Sri Chaitanya IIT Academy, India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR-HYD

Sec: Sr. IPLCO **Date: 12-12-15**

Time: 9:00 AM to 12:00 Noon **RPTM-14** **Max.Marks: 360**

KEY SHEET

PHYSICS			CHEMISTRY			MATHS	
Q.NO	ANSWER		Q.NO	ANSWER		Q.NO	ANSWER
1	4		31	2		61	3
2	1		32	1		62	2
3	3		33	1		63	4
4	3		34	2		64	2
5	4		35	3		65	3
6	3		36	2		66	4
7	1		37	1		67	3
8	4		38	2		68	2
9	1		39	2		69	4
10	4		40	1		70	1
11	4		41	1		71	3
12	1		42	1		72	4
13	2		43	1		73	3
14	3		44	1		74	4
15	2		45	4		75	2
16	3		46	1		76	1
17	2		47	3		77	3
18	1		48	4		78	2
19	2		49	3		79	4
20	1		50	3		80	2
21	1		51	3		81	2
22	2		52	1		82	3
23	1		53	3		83	1
24	3		54	1		84	3
25	4		55	2		85	4
26	2		56	2		86	1
27	1		57	3		87	4
28	2		58	4		88	2
29	3		59	4		89	4
30	3		60	3		90	1

MATHS

61. $AE + EB = 6$

$AE + 2(AE) = 6$

$AE = 2 = \frac{1}{3}(AB)$

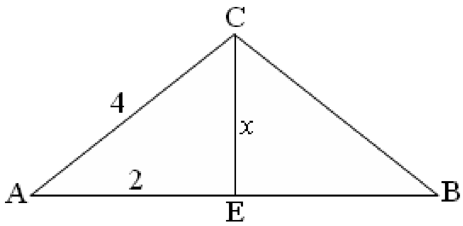
$\therefore$ Area of $\Delta^{le} ACE = \frac{1}{3}\left(\text{Area of } \Delta^{le}\ ABC\right)$……….(1)

Now : Area of $\Delta^{le} ABC = \sqrt{s(s-a)(s-b)(s-c)}$

$s = \frac{4+5+6}{2} = \frac{15}{2} \Rightarrow \Delta = \sqrt{\frac{15}{2}\left(\frac{15}{2}-5\right)\left(\frac{15}{2}-4\right)\left(\frac{15}{2}-6\right)}$

$= \sqrt{\frac{15}{2}.\frac{5}{2}.\frac{7}{2}.\frac{3}{2}}$

$\Delta = \frac{15}{4}\sqrt{7}$ …………..(2)



Now Let $CE = x$,

$\therefore$ Area of $\Delta^{le} ACE = \sqrt{\frac{6+x}{2}.\frac{6-x}{2}.\frac{x+2}{2}.\frac{x-2}{2}}$

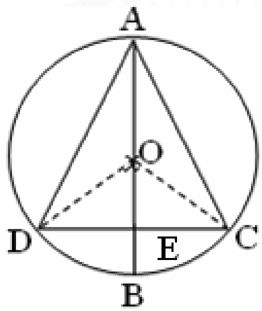
$= \frac{1}{4}\sqrt{\left(36-x^2\right)\left(x^2-4\right)}$……….(3)

From (1), (2), (3) we have

$\frac{1}{4}\sqrt{\left(36-x^2\right)\left(x^2-4\right)} = \frac{1}{3} \times \frac{15}{4}\sqrt{7}$

$\Rightarrow x^2 = 11 \Rightarrow x = \sqrt{11}$

62. Clearly AD = AC



$\therefore$ arc(AD) = arc (AC)

Arc (ADC) = $\frac{2}{3}.2\pi r$

$= \frac{4\pi r}{3}$

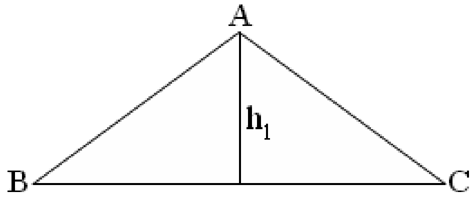
$\therefore arc(AC) = \frac{2\pi}{3} r = arc(AD)$

$\therefore \angle AOD = \angle AOC = \frac{2\pi}{3} \Rightarrow \angle DOC = \frac{2\pi}{3}$

$\therefore \Delta^{le}\text{ADC}$ is equilateral Δ^{le}.

