Sri Chaitanya IIT Academy.,India.

A.P ✪ T.S ✪ KARNATAKA ✪ TAMILNADU ✪ MAHARASTRA ✪ DELHI ✪ RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec: Sr.Super60 | 2020_P1 | Date: 18-09-2022

Time: 09.00Am to 12.00Noon | RPTA-02 | Max. Marks: 198

KEY SHEET

PHYSICS

1	**C**	2	**A**	3	**B**	4	**C**	5	**B**	6	**B**
7	**AB**	8	**BCD**	9	**ABCD**	10	**ACD**	11	**ABD**	12	**ACD**
13	**1.50**	14	**2.5**	15	**26**	16	**10**	17	**5**	18	**4**

CHEMISTRY

19	**B**	20	**D**	21	**D**	22	**A**	23	**D**	24	**B**
25	**BC**	26	**AC**	27	**AD**	28	**BC**	29	**ABD**	30	**ACD**
31	**2**	32	**60**	33	**1386**	34	**6**	35	**10**	36	**4**

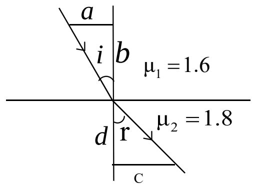
MATHEMATICS

37	**C**	38	**D**	39	**D**	40	**B**	41	**D**	42	**A**
43	**BCD**	44	**BC**	45	**AC**	46	**AD**	47	**AB**	48	**AB**
49	**0**	50	**6**	51	**0**	52	**0**	53	**49**	54	**27**

SOLUTIONS

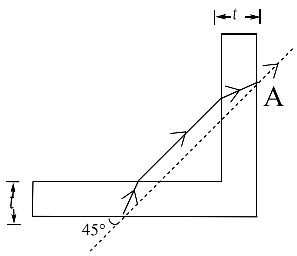
PHYSICS

1.



$$\mu_1 \sin i = \mu_2 \sin r, 1.6\times\frac{a}{\sqrt{a^2+b^2}} = 1.8\times\frac{c}{\sqrt{c^2+d^2}}, \frac{16}{10}\times\frac{a}{1} = \frac{18}{10}\times\frac{c}{1} \Rightarrow \frac{a}{c} = \frac{9}{8}$$

2.



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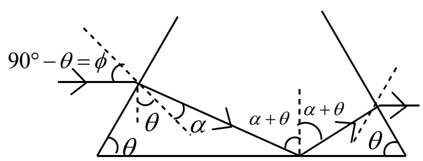


Water

$\alpha + \theta > i_c$

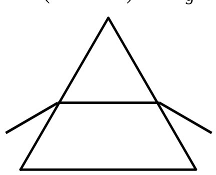
Where i_C is critical angle for glass-water interface….(1)

$\theta > i_C - \alpha$

For air glass interface

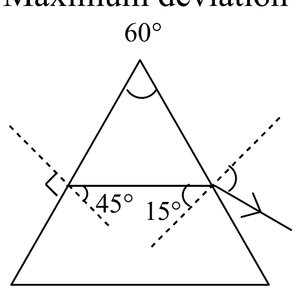
$\sin(90-\theta) = \mu_g \sin\alpha$ ……….(ii)

4.



$$\mu = \frac{Sin\left(\frac{A+30}{2}\right)}{Sin\left(\frac{A}{2}\right)} \quad \sqrt{2} = \frac{\sin\left(\frac{A+30}{2}\right)}{\sin\left(\frac{A}{2}\right)} \quad A = 60^0$$

