8. PROPERTIES OF TRIANGLES – I

Class: IX ; MATHEMATICS ①

FOUNDATION$^+$: SOLUTIONS

TEACHING TASK 2025|26

JEE MAINS LEVEL

01. Given $A : B : C = 2 : 3 : 5$

We have $A = \frac{2}{10} \times 180^\circ = 36^\circ$

$B = \frac{3}{10} \times 180^\circ = 54^\circ$

$C = \frac{5}{10} \times 180^\circ = 90^\circ$

Here, greatest angle $= C = 90^\circ$

and, least angle $= A = 36^\circ$

we have $\frac{c}{\sin 90^\circ} = \frac{a}{\sin 36^\circ}$

$\Rightarrow \frac{c}{a} = \frac{\sin 90^\circ}{\sin 36^\circ} = \frac{1}{\left(\frac{\sqrt{10-2\sqrt{5}}}{4}\right)} = \frac{4}{\sqrt{10-2\sqrt{5}}}$

$\therefore c : a = 4 : \sqrt{10-2\sqrt{5}}$ Ans: B

02. Given $A + C = 2B$

$\Rightarrow A + B + C = 3B$

$\Rightarrow 180^\circ = 3B$

$\Rightarrow B = 60^\circ$

$\Rightarrow A + C = 120^\circ$

$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$

$\cos 60^\circ = \frac{a^2 + c^2 - b^2}{2ac}$

$\Rightarrow \frac{1}{2} = \frac{a^2 + c^2 - b^2}{2ac}$

$\Rightarrow b^2 = a^2 - ac + c^2$

Now, $\frac{a+c}{\sqrt{a^2 - ac + c^2}} = \frac{a+c}{\sqrt{b^2}}$

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

Now, $\frac{a+c}{b} = \frac{2R\sin A + 2R\sin C}{2R\sin B}$

$$= \frac{\sin A + \sin C}{\sin B}$$

$$= \frac{2\sin\left(\frac{A+C}{2}\right)\cos\left(\frac{A-C}{2}\right)}{\sin 60^\circ}$$

$$= \frac{2\sin\left(\cancel{\frac{120^\circ}{2}}\right)\cdot\cos\left(\frac{A-C}{2}\right)}{\cancel{\sin 60^\circ}}$$

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

Ans: A

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03 Given $c^4 - 2(a^2+b^2)c^2 + a^4 + a^2b^2 + b^4 = 0$

let $a = b = c = 1$

$\Rightarrow 1^4 - 2(1^2+1^2)1^2 + 1^4 + 1^2 \cdot 1^2 + 1^4 = 0$

$= 1 - 4 + 1 + 1 + 1 = 0$

$\therefore$ The given eqn satisfies when $a = b = c$

$\therefore$ $\triangle ABC$ is an equilateral triangle

$\therefore$ $C = 60^\circ$

Ans: C

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04 Given $x^2 - 2\sqrt{3}x + 2 = 0$

let a, b be two sides of the triangle

$\therefore$ $a+b = 2\sqrt{3}$, $ab = 2$

Now $\cos C = \frac{a^2+b^2-c^2}{2ab}$

$$= \cos\frac{\pi}{3} = \frac{(a+b)^2 - 2ab - c^2}{2ab}$$

$$\Rightarrow \frac{1}{2} = \frac{(2\sqrt{3})^2 - 2(2) - c^2}{2(2)}$$

$\Rightarrow c = \sqrt{6}$

$\therefore$ perimeter $= a+b+c$

$= 2\sqrt{3} + \sqrt{6}$ Ans. B

05 Shortcut method

Consider ΔABC is an equilateral triangle

$\therefore$ let $a=b=c=1$

$\therefore (a+b+c)(b+c-a) = \lambda bc$

$\Rightarrow (1+1+1)(1+1-1) = \lambda \cdot 1 \cdot 1$

$\Rightarrow \boxed{3 = \lambda}$

In the options: C) $0 < \lambda < 4$ satisfies Ans. C

06 Shortcut method

Given $\tan\frac{A}{2}\cdot\tan\frac{B}{2} + \tan\frac{B}{2}\cdot\tan\frac{C}{2} = \frac{2}{3}$

This eq^{n} satisfies when $A=B=C=60°$

$\tan 30°\cdot\tan 30° + \tan 30°\cdot\tan 30°$

Since LHS $= \tan 30°\cdot\tan 30° + \tan 30°\cdot\tan 30°$

$= \frac{1}{\sqrt{3}}\cdot\frac{1}{\sqrt{3}} + \frac{1}{\sqrt{3}}\cdot\frac{1}{\sqrt{3}} = \frac{1}{3}+\frac{1}{3} = \frac{2}{3}$

$\therefore$ i.e Given triangle is an equilateral triangle

Hence $a+c=2b$ satisfies equilateral triangle property $(a=b=c)$ Ans. B

07. Without loss of generality, let us consider an equilateral triangle with unit side

i.e. $a=b=c=1$. then

Altitudes $= \frac{\sqrt{3}}{2}a = \frac{\sqrt{3}}{2}\cdot 1 = \frac{\sqrt{3}}{2}$, $\Delta = \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4}$.

