_{75\%}$

$t_{75\%} = 0.75$ min

61. **(a)** In d-block metals, unpaired electrons of $(n-1)$ d subshell also participate in metallic bonding along with ns that's why interatomic metallic bonding is comparatively strong hence their melting point are high

62. **(a)** For XY, Debye Huckel Onsager equation,

$\Lambda_M = \Lambda_M^0 - A\sqrt{C}$

slope of Λ_M vs $\sqrt{C}$ is $-A = -90$

$A = 90$

At $C = 0.01M, \Lambda_M = 145$

$\therefore 145 = \Lambda_M^0 - 90 \times \sqrt{10^{-2}}$

$145 = \Lambda_M^0 - 9$

$\Lambda_M^0 = 154\ Scm^2\ mol^{-1}$

$\Lambda_M^0\ (XY) = \Lambda_M^0\ (X^+) + \Lambda_M^0\ (Y)$

$154 = 74 + \Lambda_M^0\ (Y^-)$

$\Lambda_M^0\ (Y^-) = 154 - 74 = 80\ Scm^2\ mol^{-1}$

63. **(a)** n-butane is C_4H_{10}

$n_{C_4H_{10}} = \frac{116}{58} = 2mol$

$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

1 mol C_4H_{10} gives 4 mol of CO_2

2 mol C_4H_{10} gives 8 mol of CO_2

$W_{CO_2} = 8 \times 44$

$= 352$ g

64. **(c)** $\ell nk = \ell nA - \frac{E_a}{RT}$

$\ell nA = 6$ (from graph)

$k = e^2$, T =?

$\ell ne^2 = 6 - \frac{6.64 \times 1000}{8.3 \times T}$

$2 = 6 - \frac{6640}{8.3 \times T}$

$\frac{6640}{8.3 \times T} = 4$

$T = 200$ K

65. **(d)** Heating NaCl with concentrated H_2SO_4 and MnO_2 reduces Mn , not oxidises it

S-(I)

$4NaCl + \overset{+4}{Mn}O_2 + 4H_2SO_4 \rightarrow \overset{+2}{Mn}cl_2 + 4NaHSO_4 + 2H_2O + Cl_2$

i.e. statement is wrong.

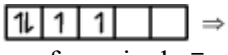
S-(II)

$2NaI + \overset{+4}{Mn}O_2 + 4H_2SO_4 \rightarrow I_2(\uparrow) + \overset{+2}{Mn}SO_4 + Na_2SO_4 + 2H_2O$

Heating NaI with conc. H_2SO_4 and MnO_2 reduce Mn.

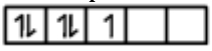
statement is correct.

66. **(a)** (a) $[Mn(CN)_6]^{-3} \Rightarrow\ d^2sp^3$

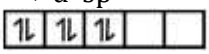
$\Rightarrow Mn^{+3} = 3d^4 \Rightarrow$  $\Rightarrow n = 2$

$\Rightarrow$ Maximum no. of unpaired e^- so highest spin only magnetic moment.

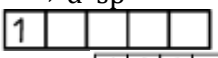
(b) $[Fe(CN)_6]^3 \Rightarrow\ d^2sp^3$

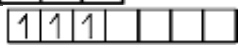
$\Rightarrow Fe^{+3} = 3d^5 \Rightarrow$  $\Rightarrow n = 1$

(c) $[Co(NH)_6]^{3+} \Rightarrow d^2sp^3$

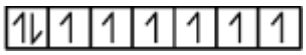
$\Rightarrow Co^{+3} = 3d^6 \Rightarrow$  $\Rightarrow n = 0$

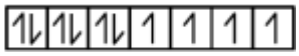
(d) $[Ti(H_2O)_6]^{3+} \Rightarrow d^2sp^3$

$\Rightarrow Ti^{+3} = 3d^1 \Rightarrow$  $\Rightarrow n = 1$

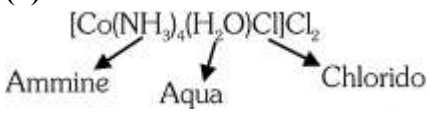
67. (d) (a) $Nd^{+3} \Rightarrow 4f^3 \Rightarrow$  $\Rightarrow n = 3$

(b) $Ce^{+3} \Rightarrow 4f^1 \Rightarrow$  $\Rightarrow n = 1$

(c) $Tb^{+3} \Rightarrow 4f^8 \Rightarrow$  $\Rightarrow n = 6$

(d) $Ho^{+3} \Rightarrow 4f^{10} \Rightarrow$  $\Rightarrow n = 4$

68. (d)