$OA = 1 \Rightarrow OE = \frac{1}{2} \Rightarrow AE \Rightarrow \frac{3}{2}\left(\because \text{AE is Median}\right)$

63. $\Delta = \frac{1}{2}h_1.a$



$h_1 = \frac{2\Delta}{a}$

$lly\ \ h_2 = \frac{2\Delta}{b}$

$h_3 = \frac{2\Delta}{c}$

$$\frac{h_1 + r}{h_1 - r} = \frac{\frac{2\Delta}{a} + \frac{\Delta}{s}}{2\frac{\Delta}{a} - \frac{\Delta}{s}} = \frac{2s + a}{2s - a}, lly\ \frac{h_2 + r}{h_2 - r} = \frac{2s + b}{2s - b}, \frac{h_3 + r}{h_3 - r} = \frac{2s + c}{2s - c}$$

$$\frac{h_1 + r}{h_1 - r} + \frac{h_2 + r}{h_2 - r} + \frac{h_3 + r}{h_3 - r} = \sum \frac{2s + a}{2s - a} = \sum\left(\frac{4s}{2s - a} - 1\right) = \left(\sum \frac{4s}{2s - a}\right) - 3 \ldots\ldots\ldots(1)$$

Now $\frac{4s}{2s - a} + \frac{4s}{2s - b} + \frac{4s}{2s - c} \geq \frac{9}{\frac{2s - a}{4s} + \frac{2s - b}{4s} + \frac{2s - c}{4s}}$

$$\left(\sum \frac{h_1 + r}{h_1 - r}\right) + 3 \geq \frac{9}{(1)}$$

$$\therefore \sum\left(\frac{h_1 + r}{h_1 - r}\right) \geq 6$$

64. Let $\angle EDB = \alpha$

Let $\angle CAB = \angle CBA = \theta$

$\therefore\ 20 + \theta + \theta = 180^0$

$2\theta = 180 - 20 \Rightarrow \theta = 80^0$

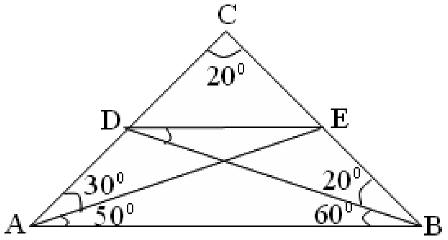
$\therefore \angle CAE = 30^0 \Rightarrow \angle CEA = 130^0$ and $\angle AEB = 50^0 \Rightarrow AB = EB = y$

Let $AC = BC = x$ and $BA = y$ Now $CE = x - y$

Apply – sine – rule in $\Delta^{le} AEC$

$$\frac{x}{\sin 130^0} = \frac{x - y}{\sin 30^0} \Rightarrow \frac{x - y}{x} = \frac{1}{2\sin 50^0} \text{ or } \frac{x}{x - y} = 2\cos 40^0 \ldots\ldots\ldots\ldots(1)$$

In Δ^{le} ABD- apply sine – rule.



$\frac{BD}{\sin 80} = \frac{AB}{\sin 40} \Rightarrow \frac{BD}{y} = 2\cos 40 \ldots\ldots\ldots\ldots\ldots(2)$

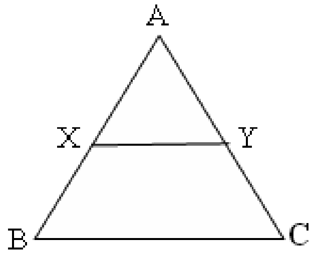
From (1) & (2) $\frac{BD}{y} = \frac{x}{x-y}$