Consider $\frac{1}{\alpha}+\frac{1}{\beta}-\frac{1}{\gamma}-\frac{2ab}{(a+b+c)\Delta}\cdot\cos^2\frac{C}{2}$

$$=\frac{2}{\sqrt3}+\frac{2}{\sqrt3}-\frac{2}{\sqrt3}-\frac{2.1.1}{(1.1.1)\left(\frac{\sqrt3}{4}\right)}\cdot\cos^2\left(\frac{60^\circ}{2}\right)$$

Ans. A

$$=0$$

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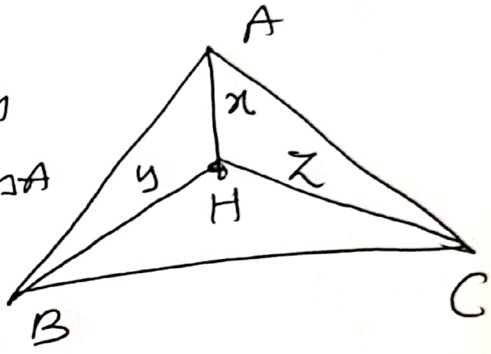
08 $H \to$ orthocentre of $\triangle ABC$



$\therefore$ The distance of H from the vertex A is $2R\,\cancel{\sin A}\cos A$

$\therefore AH = x = 2R\cos A$

$y = 2R\cos B$

$z = 2R\cos C$

Now $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=\frac{a}{2R\cos A}+\frac{b}{2R\cos B}+\frac{c}{2R\cos C}$

$$=\frac{2R\sin A}{2R\cos A}+\frac{2R\sin B}{2R\cos B}+\frac{2R\sin C}{2R\cos C}$$

$$=\tan A+\tan B+\tan C$$

In $\triangle ABC$, we have

$\tan A+\tan B+\tan C=\tan A\cdot\tan B\cdot\tan C$

$$=\Pi\tan A$$

$$=\Pi\frac{\sin A}{\cos A}$$

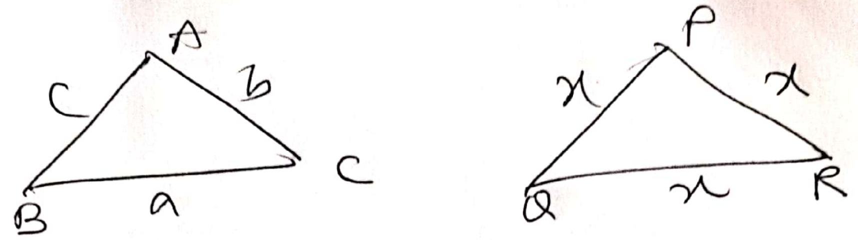
$$=\Pi\cdot\frac{a}{2R\cdot\cos A}$$

$$=\Pi\left(\frac{a}{x}\right)$$

$\therefore \frac{a}{x}+\frac{b}{x}+\frac{c}{x}=\frac{a}{x}\cdot\frac{b}{x}\cdot\frac{c}{x}$

Ans: A

09



Given a, b, c are in A.P

$\Rightarrow 2b = a + c$

perimeter $\triangle ABC = a+b+c$

$= a+c+b$

$= 2b+b$

$= 3b$

perimeter $\triangle PQR = 3x$

Given $3b = 3x \Rightarrow b = x \rightarrow (1)$

Area of $\triangle ABC = \frac{3}{5} \times$ Area of $\triangle PQR$

$= \frac{3}{5} \times \frac{\sqrt{3}}{4} x^2$

$= \frac{3\sqrt{3}}{20} b^2$

Ans: B

10 Given in $\triangle ABC$, a, b and A are given

We have $\cos A = \frac{b^2+c^2-a^2}{2bc}$

$\Rightarrow b^2+c^2-a^2 = 2bc\cos A$

Also we have $c_1 + c_2 = 2b\cos A$

$c_1 c_2 = b^2 - a^2$

Now, $c_1 - c_2 = \sqrt{(c_1+c_2)^2 - 4c_1c_2}$

$= \sqrt{(2b\cos A)^2 - 4(b^2-a^2)}$

$= \sqrt{4b^2\cos^2 A - 4b^2 + 4a^2}$

$= \sqrt{4a^2 - 4b^2\sin^2 A}$

$$= \sqrt{4a^2 - (2b\cos A)^2 \cdot \tan^2 A}$$

$$= \sqrt{4a^2 - (c_1 + c_2)^2 \cdot \tan^2 A}$$

Ans: A

JEE ADVANCED LEVEL

01. Given $c^2x^2 - c(a+b)x + ab = 0 \longrightarrow (1)$

Given $\sin A$ and $\sin B$ are the roots of (1)

