1. (2) $mvr = \frac{nh}{2\pi} = \frac{3h}{2\pi}$

de-Broglie Wavelength $\lambda = \frac{h}{mv} = \frac{2\pi r}{3} = \frac{2\pi}{3}\frac{a_0(3)^2}{z_{Li}} = 2\pi a_0$

2. (7) Form closer to M

$\frac{GMm}{9l^2} - \frac{Gm^2}{l^2} = ma$ ...(i)

and for the other m:

$\frac{Gm^2}{l^2} + \frac{GMm}{16l^2} = ma$ ...(ii)

From both the equations,

k = 7

3. (4) $E(t) = A^2 e^{-\alpha t}$

$\Rightarrow dE = -\alpha A^2 e^{-\alpha t} dt + 2AdAe^{-\alpha t}$

Putting the values for maximum error,

$\Rightarrow \frac{dE}{E} = \frac{4}{100} \Rightarrow$ % error = 4

4. (6) $I = \int \frac{2}{3}\rho 4\pi r^2 r^2 dr$

$I_A \propto \int (r)(r^2)(r^2) dr$

$I_B \propto \int (r^5)(r^2)(r^2) dr$

$\therefore \frac{I_B}{I_A} = \frac{6}{10}$

5. (3) First and fourth wave interfere destructively. So, from the interference of 2nd and 3rd wave only,

$\Rightarrow I_{net} = I_0 + I_0 + 2\sqrt{I_0}\sqrt{I_0}\cos\left(\frac{2\pi}{3} - \frac{\pi}{3}\right) = 3I_0$

$\Rightarrow n = 3$

6. (2)

$\lambda_P = \frac{1}{\tau}; \lambda_Q = \frac{1}{2\tau}$

$\frac{R_P}{R_Q} = \frac{(A_0\lambda_P)e^{-\lambda_P t}}{A_0\lambda_Q e^{-\lambda_Q t}}$

At $t = 2\tau; \frac{R_P}{R_Q} = \frac{2}{e}$

7. (2) Snell's Law on 1st surface: $\frac{\sqrt{3}}{2}$ = nsin r_1

$\sin r_1 = \frac{\sqrt{3}}{2n}$ ...(i)

$\Rightarrow \cos r_1 = \sqrt{1 - \frac{3}{4n^2}} = \frac{\sqrt{4n^2 - 3}}{2n}$

$r_1 + r_2 = 60^0$ ...(ii)

Snell's Law on 2nd surface:

$n\sin r_2 = \sin\theta$

Using equation (i) and (ii)

$n\sin(60^0 - r_1) = \sin\theta$

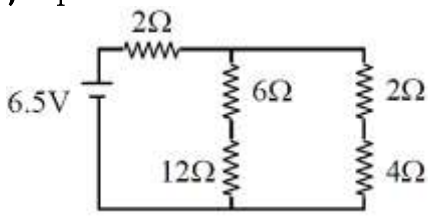
$$n\left[\frac{\sqrt{3}}{2}\cos r_1-\frac{1}{2}\sin r_1\right]=\sin\theta$$

$$\frac{d}{dn}\left[\frac{\sqrt{3}}{4}\left(\sqrt{4n^2-3}-1\right)\right]=\cos\theta\frac{d\theta}{dn}$$

for $\theta=60^0$ and $n=\sqrt{3}$

$$\Rightarrow\frac{d\theta}{dn}=2$$

8. (1) Equivalent circuit:



$$R_{eq}=\frac{13}{2}\Omega$$

So, current supplied by cell = 1 A

9. (a) Q value of reaction = (140 + 94) × 8.5 – 236 × 7.5 = 219 Mev

So, total kinetic energy of Xe and Sr = 219 – 2 – 2 = 215 Mev

So, by conservation of momentum, energy, mass and charge,

10. (a, d) From the given conditions, $\rho_1<\sigma_1<\sigma_2<\rho_2$

From equilibrium, $\sigma_1+\sigma_2=\rho_1+\rho_2$

$$V_P=\frac{2}{9}\left(\frac{\rho_1-\sigma_2}{\eta_2}\right)g \text{ and } V_Q=\frac{2}{9}\left(\frac{\rho_2-\sigma_1}{\eta_1}\right)g$$