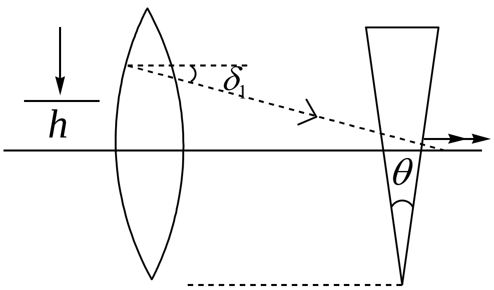
Maximum deviation will happen with the grazes in the prism



$$\sqrt{2}\sin 15^0 = 1\sin e, \sqrt{2}\frac{\left(\sqrt{3}-1\right)}{2\sqrt{2}} = \sin e$$

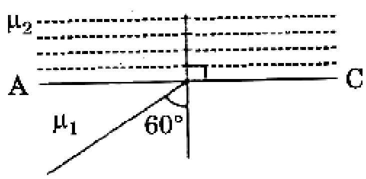
$$\delta = 90^0 + \sin^{-1}\left(\frac{\sqrt{3}-1}{2}\right) - 60^0 \;\; = 30^0 + \sin^{-1}\left(\frac{\sqrt{3}-1}{2}\right)$$

5.



$$\tan\delta_1 = \frac{h}{f}, \delta_{net} = 0 = -\delta_L + \delta_P = 0, \quad \frac{h}{f} = (\mu-1)\theta \Rightarrow \frac{h}{f\theta} + 1 = \mu$$

6.

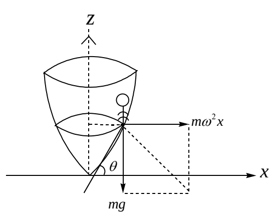


$$\frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r} = \frac{sin 60^0}{\sin 90^0}, \mu_2 - \mu_1 \sin 60 = \frac{3}{2}\times\frac{\sqrt{3}}{2}$$

At limiting condition $\mu_2 = \frac{3\sqrt{3}}{4}$

For all other values $\mu_2 < \frac{3\sqrt{3}}{4}$ TIR will take place.

7.

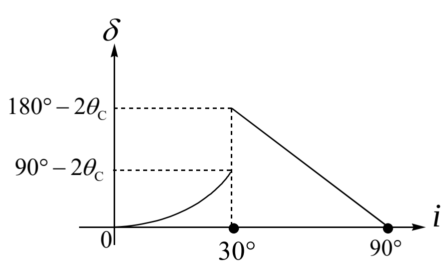


In the frame mercury.

$$\tan\theta = \frac{dz}{dx} = \frac{\omega^2 x}{g}, \quad z = \frac{\omega^2 x^2}{2g}, \quad x^2 = \frac{2g}{\omega^2}z = 4fz$$

$$4f = \frac{2g}{\omega^2}, 10\times10^{-2} = f = \frac{g}{2\omega^2} = \frac{10}{2\times\omega^2}, \qquad \omega^2 = \frac{100}{2} = 50$$

8.



Or, $\sin 30^0 = \frac{\mu_2}{\mu_1}$ so $\frac{\mu_2}{\mu_1} = \frac{1}{2}$ And $\delta_{\max}\left(180^0 - 2\theta_C\right) = 120^0$ during TIR

9. For convex lens

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} m_1 - m_2 = \frac{v^2 - u^2}{uv} = \frac{(u-v)(u+v)}{uv} ....(i)$$

$$\frac{1}{f} = \frac{u-v}{uv} ....(ii)$$

$x = v - u$

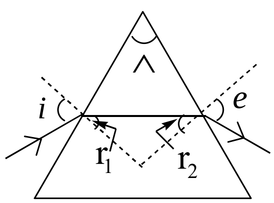
Using equns. $(i),(ii)$ $and\,(iii)$ $f = \frac{x}{m_1 - m_2}$

10. At $v = 0, mag = 1 \Rightarrow h_2 = h$ At $u = 3f, v = v_1 = \frac{3f}{2}$ $|m| = \frac{v}{u} = \frac{3f/2}{3f} = \frac{1}{2}, h_1 = \frac{h}{2}$

$v_1 = \frac{3f}{2}$ $v_2 = position\;\; of\;\; mag = 1;$ $v_2 = 2f, \frac{v_1}{v_2} = \frac{3f/2}{2f} = \frac{3}{4}$

11. For parallel slab $n_1 \sin\theta_i = n_2 \sin\theta_f$ And l depends on refractive angle in slab $\therefore l$ depends on refractive angle of slab and independent of n_2

12.