69. (a) Process-1 is Isothermal reversible process

$$w_1 = -nRT\ln\left(\frac{V_f}{V_i}\right)$$

$$= -1 \times 2 \times T_1 \ln\left(\frac{V_2}{V_1}\right)$$

$$= -2\ T_1 \ln\left(\frac{V_2}{V_1}\right)$$

Process-3 is Isothermal reversible process

$$w_3 = -nRT\ln\left(\frac{V_f}{V_i}\right)$$

$$= -1 \times 2 \times T_2 \ln\left(\frac{V_4}{V_3}\right)$$

$$= -2\ T_2 \ln\left(\frac{V_4}{V_3}\right)$$

$$w_1 + w_3 = -2\ T_1 \ln\left(\frac{V_2}{V_1}\right) - 2\ T_2 \ln\left(\frac{V_4}{V_3}\right)$$

Process-2 is Reversible adiabatic process (expansion)

$w_2 = \Delta U_2 = nC_v\Delta T$

$= 1 \times C_v(T_2 - T_1)$

$= C_v(T_2 - T_1)$

Process-4 is Reversible adiabatic process (compression)

$w_4 = \Delta U_4 = nC_v\Delta T$

$= 1 \times C_v(T_1 - T_2)$

$= -C_v(T_2 - T_1)$

$w_2 + w_4 = \Delta U_2 + \Delta U_4$

$= 0$

70. (a) $IP_1: -O < N < F$

First IP of O is lower than both N and F.

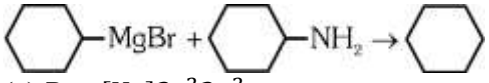
Reason: After removal of electron O becomes $2p^3$ (half-filled)

71. (a) (A) is correct. Raoult's law is obeyed by ideal solution throughout the composition Range.

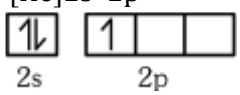
(B) is correct. They together form a solution showing negative deviation from Raoult's law

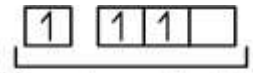
(C) is incorrect. They together form a solution showing negative deviation from Raoult's law

72. (d)



73. (a) $B = [He]2s^2 2p^2$

GS : 

Ist ES :  Ex. BF_4^-

One + three ⇒ 4 orbitals

4 orbitals can participate in bonding.

74. (a) $N \rightleftharpoons D$

$$K = \frac{[D]}{[N]}$$

$K = 1$ {as $[D] = [N]$ at equilibrium}

Now, $\Delta G^\circ = -2.303RT\log K$

$\Delta G^\circ = 0$ {as $K = 1$}

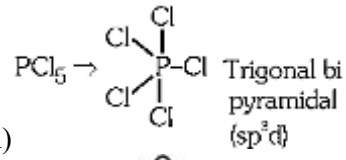
Now, $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

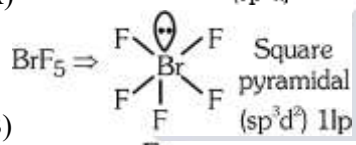
$0 = 666 - 333\ \Delta S^\circ$

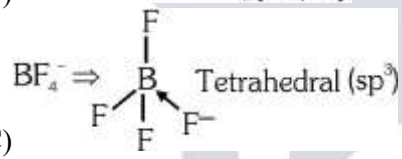
$$\Delta S^\circ = \frac{666}{333}$$

$\Delta\ S^\circ = 2\ kJ\ K^{-1}\ mol^{-1}$

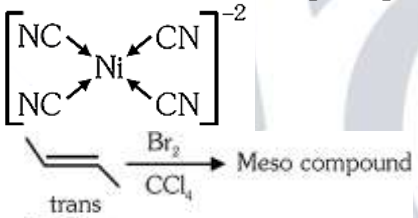
75. (b)

(A) 

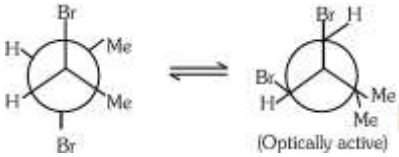
(B) 

(C) 

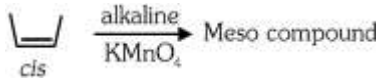
(D) $[Ni(CN)_4]^{-2} dsp^2$ ⇒ square planar



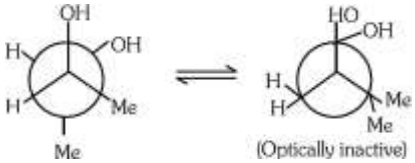
76. (d) but-2-ene



∴ Statements-I is incorrect.