So, $\dfrac{|\vec{V}_P|}{|\vec{V}_Q|}=\dfrac{\eta_1}{\eta_2}$ and $\vec{V}_P.\vec{V}_Q<0$

11. (a, c)

$$BIlc\equiv VI\Rightarrow\mu_0I^2c\equiv VI\Rightarrow\mu_0Ic=V$$

$$\Rightarrow\mu_0^2I^2c^2=V^2$$

$$\Rightarrow\mu_0I^2=\varepsilon_0V^2\Rightarrow\varepsilon_0cV=I$$

12. (d)

$$\vec{E}=\frac{\rho}{3\varepsilon_0}\overrightarrow{C_1C_2}$$

$C_1\Rightarrow$ center of sphere and $C_2\Rightarrow$ center of cavity.

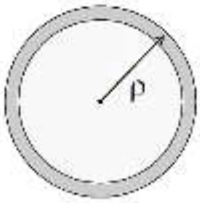
13. (a, b)

$$Y=\frac{stress}{strain}$$

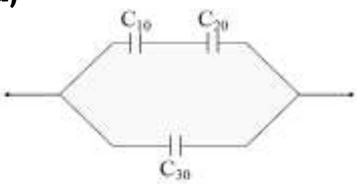
$$\Rightarrow\frac{1}{Y}=\frac{strain}{stress}\Rightarrow\frac{1}{Y_P}>\frac{1}{Y_\theta}\Rightarrow Y_P<Y_Q$$

14. (b, c)

$$P(r)=K\left(1-\frac{r^2}{R^2}\right)$$



15. (d)



$$C_{10} = \frac{4\varepsilon_0 \frac{S}{2}}{d/2} = \frac{4\varepsilon_0 S}{d}$$

$$C_{20} = \frac{2\varepsilon_0 S}{d}, C_{30} = \frac{\varepsilon_0 S}{d}$$

$$\frac{1}{C_{10}^{'}} = \frac{1}{C_{10}} + \frac{1}{C_{10}} = \frac{d}{2\varepsilon_0 S}\left[1+\frac{1}{2}\right]$$

$$\Rightarrow C_{10}^{'} = \frac{4\varepsilon_0 S}{3d}$$

$$C_2 = C_{30} + C_{10}^{'} = \frac{7\varepsilon_0 S}{3d}$$

$$\frac{C_2}{C_1} = \frac{7}{3}$$

16. (b or a, b, c) P (pressure of gas) = $P_1 + \frac{kx}{A}$

$$W = \int PdV = P_1(V_2 - V_1) + \frac{kx^2}{2} = P_1(V_2 - V_1) + \frac{(P_2 - P_1)(V_2 - V_1)}{2}$$

$$\Delta U = nC_V\Delta T = \frac{3}{2}(P_2V_2 - P_1V_1)$$

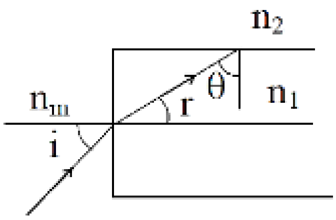
$$Q = W + \Delta U$$

Case I: $\Delta U = 3P_1V_1, W = \frac{5P_1V_1}{4}, Q = \frac{17P_1V_1}{4}, U_{spring} = \frac{P_1V_1}{4}$

Case II: $\Delta U = \frac{9P_1V_1}{2}, W = \frac{7P_1V_1}{3}, Q = \frac{41P_1V_1}{6}, U_{spring} = \frac{P_1V_1}{3}$

Note: A and C will be true after assuming pressure to the right of piston has constant value P_1.

17. (i) (a, c)



$$\theta \ge c$$

$$\Rightarrow 90^0 - r \ge c$$

$$\Rightarrow \sin(90^0 - r) \ge c$$

$$\Rightarrow \cos r \ge \sin c$$

Using $\frac{\sin i}{\sin r} = \frac{n_1}{n_m}$ and $\sin c = \frac{n_2}{n_1}$

We get, $\sin^2 i_m = \frac{n_1^2 - n_2^2}{n_m^2}$

Putting values, we get, correct options as A & C

(ii) (d) For total internal reflection to take place in both structures, the numerical aperture should be the least one for the combined structure & hence, correct option is D.