$\therefore \Delta^{le}\ AEC, \Delta^{le}\ DEB$ are similar

$\Rightarrow \angle BDE = \angle EAC = \frac{\pi}{6} = 30^0$

65. Area of Δ^{le} ABC

$\Delta = \frac{1}{2} \times (AB) \times (AC) \times \sin A$



$= \frac{1}{2} \times 20 \times \frac{45}{2} \times \sin A$

$\Delta = 225 \sin A \ldots\ldots\ldots\ldots(1)$

Area of $\Delta^{le}\ AXY$ is $\frac{1}{2}(AX) \times (AY) \times \sin A = \frac{1}{2}(AX)^2 \sin A \ldots\ldots(2)$

$\therefore \frac{1}{\cancel{2}}(AX)^2 \sin A = \frac{225 \sin A}{\cancel{2}}$

$(AX)^2 = 225 \Rightarrow AX = 15$

66. $2s = 13 + 14 + 15$

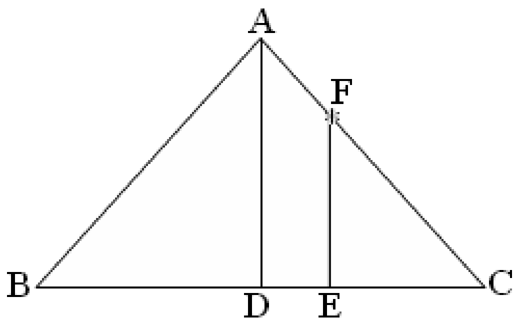
$s = \frac{42}{2} = 21$

Area of $\Delta^{le}\ ABC = \sqrt{21 \times 8 \times 7 \times 6}$

$= 7 \times 12 = 84$

Now $\frac{1}{2} \times AD \times BC = 84$

$AD = \frac{2 \times 84}{14} = 12 \Rightarrow BD = 5, DC = 9$



$\Delta^{le}\ ADC, \Delta^{le} EFC$ are similar.

$\therefore \frac{AD}{EF} = \frac{DC}{EC}$

$EC = \frac{9}{12} EF$

$$EC = \frac{3}{4}EF$$

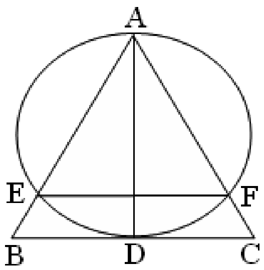
Area of Δ^{le} FEC = 42

$\frac{1}{2} \times (EF) \times EC = 42$

$\frac{EF}{2} \times \frac{(EF)3}{4} = 42 \Rightarrow (EF)^2 = \frac{2 \times 4 \times 42}{3}$