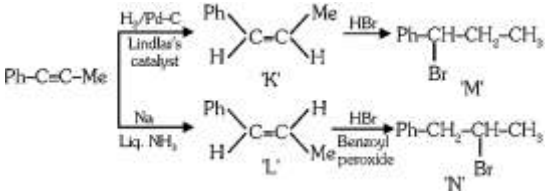


but-2-ene



∴ Statements-II is correct.

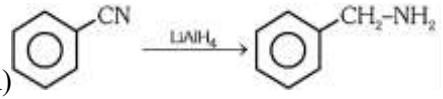
77. (a)



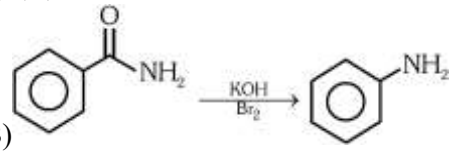
K & L are geometrical isomers.

78. **(a)** $[Cr(Py)_3Cl_3] \Rightarrow [Ma_3b_3] \Rightarrow$ It shows facial, meridional isomers.

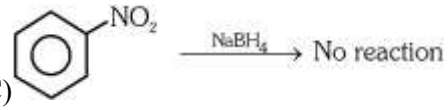
79. **(b)** (A)



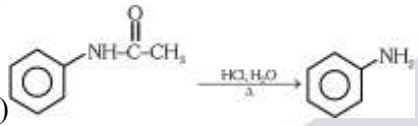
(B)



(C)



(D)



80. **(b)** (A) Vitamin A → Carrots

(B) Vitamin B_{12} → Meat

(C) Vitamin E → Sunflower oil

(D) Vitamin K → Green leafy vegetables.

81. **(b)** $\underline{N}_2O_5 \Rightarrow 2x + 5(-2) = 0$

$2x = 10$

$x = +5$

$\underline{Al}_2O_3 = 2x + 3(-2) = 0$

$2x = 6$

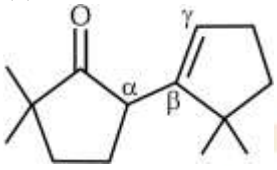
$x = +3$

$H_2\underline{S} \Rightarrow 2(+1) + x = 0$

$x = -2$

$N_2O_5 > Al_2O_3 > H_2S$

82. **(a)** Aldol condensation product should be α, β-unsaturated carbonyl compound



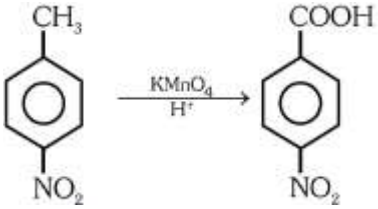
(cannot be formed)

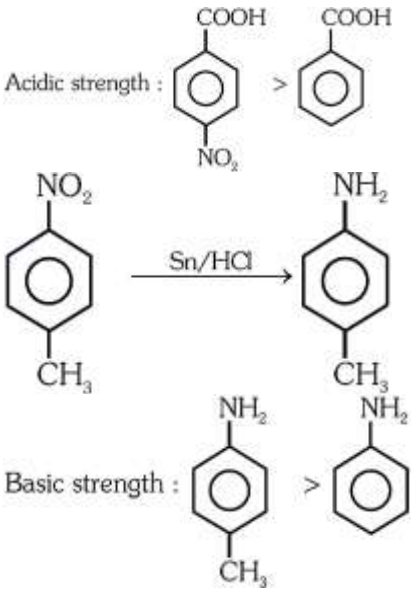
83. **(a)**

$\overset{1}{CH_2} = \overset{2}{CH} - \overset{3}{CH} = \overset{4}{CH} - \overset{5}{CH_2} - \overset{6}{CH_2} - CH_3$

Hepta–1,3–diene

84. **(a)**

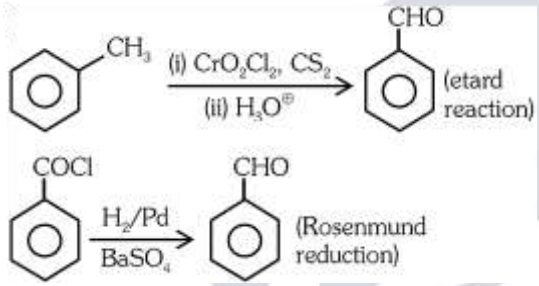




∴ Both statement I and II are correct

85. (a) $KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

86. (d)



87. (c) $[Co(NH_3)_6]Cl_3 \Rightarrow [Co(NH_3)_6]^{3+} + 3Cl$

1: 3 electorlyte

88. (c) In figure C, the curve is cutting two times on x-axis. Hence, represents two nodes.