18. (i) (a, d) $I_1 = I_2$

$\Rightarrow neA_1v_1 = neA_2v_2$

$\Rightarrow d_1w_1v_1 = d_2w_2v_2$

Now, potential difference developed across MK

V = Bvw

$\Rightarrow \frac{V_1}{V_2} = \frac{v_1w_1}{v_2w_2} = \frac{d_2}{d_1}$

& hence correct choice is A & D

(ii) (a, c) As $I_1 = I_2$

$n_1w_1d_1v_1 = n_2w_2d_2v_2$

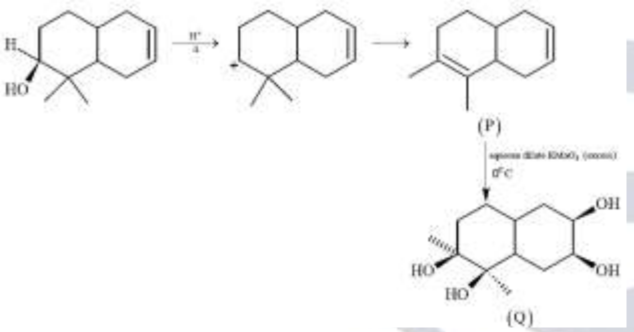
Now, $\frac{V_2}{V_1} = \frac{B_2v_2w_2}{B_2v_1w_1} = \left(\frac{B_2w_2}{B_1w_1}\right)\left(\frac{n_1w_1d_1}{n_2w_2d_2}\right) = \frac{B_2n_1}{B_1n_2}$

$\therefore$ Correct options are A & C

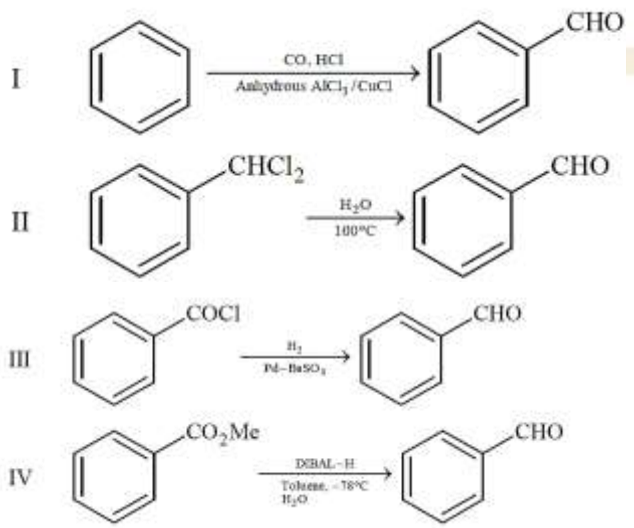
19. (8) $\left[Fe(C_2O_4)(H_2O)\right]^{2-} + MnO_4^{2-} + 8H^+ \rightarrow Mn^{2+} + Fe^{3+} + 4CO_2 + 6H_2O$

So, the ratio of rate of change of [H+] to that of rate of change of $\left[MnO_4^-\right]$ is 8.

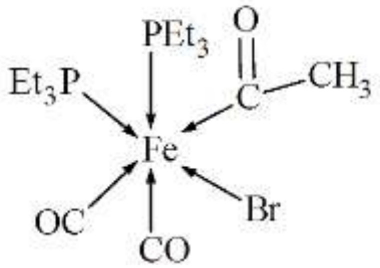
20. (4)



21. (4)



22. (3)



The number of Fe – C bonds is 3.