$EF = 4\sqrt{7}$

67. In Δ^{le} AEF



$\frac{EF}{\sin A} = AD$

$EF = (AD).\sin(60^0)$

$\therefore EF = \frac{\sqrt{3}}{2}(BC).\frac{\sqrt{3}}{2}$

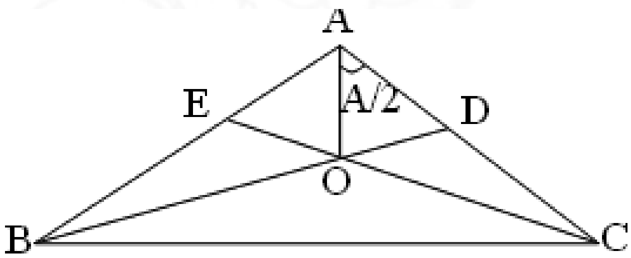
$\frac{EF}{BC} = \frac{3}{4}$

$\Delta = \frac{1}{2}(BC) \times (AD)$

$\frac{\sqrt{3}}{4}(BC)^2 = \frac{1}{2}BC \times AD$

$AD = \frac{\sqrt{3}}{2}(BC)$

68. Clearly O is Incentre of Δ^{le} ABC.



$\angle ODA = 180 - \left(A + \frac{B}{2}\right)$

$= B + C - B/2 = \frac{B}{2} + C$

$\therefore \angle AOD = 180 - \left(\frac{B}{2} + C + \frac{A}{2}\right)$

$= A + B - \left(\frac{A+B}{2}\right)$

$= \frac{A+B}{2} = 90 - C/2$

Similarly $\angle AOE = 90 - B/2$

Apply sine – rule in Δ^{le} AOD

$\frac{OD}{\sin A/2} = \frac{AO}{\sin(B/2 + C)}$

$$OD = \frac{(AO)(\sin A/2)}{\sin(B/2+C)}$$

Similarly $OE = \frac{(AO)\sin A/2}{\sin(B+C/2)}$

But $OD = OE \Rightarrow \sin(B+C/2) = \sin(B/2+C)$

$\therefore B + C/2 = 180 - (B/2+C)$

$3\left(\frac{B+C}{2}\right) = 180^0$

$B + C = 120^0$

$180 - A = 120^0 \Rightarrow \angle A = 60^0$

69. We know that $\cos A + \cos B + \cos C = 1 + \frac{r}{R}$

$$\Rightarrow 2\cos\left(\frac{A+B}{2}\right)cos\left(\frac{A-B}{2}\right) + 1 - 2\sin^2\frac{C}{2} = 1 + \frac{1}{8}$$

$\sin\frac{c}{2}.\frac{1}{2} - \sin^2\frac{c}{2} = \frac{1}{16}.$

$\frac{1}{16} - 2.\frac{1}{4}\sin\frac{c}{2} + \sin^2\frac{c}{2} = 0$

$\left(\frac{1}{4} - \sin\frac{c}{2}\right)^2 = 0$

$\Rightarrow \sin\frac{C}{2} = \frac{1}{4}$

$\cos C = 1 - 2\sin^2\frac{C}{2} = 1 - \frac{1}{8} = 7/8$

70. $\tan\left(\frac{A-B}{2}\right) = \frac{a-b}{a+b}\cot c/2$

$= \frac{\frac{a}{b}-1}{\frac{a}{b}+1}\cot c/2$

$= \frac{2+\sqrt{3}-1}{2+\sqrt{3}+1}.\cot(30^0)$

$= \frac{\sqrt{3}+1}{\sqrt{3}(\sqrt{3}+1)}.\sqrt{3} = 1 \therefore \frac{A-B}{2} = 45^0 \Rightarrow A - B = 90^0$ and $A + B = 120^0$

$\therefore 2A = 210^0 \Rightarrow \underline{|A} = 105^0$ and $\therefore \underline{|B} = 15^0$

71. $\frac{a^2+b^2+c^2}{R^2} = 4(\sin^2 A + \sin^2 B + \sin^2 C) = 8(1 + \cos A\cos B\cos C) \le 8\left(1 + \frac{1}{8}\right) = 9$

72. $r=(s-a)\tan A/2 \Rightarrow \cot A/2=\dfrac{s-a}{r}=u$

and $\cot B/2=\dfrac{s-b}{r}=v$

$\cot C/2=\dfrac{s-c}{r}=w$

$u+v+w=\dfrac{s-a+s-b+s-c}{r}=\dfrac{s}{r}$

$\therefore$ Given expression is

$49\left(u^2+4v^2+9w^2\right)=36(u+v+w)^2$

$\Rightarrow 13u^2+160v^2+405w^2-72uv-72vw-72wu=0$

$\Rightarrow \left(9u^2-72uv+144v^2\right)+\left(16v^2-72vw+81w^2\right)+\left(324w^2-72wu+4u^2\right)=0$