89. (d) Increasing order:

$CH_3CH_2OCH_2CH_3 < CH_3COCH_3 < CH_3CH_2OH < CH_3COOH$

90. (d) $Ne_2 \Rightarrow 20e^-$

$\sigma 1s^2 < \sigma^* 1s^2 < \sigma 2s^2 < \sigma^* 2s^2 < \sigma 2p_z^2$

$< \pi 2p_x^2 = \pi 2p_y^2 < \pi^* 2p_x^2 = \pi^* 2p_y^2 < \sigma^* 2p_z^2$

$\Rightarrow$ Highest Occupied Molecular Orbital (HOMO)

91. (c) The adult human vertebral column typically consists of 26 vertebrae after the sacral and coccygeal bones fuse.

92. (a) A Lichen is the symbiotic association between algae and fungi.

93. (a) The foundational Cell Theory was formulated by German botanist Matthias Schleiden and zoologist Theodor Schwann.

94. (d) Prokaryotic cells contain 70 S ribosomes (made of 50 S and 30 S subunits), can contain extrachromosomal DNA as plasmids, and often possess mesosomes. They lack membrane-bound organelles like peroxisomes.

95. (d) The arachnoid, dura mater, and pia mater are all protective membranes (meninges) that form the central nervous system. The pericardium is the membrane that encloses the heart.

96. (a) The inner mitochondrial membrane surrounds the innermost compartment called the matrix, which contains enzymes for the Krebs cycle and mitochondrial DNA.

97. (b)

List-I		**List-II**	
(A)	Cristae	**(II)**	Infoldings in mitochondria

(D)	Cisternae	**(IV)**	Disc shaped sacs in the Golgi apparatus
(C)	Thylakoids	**(I)**	Flat membrane sacs in stroma of chloroplast
(D)	Phospholipid	**(III)**	Cell membrane

98. **(b)** Chromoplasts are responsible for pigment synthesis and storage (like carotenoids and xanthophylls), giving plants their yellow, orange, or red colors.

99. **(b)** (A) Correct: It is anatomically divided into the adenohypophysis (anterior) and neurohypophysis (posterior).
(B) Correct: It secretes Follicle Stimulating Hormone (FSH).
(C) Correct: It secretes Melanocyte Stimulating Hormone (MSH) from the intermediate lobe.
(D) Incorrect: The pituitary gland does secrete prolactin.

100. **(b)** During photorespiration, RuBisCO acts as an oxygenase. Ribulose bisphosphate (RuBP) reacts with O_2 to produce one molecule of 3-phosphoglycerate and one molecule of 2-phosphoglycolate

101. **(a)** Prions are abnormal, misfolded proteins that cause neurodegenerative diseases such as Mad cow disease (bovine spongiform encephalopathy) and Creutzfeldt-Jakob disease.

102. **(b)** The reaction center for Photosystem I (PS I) is designated as P700, and its primary pigment is a specific type of Chlorophyll a that absorbs light maximally at 700 nm .

103. **(a)** When submerged in water, frogs perform cutaneous respiration, meaning they breathe through their moist, mucus-covered skin.

104. **(c)** The correct proximal-to-distal bone sequence for the human lower limb starts with the thigh bone (Femur), followed by the kneecap (Patella), the inner shin bone (Tibia), and the ankle bones (Tarsals).

105. **(a)** Phyllotaxy is defined as the botanical term for the pattern or arrangement of leaves on the stem or axis of a plant.

106. **(b)** (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
- Starch serves as Energy storage in plants.
- Antibodies are proteins that Fight infection.
- Concanavalin A is a type of protein known as a Lectin.
- Glut-4 is a protein carrier responsible for Glucose transport into cells.

107. **(c)** Statement I is correct but Statement II is incorrect
Statement I is correct: radial symmetry occurs when any plane passing through the central axis divides the organism into identical halves. Statement II is incorrect because, while adult echinoderms exhibit radial symmetry, their larval stage displays bilateral symmetry.

108. **(a)** The endomembrane system consists of membranes that work together in synthesis, packaging, modification, and transport of cellular materials. It includes:
- Endoplasmic reticulum (ER)
- Golgi apparatus
- Lysosomes
- Vacuoles

Mitochondria, chloroplasts, and peroxisomes function independently and are not part of the endomembrane system.