$i = e$ (for minimum deviation)

$r_1 + r_2 = A, r_1 + r_2$

(a) $\delta_m = 2i - A = A(given) \Rightarrow i = A \Rightarrow r_1 = \frac{A}{2} = \frac{i}{2}$

$(b)\; \mu =$

(c) $\mu\sin(r_2) = 1$ $\sin(r_2) = \frac{1}{\mu}\frac{\sin(A)}{\sin\left(\frac{A}{2}\right)} 2\cos\frac{A}{2} \Rightarrow A = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

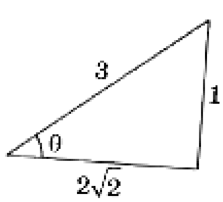
$r_1 + r_2 = A$ $r_1 = A - r_2$ $= A - \sin^{-1}\left[\frac{1}{\mu}\right]$

$\sin(i) = \mu\sin(r_1)$ $i = \sin^{-1}\left[\mu\sin\left[A - \sin^{-1}\left[\frac{1}{\mu}\right]\right]\right]$

$i_g = \sin^{-1}\left[\sqrt{\mu^2 - 1}\sin A - \cos A\right]$ $= \sin^{-1}\left[\mu\sin(A - \theta_C)\right]$ Here $\mu = \cos\frac{A}{2}$

(d) Condition of minimum deviation $i = e$ and $r_1 = r_2$ $= \frac{A}{2}$

13. Let R.I. at $y = y$ and corresponding angle of refraction is θ.

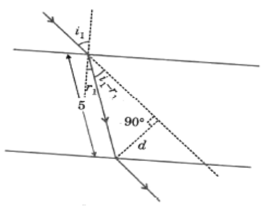


$\mu\sin\theta = \sin 30^0 ....(i)$ and $\tan\left(\frac{\pi}{2}-\theta\right) = \frac{dy}{dx} \Rightarrow \cot\theta = 8x$

$\Rightarrow \cot\theta \frac{8y^{1/2}}{2}; \cot\theta = 4y^{1/2}$ at $y = \frac{1}{2} \Rightarrow \cot\theta = \frac{4}{\sqrt{2}} = 2\sqrt{2}$

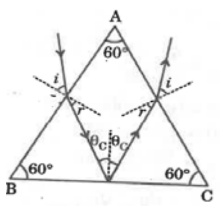
$\Rightarrow \sin\theta = \frac{1}{3} \Rightarrow \mu\times\frac{1}{3} = \frac{1}{2} \Rightarrow \mu = \frac{3}{2}$

14. From Snell`s, law $\frac{\sin 60^0}{\sin r_i} = \sqrt{3}$ $\sin r_1 = \frac{\sqrt{3}}{2}\times\frac{1}{\sqrt{3}} = \frac{1}{2} \Rightarrow r_1 = 30^0$



Now , $\sin(i_1 - r_1) = \frac{d}{5} \Rightarrow d = 5\left[\sin 60^0 - 30^0\right], d = 5\sin 30^0 = \frac{5}{2}cm = 2.5$

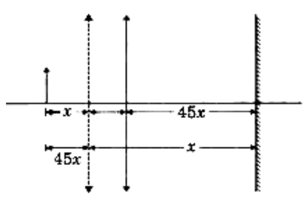
15.



Total deviation $= (i-r) + (180 - 2\theta_C) + (i-r) = 112^0$

$r = 60 - \theta_C, 2i - 120 + 2\theta_C + 180 - 2\theta_C = 112^0, 2i = 52^0, \quad i = 26^0$

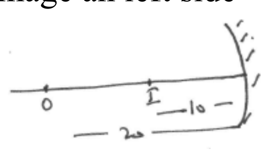
16.