$(3u-12v)^2+(4v-9w)^2+(18w-2u)^2=0$

$\Rightarrow u:v:w=1:\dfrac{1}{4}:\dfrac{1}{9}$

$\dfrac{s-a}{r}:\dfrac{s-b}{r}:\dfrac{s-c}{r}=36:9:4$

$\therefore \dfrac{s-a}{36}=\dfrac{s-b}{9}=\dfrac{s-c}{4}$

$=\dfrac{2s-(b+c)}{9+4}=\dfrac{2s-(a+b)}{36+9}=\dfrac{2s-(a+c)}{36+4}$

$=\dfrac{a}{13}=\dfrac{c}{45}=\dfrac{b}{40}$

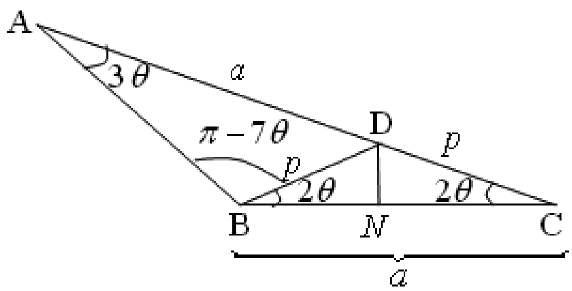
$\therefore a:b:c=13:40:45$

73. Use the formula $\Delta=\dfrac{4}{3}\sqrt{m(m-m_1)(m-m_2)(m-m_3)}$

Where $m=\dfrac{m_1+m_2+m_3}{2}$, $m_1=6, m_2=8, m_3=10$

74. In $\Delta^{le}ABC$

$\dfrac{a+p}{\sin 5\theta}=\dfrac{a}{\sin 3\theta}$ …………………..(1) $N=mid(BC)$



In $\Delta^{le} BDN, \frac{BN}{P} = \cos 2\theta$ since BDC is Isosceles

$a = 2p\cos 2\theta$ …………(2) $BN = a/2$

$\therefore$ from (1) and (2)

$$\frac{2p\cos 2\theta + p}{\sin 5\theta} = \frac{2p\cos 2\theta}{\sin 3\theta}$$

$(2\cos 2\theta + 1)\sin 3\theta = \sin 5\theta(2\cos 2\theta)$

$2\sin 3\theta\cos 2\theta + \sin 3\theta = 2\sin 5\theta\cos 2\theta$

$\sin\theta = \sin 7\theta - \sin 5\theta$

$\sin\theta = 2\cos 6\theta\sin\theta$

$\cos 6\theta = \frac{1}{2}$

$6\theta = 60^0$

$\theta = 10^0 = \frac{\pi}{18^0}$

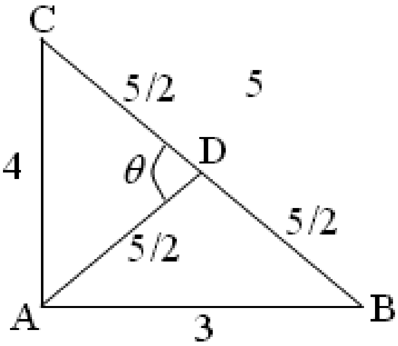
75. $\frac{r_1}{6} = \frac{r_2}{3} = \frac{r_3}{2} = \lambda$

$r_1 = 6\lambda, r_2 = 3\lambda,\ r_3 = 2\lambda \Rightarrow r = \lambda$

$a = \sqrt{(r_1 - r)(r_2 + r_3)} = 5\lambda$

$b = \sqrt{(r_2 - r)(r_1 + r_3)} = 4\lambda$

$c = \sqrt{(r_3 - r)(r_1 + r_2)} = 3\lambda$

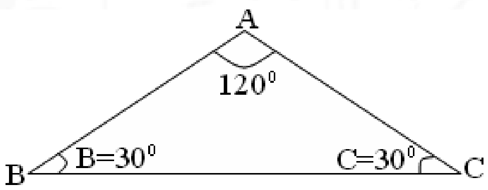


$$\therefore \cos\theta = \frac{\left(\frac{5}{2}\right)^2 + \left(\frac{5}{2}\right)^2 - 4^2}{2.\left(\frac{5}{2}\right).\left(\frac{5}{2}\right)} = \frac{-7}{25}$$

76. $r = (s-a)\tan A/2$

$\sqrt{3} = (s-a)\tan 60^0$

$\Rightarrow s - a = 1$



lly $s - b = \sqrt{3}\left(2+\sqrt{3}\right)$

$s - b = \sqrt{3}\left(2+\sqrt{3}\right)$

$s - c = \sqrt{3}\left(2+\sqrt{3}\right) \Rightarrow s = 7 + 4\sqrt{3} \Rightarrow \Delta = 12 + 7\sqrt{3}$ sq.units

77. $r = \frac{\Delta}{s} = 1 \Rightarrow \frac{7}{s} = 1 \Rightarrow s = 7 \Rightarrow a+b+c = 14$.