23. **(5)** $\left[Co(en)_2 Cl_2\right]^{+} \rightarrow$ will show cis - trans isomerism

$\left[CrCl_2(C_2O_4)_2\right]^{3-} \rightarrow$ will show cis - trans isomerism

$\left[Fe(H_2O)_4(OH)_2\right]^{+} \rightarrow$ will show cis - trans isomerism

$\left[Fe(CN)_4(NH_3)_2\right]^{-} \rightarrow$ will show cis - trans isomerism

$\left[Co(en)_2(NH_3)Cl\right]^{2+} \rightarrow$ will show cis - trans isomerism

$\left[Co(NH_3)_4(H_2O)Cl\right]^{2+} \rightarrow$ will not show cis - trans isomerism (Although it will show geometrical isomerism)

24. **(6)** $B_2H_6 + 6MeOH \rightarrow 2B(OMe)_3 + 6H_2$

1 mole of B_2H_6 reacts with 6 mole of MeOH to give 2 moles of $B(OMe)_3$.
3 mole of B_2H_6 will react with 18 mole of MeOH to give 6 moles of $B(OMe)_3$

25. **(3)** $HX \rightleftharpoons H^+ + X^-$

$$Ka = \frac{\left[H^+\right]\left[H^-\right]}{[HX]}$$

$HY \rightleftharpoons H^+ + Y^-$

$$Ja = \frac{\left[H^+\right]\left[Y^-\right]}{[HY]}$$

$\wedge_m$ for $HX = \wedge_{m_1}$

$\wedge_m$ for $HY = \wedge_{m_2}$

$$\wedge_{m_1} = \frac{1}{10}\wedge_{m_2}$$

$Ka = C\alpha^2$

$$Ka_1 = C_1 \times \left(\frac{\wedge_{m_1}}{\wedge^0_{m_1}}\right)^2$$

$$Ka_2 = C_2 \times \left(\frac{\wedge_{m_2}}{\wedge^0_{m_0}}\right)^2$$

$$\frac{Ka_1}{Ka_2} = \frac{C_1}{C_2} \times \left(\frac{\wedge_{m_1}}{\wedge_{m_2}}\right)^2 = \frac{0.01}{0.1} \times \left(\frac{1}{10}\right)^2 = 0.001$$

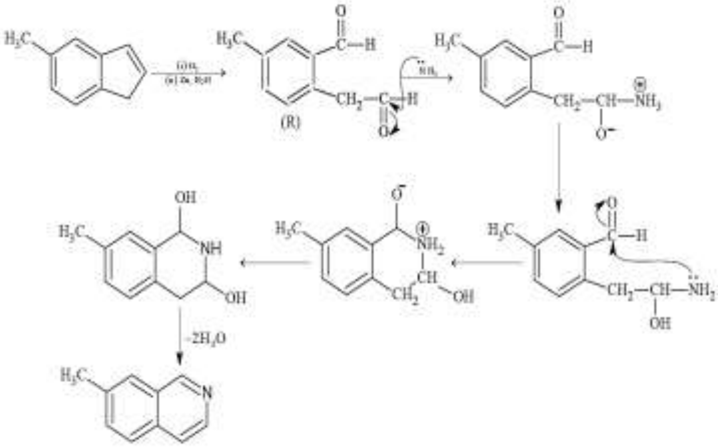
$pKa_1 - pKa_2 = 3$

26. **(9)** In conversion of ${}^{238}_{92}U$ to ${}^{206}_{82}Pb$, 8α - particles and 6β particles are ejected.
The number of gaseous moles initially = 1 mol
The number of gaseous moles finally = 1 + 8 mol; (1 mol from air and 8 mol of 2He4)
So the ratio = 9/1 = 9

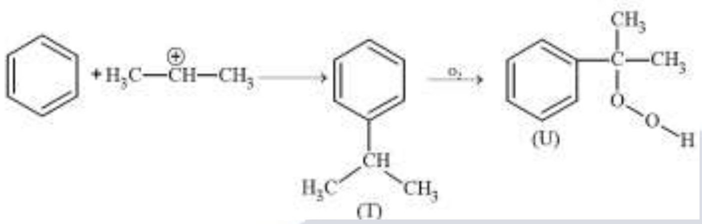
27. **(c)** At large inter-ionic distances (because a → 0) the P.E. would remain constant.

However, when r → 0; repulsion would suddenly increase.