Given, $4m_1 = m_2 \Rightarrow \frac{x}{45-x} = 4\left(\frac{45-x}{x}\right) \Rightarrow x^2 = 4(45-x)^2$

$\Rightarrow x = 2(45-x) \Rightarrow x = 30 \Rightarrow \frac{1}{u} - \frac{1}{v} = \frac{1}{f} \Rightarrow \frac{1}{15} - \left(\frac{1}{-30}\right) = \frac{1}{f} \Rightarrow f = 10cm$

17. When there is air then there is no lens effect. The slivered surface at b from a real image an left side



$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{20} + \frac{1}{10} = \frac{2}{R} \Rightarrow R = \frac{40}{3}cm$

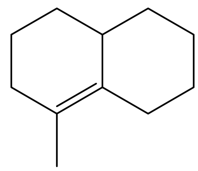
When the space is filled with water then we set a thick lens.

$\frac{1}{f_v} = \left(\frac{4}{3}-1\right)\left(\frac{2}{R}\right) = \frac{2}{3R} = \frac{2\times 3}{3\times 40} = \frac{1}{20}$ $\frac{1}{f_x} + \frac{2}{f_v} + \frac{1}{f_x} = \frac{2}{20} + \frac{3}{20} = \frac{5}{20} = \frac{1}{4}$

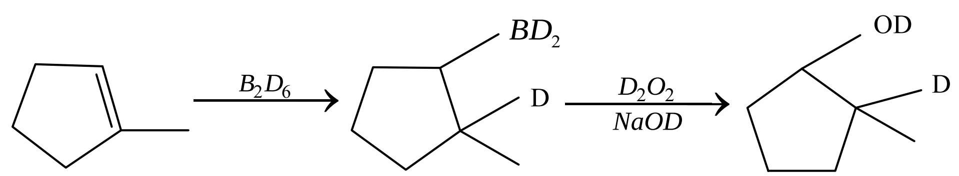
Now , using mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{20} = \frac{1}{4} \Rightarrow \frac{1}{v} = \frac{1}{5} \Rightarrow v = 5cm$

18. Conceptual

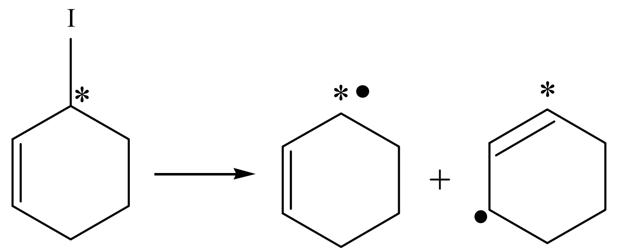
CHEMISTRY

19.  less substituted bond will be reduced, 1, 4 -addition not possible in trans diene

20.



21.



I II

Products

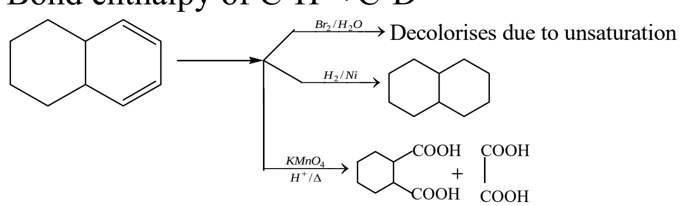
$I + II - (a)$

$II + II - (c)$

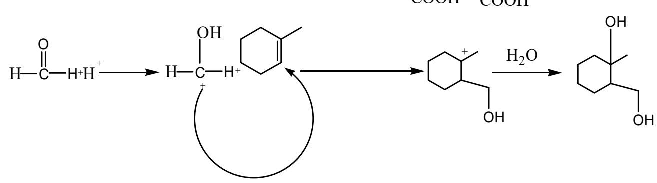
$I + II - (b)$

22. Bond enthalpy of C-H < C-D

23.