$$\therefore \sin A + \sin B = \frac{c(a+b)}{c^2}$$

$$\sin A + \sin B = \frac{a+b}{c} \longrightarrow (2)$$

$$= \frac{2R\sin A + 2R\sin B}{2R\sin C}$$

$$= \frac{\sin A + \sin B}{\sin C}$$

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

$\therefore \triangle ABC$ is an right angled triangle, $C = \frac{\pi}{2}$

$$\Rightarrow A + B = \frac{\pi}{2} \quad \Rightarrow B = \frac{\pi}{2} - A$$

$$(2) \Rightarrow \sin A + \sin B = \frac{a+b}{c}$$

$$\Rightarrow \sin A + \sin\left(\frac{\pi}{2} - A\right) = \frac{a+b}{c}$$

$$\therefore \sin A + \cos A = \frac{a+b}{c}$$

Ans: B, D

02. Given $\cos\left(\frac{A}{2}\right) = \sqrt{\frac{b+c}{2c}}$

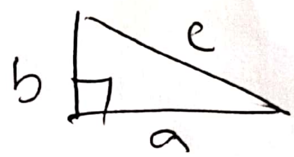
$$\Rightarrow \cos^2\left(\frac{A}{2}\right) = \frac{b+c}{2c}$$

$$\Rightarrow 2\cos^2\left(\frac{A}{2}\right) = \frac{b+c}{c}$$

$$\Rightarrow 1+\cos A = \frac{b+c}{c}$$

$$\Rightarrow \cos A = \frac{b+c}{c} - 1 = \frac{b}{c}$$

$$\Rightarrow \frac{b^2+c^2-a^2}{2bc} = \frac{b}{c}$$



$$\Rightarrow a^2+b^2=c^2$$

$\therefore \triangle ABC$ is a right angled triangle

Area of $\triangle ABC = \frac{1}{2}ab$

Also, we know Circum radius $= \frac{1}{2} \times$ hypotenuse

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

Ans. A, B

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03 Statement I:

Given $\frac{2a}{b+c-a} + \frac{2b}{c+a-b} + \frac{2c}{a+b-c}$

$$= \left(\frac{2a}{b+c-a}+1\right) + \left(\frac{2b}{c+a-b}+1\right) + \left(\frac{2c}{a+b-c}+1\right) - 3$$

$$= \frac{a+b+c}{b+c-a} + \frac{a+b+c}{c+a-b} + \frac{a+b+c}{a+b-c} - 3 \rightarrow (1)$$

We know $AM \geq H.M$

$$\Rightarrow \frac{x+y+z}{3} \geq \frac{3}{\frac{1}{x}+\frac{1}{y}+\frac{1}{z}}$$

$$\Rightarrow \frac{\frac{1}{b+c-a} + \frac{1}{c+a-b} + \frac{1}{a+b-c}}{3} \geq \frac{3}{(b+c-a)+(c+a-b)+(a+b-c)}$$

$$\Rightarrow \frac{a+b+c}{a+b-c} + \frac{a+b+c}{b+c-a} + \frac{a+b+c}{a+c-b} \geq 9$$

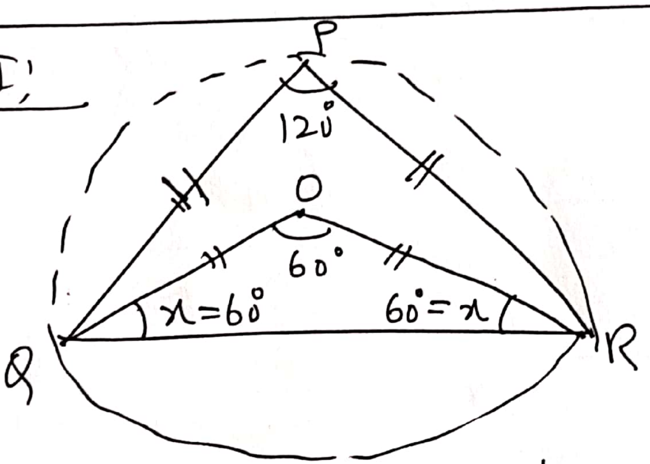
∴ The minimum value of this quantity is 9.