109. **(d)** 2 molecules of pyruvic acid are produced at the end of glycolysis from 1 molecule of glucose.
So 206 molecules of glucose will produce
$\Rightarrow 206 \times 2 = 412$ molecules of pyruvic acid

110. **(a)** 2,4-D (2,4-Dichlorophenoxyacetic acid) is a synthetic auxin used as a selective herbicide to kill broadleaved weeds without harming cereal crops.

111. **(a)** Statement I → Correct

In gymnosperms:

• Male gametophyte develops inside the microspore (microsporangium).
• Female gametophyte develops inside the megaspore retained within the megasporangium (ovule).

Statement II → Correct

Gymnosperm seeds are naked and not enclosed within fruits.

112. **(d)** • Cocci → Spherical bacteria
• Bacilli → Rod-shaped bacteria
• Vibrio → Comma-shaped bacteria
• Spirilla → Spiral-shaped bacteria

113. **(a)** (A) Flowers are bisexual and actinomorphic → Correct

(B) Five united sepals (gamosepalous) → Correct

(C) Five epipetalous stamens → Correct

(D) Ovary is inferior → Incorrect

The ovary in Solanaceae is superior and bicarpellary.

114. **(b)** (1) Joseph Priestley (1770s)

Demonstrated the role of air and showed that plants restore air made impure by burning candles.

(2) Jan Ingenhousz (1779)

Showed that green plants release oxygen only in the presence of sunlight.

(3) Julius von Sachs (1860s)

Demonstrated that photosynthesis results in the formation of glucose/starch.

(4) T.W. Engelmann (1882) and later studies

Established the relationship between chlorophyll absorption spectrum and photosynthesis.

Hence the correct sequence is:

Role of air → Release of oxygen → Production of glucose → Absorption spectra of chlorophyll a and b.

115. **(b)** The SA node (pacemaker) generates about 70-75 action potentials per minute in a healthy adult and initiates each heartbeat.

116. **(d)** For the formation of 1 molecule of glucose 6 turns of calvin cycle are required.

So for the formation of 3 molecules of glucose $\Rightarrow 3 \times 6 = 18$ turns of calvin cycle are required

117. **(d)** • Blood coagulates in response to injury → Correct
• Blood clot consists of fibrin fibres → Correct
• Fibrin is produced from fibrinogen by the action of thrombin → Correct
• Fibrinogen is produced from fibrin → Incorrect

Actually, Fibrinogen → Fibrinnot the reverse.

118. **(d)** Taxonomic classification of mango (Mangifera indica):
• Kingdom → Plantae
• Phylum (Division) → Angiospermae
• Class → Dicotyledonae
• Order → Sapindales
• Family → Anacardiaceae
• Genus → Mangifera

119. **(a)** Taxonomic hierarchy (lowest → highest):

Species ~ Genus → Family → Order – Class → Phylum → Kingdom

So,(G) → (A) → (E) → (C) → (B) → (D) → (F)

Species is the basic unit of classification. Similar species form a genus, genera form a family, and so on up to kingdom.

120. **(d)** • Marginal placentation - Pea (IV)
• Axile placentation - Tomato (II)
• Parietal placentation → Argemone (I)
• Free central placentation - Primrose (III)
• Pea shows marginal placentation, tomato axile, Argemone parietal, and Primrose free central placentation.

121. **(d)** Sphenopsida includes Equisetum (horsetail), which is a vascular cryptogam and belongs to Pteridophyta.

122. **(b)** (A) Do not occur in C_3 plants → Incorrect (photorespiration mainly occurs in C_3 plants)
(B) CO_2 is consumed and O_2 is generated → Incorrect (CO2 is released and O_2 is consumed)
(C) Phosphoglycolate is formed - Correct
(D) No synthesis of ATP and NADPH → Correct
• During photorespiration, RuBisCO acts as oxygenase and forms phosphoglycolate. This pathway causes loss of fixed carbon and does not produce ATP or NADPH.

123. **(b)** Smooth endoplasmic reticulum (SER) lacks ribosomes on its surface and is primarily involved in lipid synthesis, steroid hormone production, and detoxification.

124. **(b)** This statement is incorrect because α-cells (alpha cells) secrete glucagon, while β-cells (beta cells) of the pancreas secrete insulin.

125. **(c)** In taxonomy, a genus is a group of closely related species that share common characteristics and evolutionary ancestry (e.g., Panthera includes both lion and tiger).

126. **(d)** Fungi are eukaryotic organisms (they possess a membrane-bound nucleus). Bacteria, mycoplasma, and blue-green algae are prokaryotes.