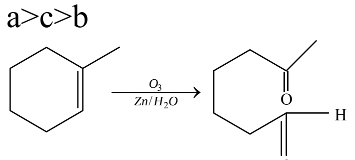
24.



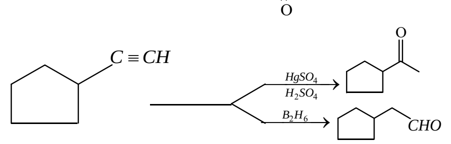
25. In 1,3- butadiene C-C single bond conformation are possible where all the atoms may not in same plane.

26. a>c>b

27.

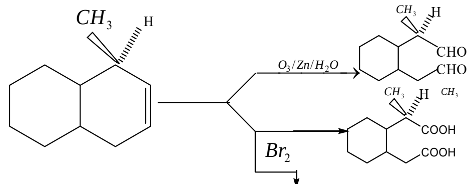


28.



29. All are correct reactions expted c

30.



Diasteromeric mixture

31. $CH_4 \rightarrow$ Hybrised orbitals=4

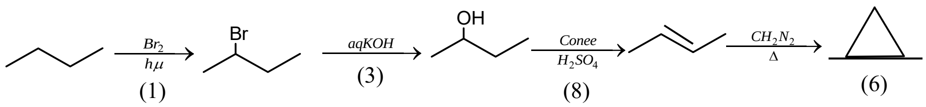
$CH_3\text{-}CH_3 \rightarrow$ Pure orbitals = 6

32. $$CnH_{2n-2} + \left(\frac{3n-1}{2}\right)O_2 \rightarrow nCo_2 + (n-1)H_2O$$

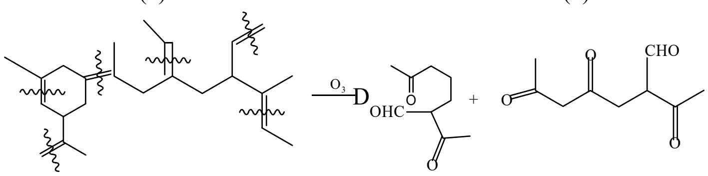
Terminal alkynes with $Cu_2Cl_2 \,/\, NH_4OH$ give red ppt

$\frac{3n-1}{2} = 8.5 \Rightarrow n = 6$ Carbons = 6 (= x) 10x = 60

33.