∴ The minimum value of expression (i)

$= 9-3$
$= 6.$ (False)

Statement: Conceptual (True) Ans. D

04 Statement I:



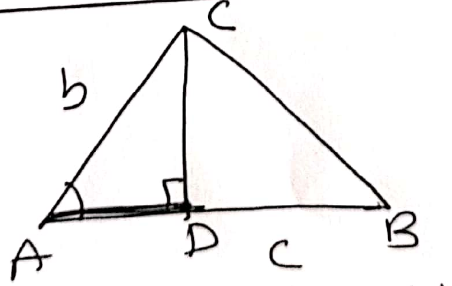
∴ $\angle Q = 120°$, $\angle R = 120°$ also given $\angle P = 120°$ which is not possible (False)

Statement II: Conceptual (False) Ans: B

05 Statement I: Conceptual (True) Ans. A

Statement II: Conceptual (True)

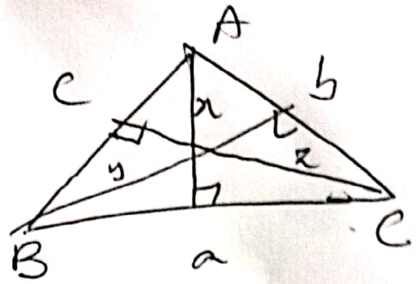
06 Assertion (A):



AD is called the projection side AC(b) on the side AB(c).

We have $\cos A = \frac{AD}{AC} = \frac{AD}{b} \Rightarrow AD = b\cos A$ (True)

Reason: Conceptual (True) Ans. A



07. We know, $\Delta = \frac{1}{2} a x$

$\Rightarrow ax = 2\Delta$

Similarly $by = cz = 2\Delta$

Given $\frac{bx}{c} + \frac{cy}{a} + \frac{az}{b} = \frac{a^2+b^2+c^2}{K}$

$\Rightarrow \frac{ab^2x + bc^2y + ca^2z}{abc} = \frac{a^2+b^2+c^2}{K}$

$\Rightarrow \frac{2\Delta b^2 + 2\Delta \cdot c^2 + 2\Delta a^2}{abc} = \frac{a^2+b^2+c^2}{K}$

$\Rightarrow \frac{2\Delta \cancel{(a^2+b^2+c^2)}}{abc} = \frac{\cancel{a^2+b^2+c^2}}{K}$

$\Rightarrow K = \frac{abc}{2\Delta} = \frac{abc}{2\left(\frac{abc}{4R}\right)} = 2R$

Ans. C

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08. Let ΔABC is an equilateral triangle with side 1 unit

$\therefore$ Also, we have $x = y = z = \frac{\sqrt{3}}{2}$

Now, $\cot A + \cot B + \cot C = K\left(\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}\right)$

$\Rightarrow \cot 60° + \cot 60° + \cot 60° = K\left(\frac{1}{\left(\frac{\sqrt{3}}{2}\right)^2} + \frac{1}{\left(\frac{\sqrt{3}}{2}\right)^2} + \frac{1}{\left(\frac{\sqrt{3}}{2}\right)^2}\right)$

$\Rightarrow \frac{3}{\sqrt{3}} = \frac{12K}{3}$

$\Rightarrow K = \frac{\sqrt{3}}{4}$

$\boxed{\text{Ans. C}}$

We know Area $= \Delta = \frac{\sqrt{3}}{4} a^2$

~~Let a, b, c~~

09. Let $\triangle ABC$ is an equilateral $\triangle$le

$$= \frac{c\sin B + b\sin C}{x} + \frac{a\sin C + c\sin A}{y} + \frac{b\sin A + a\sin B}{z}$$

$$= 3\left(\frac{c\sin B + b\sin C}{x}\right)$$

$$= 3\left(\frac{1.\sin 60^\circ + 1.\sin 60^\circ}{\left(\frac{\sqrt{3}}{2}\right)}\right) = 6$$

Ans. ~~B~~ D

10 Let a, b, c be the sides of $\triangle ABC$

$\therefore$ $s = \frac{a+b+c}{2}$

Also, s, s−a, s−b, s−c will be positive

We have A.M > G.M

$$\frac{s+(s-a)+(s-b)+(s-c)}{4} > \left[s(s-a)(s-b)(s-c)\right]^{\frac{1}{4}}$$

$$\Rightarrow \frac{4s-(a+b+c)}{4} > \Delta^{\frac{1}{2}}$$

$$\Rightarrow \frac{2s}{4} > \Delta^2$$

$$\Rightarrow \frac{s}{2} > \Delta^2$$

$$\Rightarrow \frac{s^2}{4} > \Delta$$

$$= \Delta < \frac{s^2}{4}$$

Ans: C

11. Given $a+b+c = 6\left(\frac{\sin A+\sin B+\sin C}{3}\right)$

$\Rightarrow 2R\sin A + 2R\sin B + 2R\sin C = 2(\sin A+\sin B+\sin C)$

$\Rightarrow 2R = 2$

$\Rightarrow R = 1$

We have $\frac{a}{\sin A} = 2R$

$\Rightarrow \frac{1}{\sin A} = 2$

$\sin A = \frac{1}{2}$

$A = \frac{\pi}{6}$

Ans. A

12 We have $\frac{a}{\sin A} = 2R$

$\Rightarrow \frac{5}{\sin 30^\circ} = 2R$

$\Rightarrow \frac{5}{\left(\frac{1}{2}\right)} = 2R$

$\Rightarrow R = 5$

Ans: 5

13 $B = 30^\circ, C = 45^\circ \Rightarrow A = 180^\circ - (30^\circ + 45^\circ)$