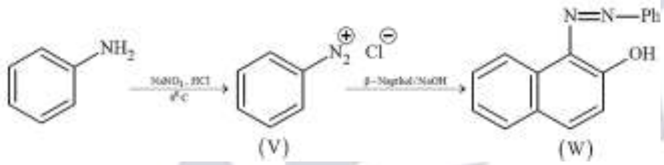
28. (a)



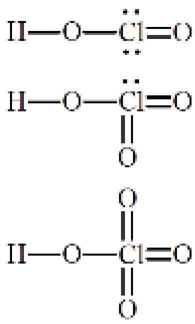
29. (b)



30. (a)



31. (b, c) H-O-Cl (I)



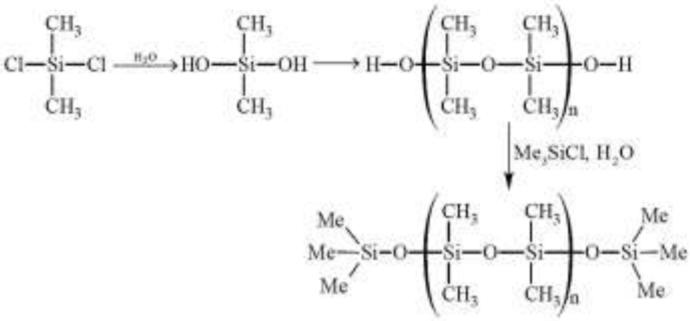
(II)

(III)

(IV)

32. (c, d) Cu^{2+}, Pb^{2+}, Hg^{2+}, Bi^{3+} give ppt with H2S in presence of dilute HCl.

33. (b)



34. (b, c, d) Adsorption of O_2 on metal surface is exothermic.

* During electron transfer from metal to O_2 electron occupies π^*_{2p} orbital of O_2.

* Due to electron transfer to O_2 the bond order of O_2 decreases hence bond length increases.

35. (i) (a) $2\ HCl + NaOH \rightarrow NaCl + H_2O$

n = 100 x1 = 100 m mole = 0.1 mole

Energy evolved due to neutralization of HCl and NaOH = 0.1 x 57 = 5.7 kJ = 5700 Joule
Energy used to increase temperature of solution = 200 x 4.2 x 5.7 = 4788 Joule
Energy used to increase temperature of calorimeter = 5700 – 4788 = 912 Joule
ms. $\Delta t = 912$
m.s x 5.7 = 912
ms = 160 Joule/^{0}C [Calorimeter constant]
Energy evolved by neutralization of CH_3COOH and NaOH
= 200x4.2x5.6x160x5.6=5600 Joule
So energy used in dissociation of 0.1 mole CH3COOH = 5700-5600 = 100 Joule
Enthalpy of dissociation = 1 kJ/mole

(ii) **(b)** $CH_3COOH = \frac{1\times 100}{200} = \frac{1}{2}$

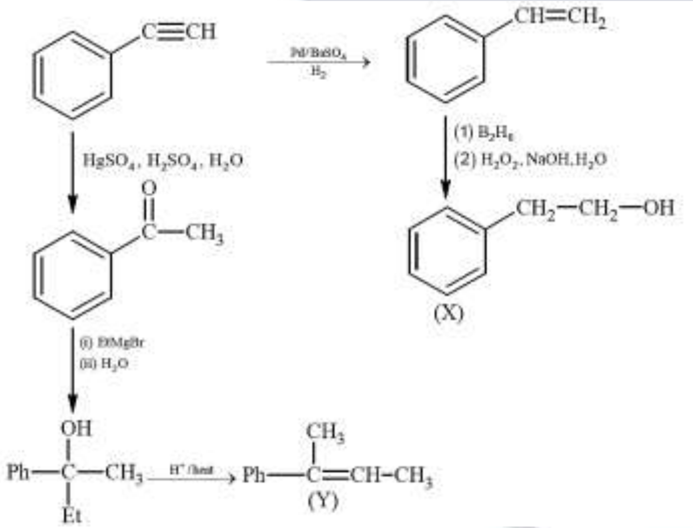
$CH_3CONa = \frac{1\times 100}{200} = \frac{1}{2}$