127. **(b)** Gibberellins promote "bolting," which is the rapid elongation of internodes prior to flowering in rosette plants like cabbage and beets.

128. **(c)** A standard eukaryotic cell cycle progresses through Interphase (Gap 1 → Synthesis → Gap 2) and then divides in the Mitotic (M) phase.

129. **(a)** Plasmogamy is the fusion of protoplasms between gametes, Karyogamy is the fusion of two nuclei, and Meiosis is a reduction division that helps generate haploid spores.

130. **(c)** Statement I is true; the term Reptilia refers to creeping or crawling locomotion. Statement II is false; not all reptiles have a three-chambered heart, as crocodiles possess a four-chambered heart.

131. **(c)** Statement I → true
Statement II → false
By the end of prophase I, chromosomes are fully condensed. Meiosis I is reductional division and does not resemble mitosis (mitosis resembles meiosis II).

132. **(c)** Chordates are characterized by the presence of a notochord, a dorsal hollow nerve cord, and pharyngeal gill slits at some stage of their life cycle. Therefore, the "absence of gills" (or more accurately, pharyngeal gill slits) is not a characteristic of chordates; rather, their presence is a defining feature.

133. **(c)** For arithmetic growth $\Rightarrow L_t = L_0 + rt$
$L_t = ?; L_0 = 20\ cm; r = 30\ cm/\ day\ ; t = 7\ days$
So $L_t = 20 + 30 \times 7 = 20 + 210 = 230\ cm$

134. **(a)** The approximate percentage by mass of the major elements in the human body is:
• Oxygen (A): ~ 65%
• Carbon (B): ~ 18%
• Hydrogen (C): ~ 10%
• Nitrogen (D): -3%
Therefore, the descending order is Oxygen > Carbon > Hydrogen > Nitrogen.

135. **(c)** Frogs (anurans) possess 10 pairs of cranial nerves. For comparison, higher vertebrates like mammals possess 12 pairs.

136. **(a)** Streptokinase (produced by the bacterium Streptococcus) is used as a "clot buster" for removing clots from the blood vessels of patients who have undergone myocardial infarction (heart attack).
• Penicillin: An antibiotic.
• Cyclosporin A: An immunosuppressive agent.
• Statins: Blood cholesterol-lowering agents.

137. **(a)** The Bt toxin protein exists as an inactive protoxin in the Bacillus thuringiensis bacterium. When an insect ingests the crystal, the alkaline pH of the insect's gut solubilizes the crystals, converting the protoxin into its active, toxic form, which then binds to the midgut epithelial cells, causing lysis and death.

138. **(b)** • Statement I is incorrect: Down's syndrome is caused by the presence of an extra copy of chromosome 21 (Trisomy 21), not by the absence of an X-chromosome.

• Statement II is incorrect: Turner's syndrome is caused by the absence of one Xchromosome (45, XO), not by an additional copy of a chromosome.

139. **(b)** Syphilis, Gonorrhoea, and Genital warts are sexually transmitted infections (STIs). Tuberculosis is primarily a bacterial respiratory infection spread through the air.

140. **(a)** The human sperm cell possesses a long tail (flagellum) that uses whip-like flagellar movement to propel the sperm through the female reproductive tract

141. **(b)** Natural selection acts on populations to produce three main types of results:
• Stabilizing selection (A): Favors intermediate phenotypes.
• Directional selection (C): Favors one extreme phenotype.
• Disruptive/Disruptive selection (D): Favors both extreme phenotypes.
Genetic drift (B) is a separate evolutionary mechanism caused by random chance, not natural selection.

142. **(c)** ICSI is a specialized procedure where a single sperm is injected directly into the cytoplasm of the ovum to facilitate fertilization in cases of male infertility.

143. **(d)** • Rete testis, Epididymis, and Vasa efferentia are all components of the male reproductive duct system.
• The Infundibulum is part of the female reproductive system (it is the funnel-shaped opening of the fallopian tube/oviduct).

144. **(b)** Based on biological data for the Amazonian rainforest species diversity, the descending order is:
(A) Plants - Significant floral diversity.
(B) Birds - Notable avian diversity.
(C) Fishes -High aquatic diversity.
(D) Invertebrates - By far the highest number.
(E) Mammals - Relatively lower number compared to the above groups.

145. **(c)** • Statement I is correct: A surge of Luteinizing Hormone (LH) in the mid-menstrual cycle triggers the rupture of the mature Graafian follicle, leading to ovulation.
• Statement II is incorrect: After ovulation, the ruptured Graafian follicle transforms into the corpus luteum, which primarily secretes progesterone (essential for maintaining the endometrium), not a large amount of estrogen.