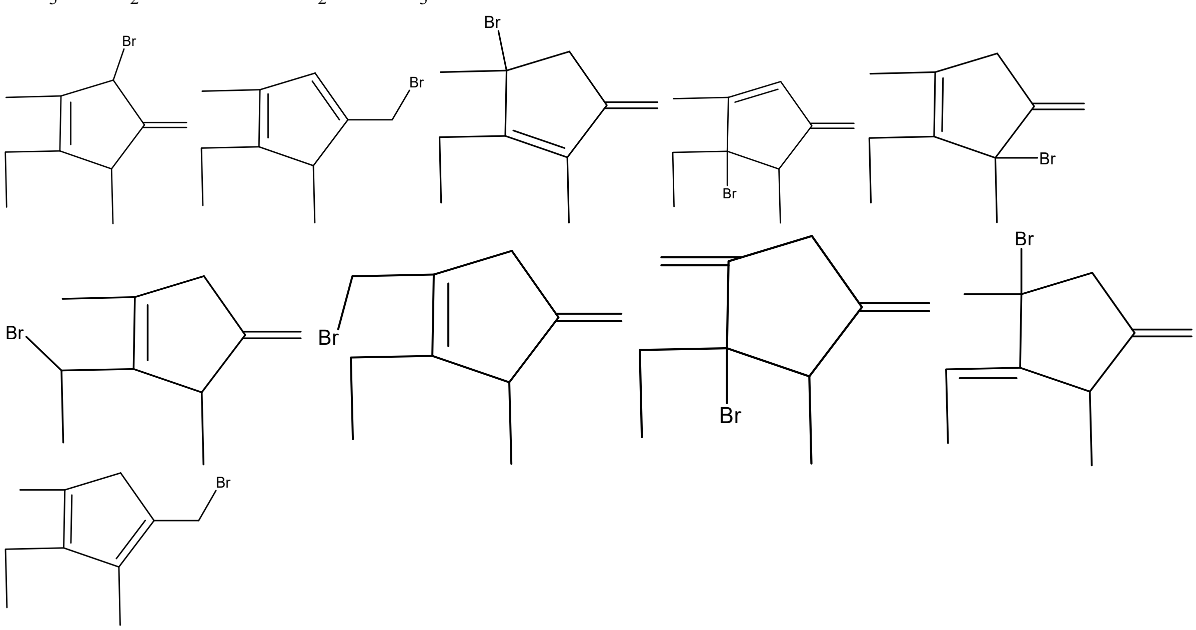


34.

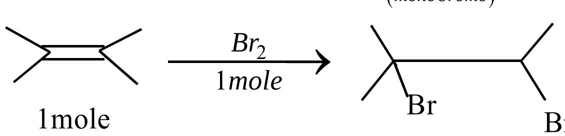


$CH_3 - CH_2 - CHO + 2CH_2O + CH_3 - CHO$

35.



36. (A) $CnH_{2n} \xrightarrow{HBr} C_n - H_{2n+1} \underset{(mono\,bromo)}{Br}$



2gm of $Br_2 \rightarrow 0.7g$ of $[A]$, 160 gm of $Br_2 \rightarrow ?$

Molecular weight of $C_nH_{2n} = \frac{0.7 \times 160}{20} = 56 \quad [n = 4]$

MATHEMATICS

37. $\begin{vmatrix} c & 1 & f \\ b & 1 & e \\ a & 1 & d \end{vmatrix} = -5 = \Delta_1; \begin{vmatrix} c & 3 & f \\ b & 2 & e \\ a & 1 & d \end{vmatrix} = 3 = \Delta_2, 2\Delta_2 - 3\Delta_1$

38. $\vec{a}\left(\vec{b}\times\vec{c}\right) \le |a||b\times c| \quad \le 2\times 4 \quad \le 8$

39. $\Delta\Delta^2 = 64 \Rightarrow \Delta^3 = 64 \Rightarrow \Delta = 4$

$\begin{vmatrix} 2a+3l & 3l+5m & 5m+4a \\ 2l+3b & 3b+5n & 5n+4l \\ 2m+3n & 3n+5c & 5c+4m \end{vmatrix} = [(2\times3\times5)+(3\times5\times4)]\Delta = (30+60)\Delta = 90(40) = 360$

40. $BA = I-(B+A)C, BAC = C-(B+A)C^2$

$A+B+C-BAC = (A+B)\left(I+C^2\right)$

$\Rightarrow \det(A+B+C-BAC) = \det(A+B)\det\left(I+C^2\right) = 0$

41. $|P| \ne 0$

42. M satisfies $M^3-5M^2+8M-4I=0$ (characteristics equation)

$\Rightarrow \left(M^4+8M\right)+\left(-5M^3+8M^2-10M\right) = 2M$ (pre multiplying M)

$\Rightarrow A+B = 2M, \det(A+B) = 32 \ \frac{\det(A+B)}{4} = 8$

43. $M^{-1} = adj\,(adj\ M)$

$M\ adj\ M = |(M)|I$

replace M *by* $adj\ M$

$(adj\ M)\,adj\,(adj\ M) = |adj\ M|I = |M^2|I$

Multiplying by M

$M(adj\ M)\ adj\ (adj\ M) = |M|^2 M$

$adj\ (adj\ M) = |M|M$

$= |M|M \Rightarrow |M^{-1}| = |M||M|$

$\frac{1}{|M|} = |M|^3|M| \Rightarrow |M| = 1$...........(1)