$pH = pK_a + \log\frac{[salt]}{[acid]}$

$pH = 5 - \log 2 + \log\frac{1/2}{1/2}$

pH=4.7

36. **(i) (c)** $C_8H_6 \rightarrow =$ double bond equivalent $= 8 + 1 - \frac{6}{2} = 6$



(i) (d)

37. **(9)**

$\vec{s} = 4\vec{p} + 3\vec{q} + 5\vec{r}$

$\vec{s} = x\left(-\vec{p} + \vec{q} + \vec{r}\right) + y\left(\vec{p} - \vec{q} + \vec{r}\right) + z\left(-\vec{p} - \vec{q} + \vec{r}\right)$

$\vec{s} = (-x + y - z)\vec{p} + (x - y - z)\vec{q} + (x + y + z)\vec{r}$

$\Rightarrow -x + y - z = 4$
$\Rightarrow x - y - z = 3$
$\Rightarrow x + y + z = 5$

On solving we get x = 4, $y = \frac{9}{2}, z = -\frac{7}{2}$

$\Rightarrow 2x + y + z = 9$

38. **(4)** For any integer k, let $\alpha_k = \cos\left(\frac{k\pi}{7}\right) + i\sin\left(\frac{k\pi}{7}\right)$, where $i = \sqrt{-1}$. The value of the expression

$$\frac{\sum_{k=1}^{12}\left|\alpha_{k+1}-\alpha_k\right|}{\sum_{k=1}^{3}\left|\alpha_{4k-1}-\alpha_{4k-2}\right|}$$ is

39. **(9)** Let seventh term be 'a' and common difference be 'd'

Given $\frac{S_7}{S_1}=\frac{6}{11}\Rightarrow a=15d$

Hence, 130 < 15d < 140

$\Rightarrow$ d = 9

40. **(8)** x^9 can be formed in 8 ways

i.e. x^9, x^{1+8}, x^{2+7}, x^{3+6}, x^{4+5}, x^{1+2+6}, x^{1+3+5}, x^{2+3+4} and coefficient in each case is 1

$\Rightarrow$ Coefficient of x^9 = 1 + 1 + 1 +...(8times) +1=8

41. **(4)** The equation of P_1 is $y^2 - 8x = 0$ and P_2 is $y^2 + 16x = 0$

Tangent to $y^2 - 8x = 0$ passes through (–4, 0)

$$\Rightarrow 0=m_1(-4)+\frac{2}{m_1}\Rightarrow\frac{1}{m_1^2}=2$$

Also, tangent to $y^2 + 16x = 0$ passes through (2, 0)

$$\Rightarrow 0=m_2\times 2-\frac{4}{m_2}\Rightarrow m_2^2=2$$

$$\Rightarrow\frac{1}{m_1^2}+m_2^2=4$$

42. **(2)** $\lim_{\alpha\to 0}\frac{e^{\cos(\alpha^n)}-e}{\alpha^m}=-\frac{e}{2}$

$$\lim_{\alpha\to 0}\frac{e\left(e^{\left(\cos(\alpha)^n-1\right)}-1\right)\left(\cos\alpha^n-1\right)}{\left(\cos\left(\alpha^n\right)-1\right)\alpha^m\alpha^{2n}}\alpha^{2n}=-\frac{e}{2}$$ if and only if 2n – m = 0

43. **(9)** $\alpha=\int_0^1 e^{\left(9x+3\tan^{-1}x\right)}\left(\frac{12+9x^2}{1+x^2}\right)dx$

Put $9x + 3\tan^{-1} x = t$

$$\Rightarrow\left(9+\frac{3}{1+x^2}\right)dx=dt$$

$$\Rightarrow\alpha=\int_0^{9+\frac{3\pi}{4}}e^t\,dt=e^{9+\frac{3\pi}{4}}-1$$

$$\Rightarrow\left(\log_e|1+\alpha|-\frac{3\pi}{4}\right)=9$$

44. **(7)** $G(1)=\int_{-1}^{1}t\left|f\left(f(t)\right)\right|dt=0$

f (-x) = - f (x)