146. **(c)** In a food chain, primary consumers are organisms that feed directly on producers (plants). Since producers are autotrophs (plants), organisms that consume them are defined as herbivores.

147. **(a)** Frequency of allele $A = 0.1 = p$
Frequency of $AA = p^2 = (0.1)^2$
$= 0.01$

148. **(b)** (A) Excess growth hormone: Leads to (III) Acromegaly in adults.
(B) Luteinizing hormone: Responsible for (IV) Ovulation.
(C) Vasopressin: Functions in the (I) Reabsorption of water and electrolytes in the kidney.
(D) Oxytocin: Stimulates (II) Contraction of uterus during childbirth.

149. **(b)** The tricuspid valve (composed of three flaps) guards the opening between the right atrium and the right ventricle, ensuring one-way blood flow. The bicuspid (mitral) valve is located between the left atrium and left ventricle.

150. **(a)** Sponges (Phylum Porifera) lack specialized respiratory systems. They exchange gases (O_2 and CO_2) with their environment (water) through simple diffusion directly across their entire body surface.

151. **(a)** A typical angiosperm anther is bilobed (two lobes). Each lobe contains two theca, making it dithecous. Therefore, each lobe has 2 theca, and the entire anther has a total of 4 theca (tetrasporangiate).
Are these explanations clear, or would you like to explore the hormonal control of the menstrual cycle in more depth?

152. **(a)** A neural signal reaching the neuromuscular junction releases a neurotransmitter, acetylcholine (ACh), into the synaptic cleft. This generates an action potential in the sarcolemma, leading to muscle contraction.

153. **(a)** The i gene in the lac operon codes for the repressor protein and is constitutively expressed (expressed continuously regardless of the presence of lactose).
(b) is incorrect: Lactose acts as an inducer and inactivates the repressor.
(c) is incorrect: The i gene has its own promoter: it is not part of the structural gene operon (z, y, a).

154. **(b)** The synergids possess special cellular thickenings at the micropylar tip called the filiform apparatus, which plays a crucial role in secreting chemicals that guide the entry and direction of the pollen tube.

155. **(d)** Non-albuminous (exalbuminous) seeds are those in which the endosperm is completely consumed by the developing embryo before seed maturation (e.g., pea, bean, groundnut). Wheat, maize, and barley are albuminous (endospermic) seeds.

156. **(c)** In angiosperms, the endosperm is formed by the fusion of two polar nuclei ($n + n$) and one male gamete (n), resulting in a triploid ($3n$) structure.
Given: $2n = 36$, so $n = 18$.
Therefore, $3n = 3 \times 18 = 54$.

157. **(d)** (A) Correct: Descending limb is permeable to water but not electrolytes.
(B) Correct: Water reabsorption in the descending limb concentrates the urine.
(D) Correct: Ascending limb allows active/passive transport of electrolytes (Na^+, Cl^-) but is impermeable to water.
(C) Incorrect: Water is not reabsorbed in the ascending limb.

158. **(d)** The human vertebral column follows this order: Cervical (neck), Thoracic (chest), Lumbar (lower back), Sacral (pelvic region), and Coccygeal (tailbone).

159. **(c)** While Haeckel's "ontogeny repeats phylogeny" theory was once popular; it was later disproved and is no longer considered scientific evidence for evolution. The other options (convergent evolution, fossil records, and homologous structures/divergent evolution) remain fundamental pillars of evolutionary theory.
Are you using these questions to prepare for a specific competitive exam, and would you like me to explain the distinction between homologous and analogous structures in more detail?

160. **(d)** Statement I is incorrect because modern Homo sapiens arose in Africa, not Australia. Statement II is correct; modern humans arose during the last ice age, approximately 75,000 to 10,000 years ago.

161. **(c)** $r = b - d$
$r = 0.002 - 0.002$
$r = 0$
$N_t = N_0 e^{rt}$
Here $t = 10$ generations
$N_t = N_0 e^{0 \times 10}$
$N_t = N_0 e^0$
Here $N_0 = 10$ million
$N_t = 10$ million

162. **(c)** The Polymerase Chain Reaction (PCR) process consists of three main steps:
(1) Denaturation: Heating to separate DNA strands.
(2) Annealing: Cooling to allow primers to bind to the template DNA.
(3) Extension: DNA polymerase synthesizes the new DNA strand.