$A = 105^\circ$

We have
$\frac{a}{\sin A} = 2R$

$\Rightarrow \frac{\sqrt{3}+1}{\sin 105} = 2R$

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

$\Rightarrow R = \sqrt{2}$

Now $\frac{c}{\sin C} = 2R$

$\frac{c}{\sin 45^\circ} = 2\sqrt{2}$

$c = 2\sqrt{2} \times \sin 45^\circ$

$= 2\sqrt{2} \times \frac{1}{\sqrt{2}}$

$c = 2$

Ans: 2

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14 a) $(a+b+c)(b+c-a) = \lambda bc$ (12)

$$\Rightarrow \frac{(2s)(2s-2a)}{bc} = \lambda$$

$$\Rightarrow \frac{4(s)(s-a)}{bc} = \lambda$$

$$\Rightarrow \cos^2\left(\frac{A}{2}\right) = \frac{\lambda}{4}$$

We know $0 \le \cos^2\left(\frac{A}{2}\right) \le 1$

$$\Rightarrow 0 \le \frac{\lambda}{4} \le 1$$

$$\Rightarrow 0 \le \lambda \le 4$$

$\therefore$ Greatest value $= 4$ (P)

b) Given $\tan A \cdot \tan B \cdot \tan C = 9$

We know $AM \ge GM$

$$\Rightarrow \frac{\tan^2 A + \tan^2 B + \tan^2 C}{3} \ge \left(\tan^2 A \cdot \tan^2 B \cdot \tan^2 C\right)^{\frac{1}{3}}$$

$$\Rightarrow \frac{K}{3} \ge (\tan A \cdot \tan B \cdot \tan C)^{\frac{2}{3}}$$

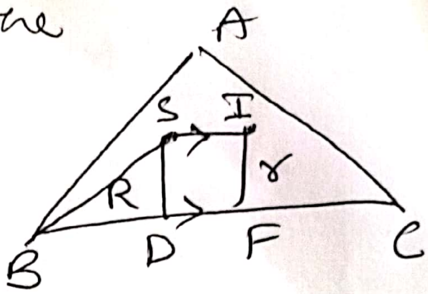
$$\Rightarrow \frac{K}{3} \ge 9^{2/3}$$

$$\Rightarrow \frac{K}{\cancel{3}} \ge 3 \cdot 9^{2/3}$$

$$\Rightarrow K \ge 9 \cdot 3^{1/3}$$

$\therefore$ Hence, Greatest value $= 9 \cdot 3^{\frac{1}{3}}$ (q)

c) In $\triangle ABC$, let S be the circumference, I be the Incentre.



Given $SI \parallel BC$

We have $SD = R\cos A$

But, from diagram $SD = IF = r$

$\therefore r = R\cos A$

$\Rightarrow R\cos A = 4R\sin\frac{A}{2}\sin\frac{B}{2}\cdot\sin\frac{C}{2}$

$\Rightarrow \cos A = 4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

$\Rightarrow \cancel{\cos A = -1 + \cos A \cos B \cos C}$

$\Rightarrow \cos A = -1 + \cos A + \cos B + \cos C$

$\Rightarrow \cos B + \cos C = 1$ (r)

d) Given $a = 5$, $b = 4$ $\cos(A-B) = \frac{31}{32}$

We know, $\cos 2\theta = \dfrac{1-\tan^2\theta}{1+\tan^2\theta}$

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

$\Rightarrow \dfrac{31}{32} = \dfrac{1-x}{1+x}$ $\left(\because x = \tan^2\left(\frac{A-B}{2}\right)\right)$