Now $\Delta = 7 \Rightarrow \frac{abc}{4R} = 7 \Rightarrow abc = 84$

$\Delta^2 = s(s-a)(s-b)(s-c)$

$49 = 7(7-a)(7-b)(7-c)$

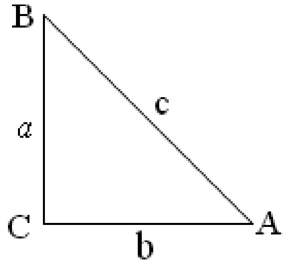
$\Rightarrow 7 = 343 - 49(a+b+c) + 7(ab+bc+bc) - abc$

$\Rightarrow ab+bc+ca = 62$

$a^2+b^2+c^2 = (a+b+c)^2 - 2(ab+bc+ca) = 72$

$\therefore \sum \frac{\cos A}{a} = \frac{a^2+b^2+c^2}{2abc} = \frac{72}{2\times 84} = \frac{3}{7}$

78. $\tan A = \frac{a}{b} = \frac{\sqrt{\sqrt{5}-1}}{\sqrt{2}}$



$\frac{a}{\sqrt{\sqrt{5}-1}} = \frac{b}{\sqrt{2}} = \lambda$

$a = \lambda\sqrt{\sqrt{5}-1}$

$b = \lambda\ \sqrt{2}$

$c = \sqrt{a^2+b^2} = \lambda\sqrt{\left(\sqrt{5}+1\right)}$

Clearly $b^2 = ac \quad \therefore a,b,c$ are in G.P

79. $x = \frac{1}{2}\left(\cos(A-C) - \cos(A+C)\right)$

$= \frac{1}{2}\left(\cos(A-C) + \frac{1}{2}\right)$

$= \frac{1}{4} + \frac{1}{2}\cos(A-C)$

and $A + C = 120^0$

$A - C < 120^o \Rightarrow \cos(A-C) > \frac{-1}{2}$

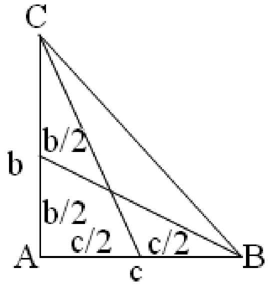
$\Rightarrow x > \frac{1}{4} + \frac{1}{2}\left(-\frac{1}{2}\right) \Rightarrow x > 0$

$x_{\max} = \frac{1}{4} + \frac{1}{2}(1) = 3/4$

Range of $x = \left(0, \frac{3}{4}\right]$

80. $c^2 + \frac{b^2}{4} = 16$ …………..(1)

$b^2 + \frac{c^2}{4} = 9$ …………….(2)



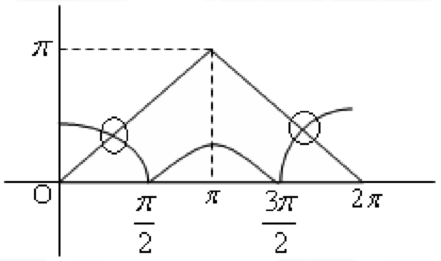
On solving (1) & (2) $b=\dfrac{4}{\sqrt{3}}$

$$c=\frac{2\sqrt{11}}{\sqrt{3}}$$

Area of $\Delta^{le} ABC=\dfrac{1}{2}bc=\dfrac{1}{2}\times\dfrac{4}{\sqrt{3}}.\dfrac{2\sqrt{11}}{\sqrt{3}}=\dfrac{4\sqrt{11}}{3}$

81. $\cos^{-1}(\cos x)=x$ If $0<x<\pi$

$=2\pi-x$ If $\pi<x<2\pi$



$\therefore$ 2-solution between 0 and 2π

By symmetry it will have an other 2 – solution between -2π and O total 4 – solutions are possible.