163. **(a)** The logistic growth model is more realistic because it accounts for environmental resistance (carrying capacity), acknowledging that resources in nature are finite (as stated in R). The exponential model assumes unlimited resources, which is rarely true in nature.

164. **(b)** When unrelated organisms (like placental mammals and marsupials) evolve similar traits to adapt to similar ecological niches in different geographical regions, it is a classic example of convergent evolution.

165. **(b)** • Secondary lymphoid organs: These are sites where lymphocytes interact with antigens and proliferate. Examples include the Spleen (C). Tonsils (B), lymph nodes, and Peyer's patches.
• Primary lymphoid organs: These are sites of lymphocyte maturation. Examples include Bone marrow (A) and Thymus (D).

166. **(d)** The human placenta acts as an endocrine tissue and produces several hormones, including human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, and progesterone. Luteinizing hormone (LH) is secreted by the anterior pituitary gland, not the placenta.

167. **(b)** In eukaryotes, there are three types of RNA polymerases:
• RNA polymerase I: Transcribes rRNAs (28S, 18S, 5.8S).
• RNA polymerase II: Transcribes the precursor of mRNA, also known as heterogeneous nuclear RNA (hnRNA).
• RNA polymerase III: Transcribes tRNA, 5S rRNA, and snRNA.

168. **(a)** • Statement I is correct: Plasmids possess their own origin of replication, allowing them to replicate independently of the chromosomal DNA.

• Statement II is correct: Plasmids are small, circular, double-stranded, extrachromosomal DNA molecules found in bacteria and some eukaryotes.

169. **(d)** A person with blood group 'O' has the genotype ii. To have an 'O' child, both parents must contribute an ' i ' allele.

In option (d), the father has genotype I^AI^B and the mother has genotype I^Ai. Since the father does not carry the i allele, the child can never inherit the genotype ii. Therefore, it is impossible for this couple to have a child with blood group ' O '.

170. **(a)** Homology refers to structures that are similar because they share a common ancestral origin. Because human and bat forelimbs share a similar underlying anatomical structure (same bones: humerus, radius, ulna, carpals, metacarpals, and phalanges), they are considered homologous.

171. **(c)** Colostrum, the yellowish fluid produced during the initial days of lactation, is rich in IgA antibodies. These provide "passive immunity" to the newborn, which is critical for protecting the infant's developing immune system.

172. **(a)** This is a classic example of competitive release. The introduction of goats to the Galapagos Islands led to the extinction of the Abingdon tortoise because the goats were significantly more efficient browsers (competing for the same food source), effectively starving the tortoises.

173. **(c)** The human ovum (secondary oocyte) is surrounded by an inner layer called the zona pellucida, which is a non-cellular layer of glycoprotein. It is secreted by the oocyte itself and is essential for sperm binding and preventing polyspermy.

174. **(d)** (A) Both species are harmed: Competition (III).
(B) One species is harmed and the other is benefited: Predation (I).
(C) Both species are benefited: Mutualism (II).
(D) One is benefited while the other has no effect: Commensalism (IV).

175. **(a)** Mendel observed that F_1 progeny is tall because the allele for "tallness" is dominant over the allele for "dwarfness." The law of dominance explains why the recessive trait does not manifest in the F_1 generation.

176. **(a)** To extract DNA, one must first break down the cell wall/membrane to release the cell contents. Different enzymes are specific to different organisms: lysozyme is used to break down the peptidoglycan cell walls of bacteria, and cellulase is used to break down the cellulose cell walls of plants.

177. **(c)** Morphine is a potent opiate analgesic extracted from the poppy plant (Papaver somniferum). It is highly effective as a sedative and painkiller for patients undergoing surgery.

178. **(b)** (A) Correct: Energy flow in an ecosystem is always unidirectional (from producers to higher trophic levels).
(B) Correct: Since energy is lost as heat at every step (following the 10% law), the pyramid of energy is always upright (never inverted).
(C) Incorrect: Energy transfer follows the 10% law (Lindeman's law), not the 1% law.

179. **(d)** Fertilization takes place in mosquito gut
• Asexual reproduction occurs in human liver cells and RBCs.
• Gametocytes develop in human RBCs, not in the mosquito.
• Sexual reproduction and fertilization occur in the gut of the female Anopheles mosquito.

180. **(a)** • Transformation → Introduction of recombinant DNA into host bacteria.
• Cloning site → Recognition site for a restriction enzyme.
• Selection → Uses antibiotic resistance markers to identify transformants.
• Ori (Origin of replication) → Site from where DNA replication begins.