$\Rightarrow x = \frac{1}{63}$

$\Rightarrow \tan^2\left(\frac{A-B}{2}\right) = \frac{1}{63}$

We have, $\tan\left(\frac{A-B}{2}\right) = \frac{a-b}{a+b}\cot\frac{C}{2}$

$$\Rightarrow \frac{1}{\sqrt{63}} = \frac{5-4}{5+4}\cot\frac{C}{2}$$

$$\Rightarrow \cot\frac{C}{2} = \frac{9}{\sqrt{63}}$$

$$\Rightarrow \tan\frac{C}{2} = \frac{\sqrt{63}}{9}$$

We know, $\cos C = \frac{1-\tan^2\frac{C}{2}}{1+\tan^2\frac{C}{2}} = \frac{1-\left(\frac{\sqrt{63}}{9}\right)^2}{1+\left(\frac{\sqrt{63}}{9}\right)^2}$

$$\therefore \cos C = \frac{1}{8}$$

We know, $c^2 = a^2+b^2-2ab\cos C$

$$= 25+16-2.5.4.\frac{1}{8}$$

$$= 36$$

$$\therefore c = 6 \quad (s)$$

Ans. p, q, r, s

15 a) $A = 60°$

$$\cos A = \frac{b^2+c^2-a^2}{2bc}$$

$$\Rightarrow \cos 60° = \frac{b^2+c^2-a^2}{2bc} \Rightarrow \frac{1}{2} = \frac{b^2+c^2-a^2}{2bc}$$

$$\Rightarrow b^2+c^2 = a^2+bc \longrightarrow (1)$$

Now, $\frac{b}{c+a} + \frac{c}{a+b}$

Now, $\frac{b}{c+a}+\frac{c}{a+b}$

$$= \frac{ba+b^2+c^2+ca}{(c+a)(a+b)}$$

$$= a(b+a)+c(b+a)$$

$$= \frac{\cancel{(a+b)}(a+c)}{\cancel{(c+a)}\cancel{(a+b)}} = 1 \text{ (s)}$$

b) Given $C=60^\circ$

$$\cos C = \frac{a^2+b^2-c^2}{2ab}$$

$$\Rightarrow \cos 60^\circ = \frac{a^2+b^2-c^2}{2ab} \Rightarrow \frac{1}{2} = \frac{a^2+b^2-c^2}{2ab}$$

$$\Rightarrow a^2+b^2 = ab+c^2 \longrightarrow (1)$$

Consider, $\frac{1}{a+c}+\frac{1}{b+c}-\frac{3}{a+b+c}$

$$= \frac{a+b+2c}{ab+ac+bc+c^2} - \frac{3}{a+b+c}$$

$$= \frac{(a+b+2c)(a+b+c)-3(ab+bc+ca+c^2)}{(ab+bc+ca+c^2)(a+b+c)}$$

$$= \frac{\left[a^2+ab+ac+ba+b^2+bc+2ac+2bc+2c^2 - 3ab-3bc-3ca-3c^2\right]}{(ab+bc+ca+c^2)(a+b+c)}$$

$$= \frac{a^2+b^2-c^2-ab}{(ab+bc+ca+c^2)(a+b+c)}$$

$$= \frac{0}{(ab+bc+ca)+c^2)(a+b+c)} = 0$$

$$\therefore \frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c} \quad (r)$$

$\boxed{c)}$ Given $B = 60^\circ$

Now, $\cos B = \dfrac{c^2+a^2-b^2}{2ca}$

$$\Rightarrow \cos 60^\circ = \frac{c^2+a^2-b^2}{2ca}$$

$$\Rightarrow c^2+a^2-b^2-ac=0 \longrightarrow (1)$$

Consider $\dfrac{1}{a+b} + \dfrac{1}{\boxed{b+c}} - \dfrac{3}{a+b+c}$

$$= \frac{(b+c)(a+b+c) + (a+b)(a+b+c) - 3(a+b)(b+c)}{(a+b)(b+c)(a+b+c)}$$

$$= 0$$

$$\therefore \frac{1}{a+b} + \frac{1}{b+c} = \frac{3}{a+b+c} \quad (r)$$

d) Given $C = 60^\circ$

$$\therefore \cos C = \frac{a^2+b^2-c^2}{2ab}$$

$$\Rightarrow \frac{1}{2} = \frac{a^2+b^2-c^2}{2ab}$$

$$\Rightarrow a^2+b^2-c^2-ab=0 \longrightarrow (1)$$

Now, $\frac{b}{c^2-a^2}+\frac{a}{c^2-b^2}$

$$=\frac{bc^2-b^3+ac^2-a^3}{(c^2-a^2)(c^2-b^2)}$$

$$=\frac{c^2(a+b)-(a^3+b^3)}{(c^2-a^2)(c^2-b^2)}$$

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

$$=\frac{(a+b)[c^2-a^2+ab-b^2]}{(c^2-a^2)(c^2-b^2)}$$

$$=\frac{(a+b)(0)}{(c^2-a^2)(c^2-b^2)}=0\ (t)$$

Ans. s, r, r, t

LEARNERS TASK (CUQ'S)