Given f (1) = $\frac{1}{2}$

$$\lim_{x\to 1}\frac{F(x)}{G(x)}=\lim_{x\to 1}\frac{\frac{F(x)-F(1)}{x-1}}{\frac{G(x)-G(1)}{x-1}}=\frac{f(1)}{\left|f\left(f(1)\right)\right|}=\frac{1}{14}$$

$$\Rightarrow \frac{1/2}{|f(1/2)|}=\frac{1}{14}$$

$$\Rightarrow f\left(\frac{1}{2}\right)=7$$

45. **(d)** $\frac{192}{3}\int_{1/2}^{x} t^3 dt \le f(x) \le \frac{192}{2}\int_{1/2}^{x} t^3 dt$

$$16x^4-1 \le f(x) \le 24x^4-\frac{3}{2}$$

$$\int_{1/2}^{1}\left(16x^4-1\right)dx \le \int_{1/2}^{1} f(x)dx \le \int_{1/2}^{1}\left(24x^4-\frac{3}{2}\right)dx$$

$$1<\frac{26}{10}\le \int_{1/2}^{1} f(x)dx \le \frac{39}{10}<12$$

46. **(a, d)** Here, $0<(x_1-x_2)^2<1$

$$\Rightarrow 0<(x_1+x_2)^2-4x_1x_2<1$$

$$\Rightarrow 0<\frac{1}{\alpha^2}-4<1$$

$$\Rightarrow \alpha \in \left(-\frac{1}{2},-\frac{1}{\sqrt{5}}\right)\cup\left(\frac{1}{\sqrt{5}},\frac{1}{2}\right)$$

47. **(b, c)** $\frac{\pi}{2}<\alpha<\pi, \pi<\beta<\frac{3\pi}{2} \Rightarrow \frac{3\pi}{2}<\alpha+\beta<\frac{5\pi}{2}$

$$\Rightarrow \sin\beta<0; \cos\alpha<0$$

$$\Rightarrow \cos(\alpha+\beta)>0$$

48. **(a, b)** For the given line, point of contact for $E_1:\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is $\left(\frac{a^2}{3},\frac{b^2}{3}\right)$

and for $E_2:\frac{x^2}{B^2}+\frac{y^2}{A^2}=1$ is $\left(\frac{B^2}{3},\frac{A^2}{3}\right)$

Point of contact of x + y = 3 and circle is (1, 2)

Also, general point on x + y = 3 can be taken as $\left(1\mp\frac{r}{\sqrt{2}},2\pm\frac{r}{\sqrt{2}}\right)$ where, $r=\frac{2\sqrt{2}}{3}$

So, required points are $\left(\frac{1}{8},\frac{8}{3}\right)$ and $\left(\frac{5}{3},\frac{4}{3}\right)$

Comparing with points of contact of ellipse,

$a^2 = 5$, $B^2 = 8$

$b^2 = 4$, $A^2 = 1$

$\therefore e_1e_2=\frac{\sqrt{7}}{2\sqrt{10}}$ and $e_1^2+e_2^2=\frac{43}{40}$

49. **(a, b, d)** Tangent at P, $xx_1 - yy_1 = 1$ intersects x axis at $M\left(\frac{1}{x_1},0\right)$

Slope of normal = $=-\frac{y_1}{x_1}=\frac{y_1-0}{x_1-x_2}$

$$\Rightarrow x_2=2x_1 \Rightarrow N\equiv(2x_1,0)$$

For centroid $l=\frac{3x_1+\frac{1}{x_1}}{3}, m=\frac{y_1}{3}$

$$\frac{dl}{dx_1} = 1 - \frac{1}{3x_1^2}$$

$$\frac{dm}{dy_1} = \frac{1}{3}, \frac{dm}{dx_1} = \frac{1}{3}\frac{dy_1}{dx_1} = \frac{x_1}{3\sqrt{x_1^2 - 1}}$$

50. **(a, c)** Let $\int_0^{\pi} e^t \left(\sin^6 at + \cos^4 at\right) dt = A$

$$I = \int_{\pi}^{2\pi} e^t \left(\sin^6 at + \cos^4 at\right) dt$$

Put t = π + x

dt = dx

for a = 2 as well as a = 4

$$I = e^{\pi} \int_0^{\pi} e^x \left(\sin^6 ax + \cos^4 ax\right) dx$$

$$I = e^{\pi} A$$

Similarly, $\int\limits_{2\pi}^{3\pi} e^t \left(\sin^6 at + \cos^4 at\right) dt = e^{2\pi} A$

So, $L = \dfrac{A + e^{\pi} A + e^{2\pi} A + e^{3\pi} A}{A} = \dfrac{e^{4\pi} - 1}{e^{\pi} - 1}$

For both a = 2, 4

51. **(b, c)** Let H (x) = f (x) – 3g (x)

H (-1) = H (0) = H (2) = 3.