$\frac{adjM}{|M|} = |M|^2|M| \Rightarrow adj\ M = M\ as\ |M| = 1 \to M(adjM) = M^2 \Rightarrow M^2 = I$

$adjM = M\ as\ |M| = 1$

$(adj\ M)^2 = I\ (as\ adj\ M = M)$

44. $X = \sum_{k=1}^{6} P_k \begin{bmatrix} 2 & 1 & 3 \\ 1 & 0 & 2 \\ 3 & 2 & 1 \end{bmatrix} P_K^T$

Let $A = \begin{bmatrix} 2 & 1 & 3 \\ 1 & 0 & 2 \\ 3 & 2 & 1 \end{bmatrix}, A = A^T, X^T = \left(P_1AP_1^T + P_2AP_2^T + ... + P_6AP_6^T\right)^T \quad = X$

So X is symmetric matrix

Let $Q=\begin{bmatrix}1\\1\\1\end{bmatrix}, XQ=P_1AP_1^TQ+P_2AP_2^TQ+......+P_6AP_6^TQ \quad =P_1AQ+P_2AQ+......+P_6AQ$

$=(P_1+P_2+......+P_6)AQ.$ *where* $AQ=\begin{bmatrix}6\\3\\6\end{bmatrix}$

$=\begin{bmatrix}2&2&2\\2&2&2\\2&2&2\end{bmatrix}\begin{bmatrix}6\\3\\6\end{bmatrix}=\begin{bmatrix}30\\30\\30\end{bmatrix}=30Q, XQ=30Q\Rightarrow(X-30I)Q=0$

So, $|X-30I|=0$, has non-trival solution.

When trace $(P_kAP'_K)=3$

$\Rightarrow Trace\ X=3\times6=18$

45. $\det(R)=\det(Q)=48-4x^2$

$R=\frac{1}{6}\begin{bmatrix}12&6&4\\0&24&8\\0&0&36\end{bmatrix}=\begin{bmatrix}2&1&\frac{2}{3}\\0&4&\frac{4}{3}\\0&0&6\end{bmatrix}$

Given $\Rightarrow(R-6I)\begin{bmatrix}1\\a\\b\end{bmatrix}=0, \begin{bmatrix}-4&1&\frac{2}{3}\\0&-2&\frac{4}{3}\\0&0&0\end{bmatrix}\begin{bmatrix}1\\a\\b\end{bmatrix}=0$ *So,* $a+b=5.$

B) For $x=1$

$\det(R)=48-4x^2=48-4=40$

$\det(R)\neq0$

$R\begin{bmatrix}\alpha\\\beta\\\gamma\end{bmatrix}=\begin{bmatrix}0\\0\\0\end{bmatrix}\Rightarrow\alpha=\beta=\gamma=0$

Hence , $\alpha\hat{i}+\beta\hat{j}+r\hat{k}$ cannot a unit vector.

C) $\det\begin{vmatrix}2&x&x\\0&4&0\\x&x&5\end{vmatrix}+8=4\begin{vmatrix}2&x\\x&6\end{vmatrix}+8=4(10-x^2)+8=40-4x^2+8=48-4x^2$

D) $PQ=QP\begin{bmatrix}1&1&1\\0&2&2\\0&0&3\end{bmatrix}\begin{bmatrix}2&x&x\\0&4&0\\x&x&6\end{bmatrix}=\begin{bmatrix}2&x&x\\0&4&0\\x&x&6\end{bmatrix}\begin{bmatrix}1&1&1\\0&2&2\\0&0&3\end{bmatrix}$