01. $a=3$, $A=60°$

We have $\frac{a}{\sin A}=2R$

$\Rightarrow \frac{3}{\sin 60°}=2R \Rightarrow R=\sqrt{3}$ Ans. B

02. $a=10cm$, $R=5cm$

$\Rightarrow \frac{a}{\sin A}=2R$

$\Rightarrow \frac{10}{\sin A}=2\times 5$

$\sin A=1$

$A=90°$ Ans. D

(18)

03 $A = 30^\circ,\ C = 90^\circ,\ c = 7\sqrt{3}$

$\frac{c}{\sin C} = 2R$

$\Rightarrow \frac{7\sqrt{3}}{\sin 90^\circ} = 2R$

$\Rightarrow 2R = 7\sqrt{3} \longrightarrow (1)$

$\frac{a}{\sin A} = 2R$

$\frac{a}{\sin 30^\circ} = 7\sqrt{3}$

$\Rightarrow a = \frac{7\sqrt{3}}{2}$ Ans. C

04 $a = 20,\ b = 21\ \cos C = \frac{4}{5}$

$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

$\Rightarrow \frac{4}{5} = \frac{400 + 441 - c^2}{2 \cdot 20 \cdot 21}$ $\Rightarrow c = 13$

Ans : B

05 $a = 2,\ b = 3,\ c = 4$

$\cos A = \frac{b^2 + c^2 - a^2}{2bc} = \frac{9 + 16 - 4}{2 \cdot 3 \cdot 4} = \frac{7}{8}$ Ans. A

06 $\tan\left(\frac{A}{2}\right) = \frac{\Delta}{s(s-a)}$

$= \frac{30}{15(15-5)} = \frac{1}{5}$

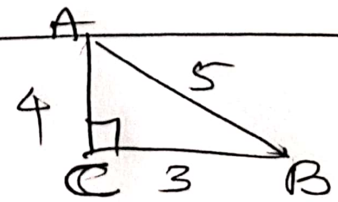
Ans. D

07 $\tan\left(\frac{B}{2}\right) = \frac{\Delta}{s(s-b)} = \frac{330}{60(66-60)} = \frac{5}{6}$

$\therefore \cot\left(\frac{B}{2}\right) = \frac{6}{5}$

Ans. B

08 $a = 3,\ b = 4,\ c = 5$



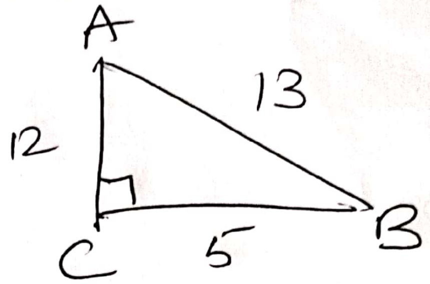
$\therefore C = 90^\circ$

$\cos\frac{C}{2} = \cos 45^\circ = \frac{1}{\sqrt{2}}$

Ans D

09 $C = 90^\circ$

$\sin 45^\circ = \frac{1}{\sqrt{2}}$



Ans A

10 Let us suppose $\triangle ABC$ is an equilateral $\triangle$le with $a = b = c = 1$

Now, $abc \sin\frac{A}{2} \cdot \sin\frac{B}{2} \cdot \sin\frac{C}{2}$

$= 1 \cdot 1 \cdot 1 \cdot \sin 30^\circ \cdot \sin 30^\circ \cdot \sin 30^\circ$

$= \frac{1}{8}$

Now, $\frac{\Delta^2}{S} = \frac{\left(\frac{\sqrt{3}}{4}\right)^2}{\left(\frac{3}{2}\right)} = \frac{3}{16} \cancel{\times} \frac{2}{3} = \frac{1}{8}$

Ans: B

JEEMAINS LEVEL

01\. Let $\triangle ABC$ is an equilateral $\triangle$le

$\therefore \frac{\sum \sin(B-C)}{bc} = \frac{\sum \sin(60^\circ - 60^\circ)}{bc} = 0$

Ans: C

02 Let $\triangle ABC$ be an equilateral $\triangle$le

$b^2 \sin 2C + c^2 \sin 2B$

$= (1)^2 \sin 120^\circ + (1)^2 \sin 120^\circ = 2\sin 120^\circ = 2 \times \frac{\sqrt{3}}{2} = \sqrt{3}$