Applying Rolle's Theorem in the interval [-1, 0]

H'(x) = f'(x) – 3g'(x) = 0 for at least one c $\in$ (-1, 0).

As H"(x) never vanishes in the interval

$\Rightarrow$ Exactly one c $\in$ (-1, 0) for which H'(x) = 0

Similarly, apply Rolle's Theorem in the interval [0, 2].

$\Rightarrow$ H'(x) = 0 has exactly one solution in (0, 2)

52. **(a, b)** $f(x) = \left(7\tan^6 x - 3\tan^2 x\right)\left(\tan^2 x + 1\right)$

$$\int\limits_0^{\pi/4} f(x)dx = \int\limits_0^{\pi/4} \left(7\tan^6 x - 3\tan^2 x\right)\sec^2 x dx$$

$$\Rightarrow \int\limits_0^{\pi/4} f(x)dx = 0$$

$$\int\limits_0^{\pi/4} xf(x)dx = \left[x\int f(x)dx\right]_0^{\pi/4} - \int\limits_0^{\pi/4}\left[\int f(x)dx\right]dx$$

$$\int\limits_0^{\pi/4} xf(x)dx = \frac{1}{12}$$

53. **(i) (a, b, c)** (a) f'(x) = F(x) + xF'(x)

f'(1) = F(1) + F'(1)

f'(1) = F'(1) < 0

f'(1) < 0

(b) f(2) = 2F(2)

F(x) is decreasing and F(1) = 0

Hence F(2) < 0

$\Rightarrow$ f(2) < 0

(c) f'(x) = F(x) + x F'(x)

F(x) < 0 $\forall$ x $\in$ (1, 3)

F'(x) < 0 $\forall$ x $\in$ (1, 3)

Hence f'(x) < 0 $\forall$ x $\in$ (1, 3)

(ii) **(c, d)** $\int_1^3 f(x)dx = \int_1^3 xF(x)dx$

$$= \left[\frac{x^2}{2}F(x)\right]_1^3 - \frac{1}{2}\int_1^3 x^2F'(x)dx$$

$$= \frac{9}{2}F(3) - \frac{1}{2}F(1) + 6 = -12$$

$$40 = \left[x^3F'(x)\right]_1^3 - 3\int_1^3 x^2F'(x)dx$$

40 = 27F'(3) – F'(1) + 36 … (i)
f'(x) = F(x) + xF'(x)
f'(3) = F(3) + 3F'(3)
f'(1) = F(1) + F'(1)
9f'(3) –f'(1) + 32 = 0.

54. **(i) (a, b)** P(Red Ball) = P(I)·P(R | I) + P(II)·P(R | II)

$$P(II \mid R) = \frac{1}{3} = \frac{P(II).P(R \mid II)}{P(I).P(R \mid I) + P(II).P(R \mid II)}$$

$$= \frac{1}{3} = \frac{\frac{n_3}{n_3+n_4}}{\frac{n_1}{n_1+n_2} + \frac{n_3}{n_3+n_4}}$$

Of the given options, A and B satisfy above condition

(ii) (c, d) P (Red after Transfer) = P(Red Transfer) . P(Red Transfer in II Case) + P (Black Transfer) . P(Red Transfer in II Case)

$$P(R) = \frac{n_1}{n_1+n_2}\frac{(n_1-1)}{(n_1+n_2-1)} + \frac{n_2}{n_1+n_2}.\frac{n_1}{n_1+n_2-1} = \frac{1}{3}$$

Of the given options, option C and D satisfy above condition.