82. $\angle A=\angle B=\dfrac{1}{2}\left[\tan^{-1}\left(\dfrac{\sqrt{6}+1}{\sqrt{3}-\sqrt{2}}\right)+\tan^{-1}\left(\dfrac{1}{\sqrt{2}}\right)\right]$

$=\dfrac{1}{2}\left[\pi+\tan^{-1}\left(\dfrac{2\sqrt{3}+\sqrt{3}}{-3}\right)\right]$ $\left(\because\dfrac{\sqrt{6}+1}{\sqrt{3}-\sqrt{2}}.\dfrac{1}{\sqrt{2}}>1\right)$

$=\dfrac{1}{2}\left[\pi-\dfrac{\pi}{3}\right]=\dfrac{\pi}{3}$

$\therefore\angle C=\dfrac{\pi}{3}$ Δ^{le} ABC is equilateral

$\Delta=\dfrac{\sqrt{3}}{4}\left(c^2\right)=\dfrac{\sqrt{3}}{4}\times 36.\left(\sqrt{3}\right)=27$ sq.units

83. $\left(\sin^{-1}x\right)^3+\left(\cos^{-1}x\right)^3=\left(\sin^{-1}x+\cos^{-1}x\right)^3-3\sin^{-1}x\cos^{-1}x\left(\sin^{-1}x+\cos^{-1}x\right)$

$=\dfrac{\pi^3}{8}-3\sin^{-1}x\left(\dfrac{\pi}{2}-\sin^{-1}x\right).\dfrac{\pi}{2}$

$=\dfrac{\pi^3}{8}-\dfrac{3\pi^2}{4}\sin^{-1}x+\dfrac{3\pi}{2}\left(\sin^{-1}x\right)^2$

$$=\frac{\pi^3}{8}+\frac{3\pi}{2}\left[\left(\sin^{-1}x\right)^2-\frac{\pi}{2}\sin^{-1}x\right]$$

$$=\frac{\pi^3}{8}+\frac{3\pi}{2}\left[\left(\sin^{-1}x-\frac{\pi}{4}\right)^2-\frac{\pi^2}{16}\right]$$

$$=\frac{\pi^3}{8}+\frac{3\pi}{2}\left(\sin^{-1}x-\frac{\pi}{4}\right)^2-\frac{3\pi^3}{32}$$

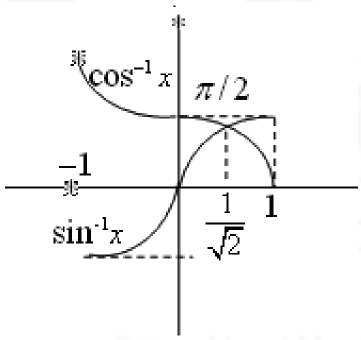
$$=\frac{\pi^3}{32}+\frac{3\pi}{2}\left(\sin^{-1}x-\frac{\pi}{4}\right)^2$$

Its min $\rightarrow\frac{\pi^3}{32}$, max$\rightarrow\frac{\pi^3}{32}+\frac{3\pi}{2}\times\frac{9\pi^2}{16}$

$$=\frac{28\pi^3}{32}=\frac{7\pi^3}{8}$$

Range $\left[\frac{\pi^3}{32},\frac{7\pi^3}{8}\right]\Rightarrow\alpha\in\left[\frac{1}{32},\frac{7}{8}\right]$

84. Clearly $\sin^{-1}x>\cos^{-1}x$ Iff $x\in\left(\frac{1}{\sqrt{2}},1\right]$.

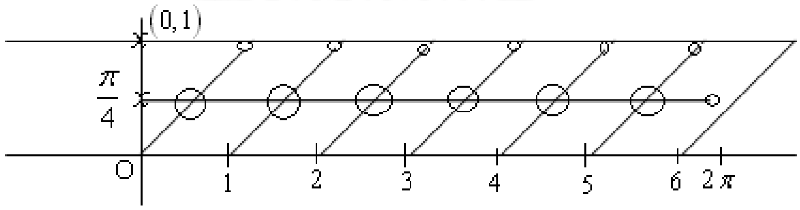


85. $\tan^2\{x\}=1\Rightarrow\tan\{x\}=\pm1$

But $0\le\{x\}<1\Rightarrow\{x\}\in$ quadrant 1

$\Rightarrow\tan\{x\}>0$

$\therefore\tan\{x\}=1\Rightarrow\{x\}=\tan^{-1}(1)=\pi/4$



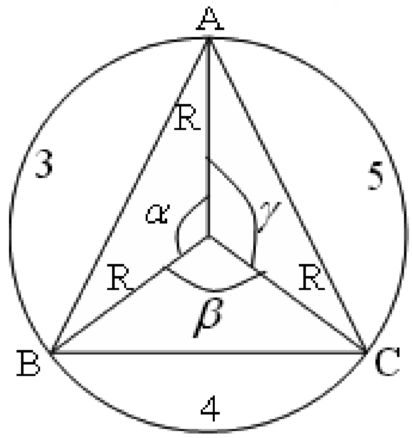
Only 6 – values of x are possible.