If we equate a_{12} from both

$x+4+x=2+2x\Rightarrow4=2\Rightarrow x\in\phi,$ *no value exists*

46. $(MN)^2 = 3MN \Rightarrow NMNMNM = 3NMNM \Rightarrow (NM)^3 = 3(NM)^2 \Rightarrow (NM) = 3I$

$\Rightarrow P = \frac{1}{3}I$ so, $\det(p + p^2 + ...) = \frac{1}{4}$

47. $C_3 \to C_3 + C_2 - C_1 \qquad \Delta(r) = \begin{vmatrix} \frac{1}{(r+2)^2} & \frac{1}{(r+2)} & 0 \\ \frac{1}{(r+3)^2} & \frac{1}{r+1} & 0 \\ -2 & -1 & 1 \end{vmatrix}; \Delta(r) = \frac{1}{(r+1)(r+2)^2} - \frac{1}{(r+2)(r+3)^2}$

$\left(\frac{1}{2.3^2} - \frac{1}{3.4^2}\right) + \left(\frac{1}{3.4^2} - \frac{1}{4.5^2}\right) .... \left(\frac{1}{(n+1)(n+2)^2} - \frac{1}{(n+2)(n+3)^2}\right)$

$= \frac{1}{2.3^2} - \frac{1}{(n+2)(n+3)^2}; n = 7 = \frac{1}{2.9} - \frac{1}{9.100} = \frac{49}{900}$

48. Conceptual

49. $|A| = 0$

50. $a_{11}^2 + a_{12}^2 + a_{13}^2 = 1$

51. $9 = \sum \tan A \tan B = \tan A + \tan B + (\tan A + \tan B)\left(\frac{\tan A + \tan B}{\tan A \tan B - 1}\right)$

$\therefore 9(\tan A \tan B - 1) = \tan A \tan B(\tan A \tan B - 1) + (\tan A + \tan B)^2$

$\therefore (\tan A - \tan B)^2 + (\tan A \tan B - 3)^2 = 0$

$\therefore \Delta ABC$ is equilateral ..Determinant =0

52. $3ABA^{-1} + A = 2A^{-1}BA \Rightarrow 3ABA^{-1} + A + 2A = 2A^{-1}BA + 2A$

$\Rightarrow 3A(BA^{-1} + I) = 2(A^{-1}B + I)A$

$\Rightarrow 3A(B + IA)A^{-1} = 2A^{-1}(B + AI)A$ *Let* $B + AI = X$

$\Rightarrow 3AXA^{-1} = 2A^{-1}XA \Rightarrow 3^n|A||X||A^{-1}| = 2^n|A^{-1}||X||A| \Rightarrow 3^n|X| = 2^n|X|$

(Cancellation is allowed because A is non singular)

$3^n|X| = 2^n|X| \Rightarrow 0$ $i.e, |A + B| = 0.......(1)$

Let $M = ABA^{-1} - A^{-1}BA$

$AM = A^2BA^{-1} - BA \Rightarrow BA = A^2BA^{-1} - AM$

$3ABA^{-1} + A = 2A^{-1}BA = 2A^{-1}(A^2BA^{-1} - AM) = 2ABA^{-1} - 2M$

$\Rightarrow ABA^{-1} + A = -2M \Rightarrow A(BA^{-1} + I) = -2M$

Taking determinants both sides we get $|-2M| = |A||A + B||A^{-1}| = 0$

From(1) $\Rightarrow |ABA^{-1} \quad - ABA| = 0$

53. $\Delta = \begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix} \times \begin{vmatrix} -\beta & -\gamma & -\alpha \\ \alpha & \beta & \gamma \\ \gamma & \alpha & \beta \end{vmatrix} = (\alpha + \beta + \gamma)^2 + \left((\alpha + \beta + \gamma)^2 - (\alpha\beta + \beta\gamma + \gamma\alpha)\right)^2 \quad = 1(1 + 6)^2 = 49$

54. $\Delta = (1 + a^2 + b^2) \geq (1 + 2|ab|)^3 = 27$