86. $\cot^{-1}x = t$, $4t^2 - 16t + 15 \le 0$

$$(2t-5)(2t-3) \le 0$$
$$\frac{3}{2} \le t \le \frac{5}{2}$$
$$\frac{3}{2} \le \cot^{-1}x \le \frac{5}{2}$$
$$\cot 3/2 \ge x \ge \cot 5/2$$
$$\therefore \cot\frac{5}{2} \le x \le \cot 3/2$$

87. $2\pi R = 12 \Rightarrow \pi R = 6$

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



$$arc(AB) = R.\alpha$$
$$3 = \frac{6}{\pi}.\alpha \Rightarrow \alpha = \frac{\pi}{2}$$
$$arc(BC) = R.\beta \Rightarrow \beta = \frac{4}{R}$$
$$\beta = \frac{4}{6} \times \pi = \frac{2\pi}{3}$$
$$arc(AC) = R\gamma \Rightarrow = \frac{5}{6}\pi$$

Area of Δ^{le} ABC

= Area of $\Delta^{le}OAB$ + Area of $\Delta^{le}OBC$ + Area of $\Delta^{le}OAC$

$$= \frac{1}{2}R^2\sin\alpha + \frac{1}{2}R^2\sin\beta + \frac{1}{2}R^2\sin\gamma$$
$$= \frac{1}{2} \times R^2\left(\sin\frac{\pi}{2} + \sin\frac{2\pi}{3} + \sin\frac{5\pi}{6}\right)$$
$$= \frac{1}{2} \times \frac{36}{\pi^2}\left(1 + \frac{\sqrt{3}}{2} + \frac{1}{2}\right) \qquad = \frac{18}{\pi^2}\left(\frac{3+\sqrt{3}}{2}\right)$$
$$= \frac{9\sqrt{3}\left(\sqrt{3}+1\right)}{\pi^2} \text{ sq.units}$$

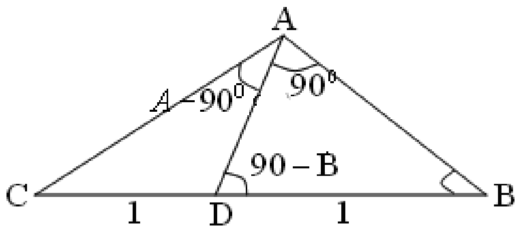
88. $$\frac{\cot A + \cot C}{\cot B} = \frac{\sin^2 B}{\sin A \sin C \cos B} = \frac{b^2}{ac\dfrac{\left(a^2+c^2-b^2\right)}{2ac}}$$

$$= \frac{2b^2}{a^2+c^2-b^2} = \frac{2b^2}{(2014)b^2} = \frac{2}{2014}$$

89. By m – n theorem

$$(1+1)\cot(90-B) =$$

$1.\cot(A-90)-1.\cot 90$



$2\tan B = -\tan A$

$\frac{\tan A}{\tan B} = -2$

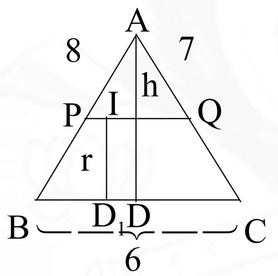
90. $\Delta = rs$

$\frac{1}{2}\times h\times 6 = r\times\frac{21}{2}$

$\frac{h}{r} = \frac{7}{2}$ …………..(1)

$\Delta^{le} APQ$ and $\Delta^{le} ABC$ are similar

$\frac{h-r}{h} = \frac{PQ}{6} \Rightarrow 1-\frac{r}{h} = \frac{PQ}{6} \Rightarrow 1-\frac{2}{7} = \frac{PQ}{6} \Rightarrow PQ = \frac{30}{7}$



AB=8, BC=6, AC=7, AD = h, $ID_1 = r$