Now, $4\Delta = 4\times\frac{\sqrt{3}}{4} = \sqrt{3}$ Ans: A

---

03 $a\cos A = b\cos B$

$\Rightarrow 2R\sin A\cos A = 2R\sin B\cos B$

$\Rightarrow \sin 2A = \sin 2B$

$\Rightarrow 2A = 2B$

$\Rightarrow A = B$

or $\sin 2A = \sin(180^\circ - 2B)$

$\Rightarrow 2A = 180^\circ - 2B$

$\Rightarrow A + B = 90^\circ$

$\Rightarrow \angle C = 90^\circ$

$\therefore \triangle ABC$ is right angled isosceles Ans: C

---

04 Given $\frac{b}{c+a} + \frac{c}{a+b} = 1$

$\Rightarrow \frac{ba+b^2+c^2+ca}{(c+a)(a+b)} = 1$

$\Rightarrow \frac{b^2+c^2-a^2}{2bc} = \frac{1}{2}$

$\Rightarrow \cos A = \frac{1}{2} \Rightarrow A = 60^\circ$ Ans A

---

05 $a=\sqrt{2}$, $b=\sqrt{6}$, $c=\sqrt{8}$

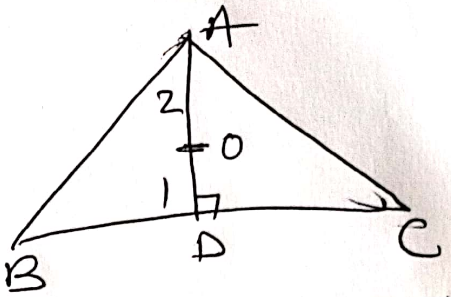
$\cos A = \frac{b^2+c^2-a^2}{2bc} = \frac{6+8-2}{2\cdot\sqrt{6}\cdot\sqrt{8}} = \frac{\sqrt{3}}{2}$

$\therefore A = 30^\circ$

Similarly $B = 60^\circ$, $C = 90^\circ$ Ans C

06 Let $\triangle ABC$ be an equilateral $\triangle$le

Let $a=b=c=1$



Also $AB = \frac{\sqrt{3}}{2}$

We know, $AO:OD = 2:1$

$AO:OD = 2:1$

$AO = \frac{2}{3} \times AD$

$= \frac{2}{3} \times \frac{\sqrt{3}}{2} = \frac{1}{\sqrt{3}}$

$\therefore p = q = r = \frac{1}{\sqrt{3}}$

Now $aqr = 1 \times \frac{1}{\sqrt{3}} \times \frac{1}{\sqrt{3}} = \frac{1}{3}$

$\therefore aqr + brp + cpq = 3 \times \frac{1}{3} = 1$

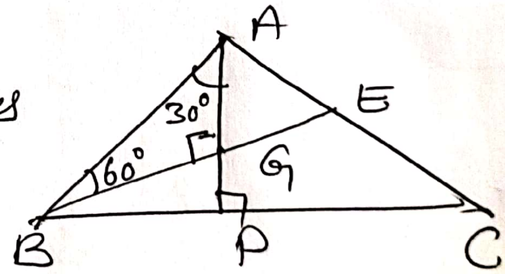
Ans: B

Now, $abc = 1.1.1 = 1$

---

07 Given $AD = 4$

Since, centroid (G) divides AD in the ratio $2:1$



We have, $AG = \frac{2}{3} \times 4 = \frac{8}{3}$

Now, $\tan 60^\circ = \frac{AG}{BG}$

$\Rightarrow \sqrt{3} = \frac{8}{3BG}$

$\Rightarrow BG = \frac{8}{3\sqrt{3}}$

Ar $\triangle ABG = \frac{1}{2} \times BG \times AG$

$= \frac{1}{2} \times \frac{8}{3\sqrt{3}} \times \frac{8}{3}$

$= \frac{32}{9\sqrt{3}}$

Ar $\triangle ABC = 3 \times$ Ar $\triangle ABG$

$= \frac{32}{3\sqrt{3}}$

Ans: C

08 $(a+b+c)(b+c-a) = 3bc$

$\Rightarrow (2s)(2s-2a) = 3bc$

$\Rightarrow \dfrac{s(s-a)}{bc} = \dfrac{3}{4}$

$\Rightarrow \cos^2\dfrac{A}{2} = \dfrac{3}{4}$

$\Rightarrow \cos\dfrac{A}{2} = \dfrac{\sqrt{3}}{2} \Rightarrow A = 60^\circ$ Ans.. A

---

09 Given $1 - \tan\dfrac{A}{2} \cdot \tan\dfrac{B}{2}$

$= 1 - \sqrt{\dfrac{(s-b)(s-c)}{s(s-a)} \cdot \dfrac{(s-a)(s-c)}{s(s-b)}}$

$= 1 - \dfrac{s-c}{s}$

$= \dfrac{c}{s} = \dfrac{2c}{2s} = \dfrac{2c}{a+b+c}$ Ans. C

---

10 Given a, b, c are in AP

$2b = a+c \rightarrow (1)$

$\Rightarrow$

Now, $\dfrac{a\sin\dfrac{A}{2} \cdot \sin\dfrac{C}{2}}{\sin\dfrac{B}{2}}$

$= \dfrac{2\sqrt{\dfrac{(s-b)(s-c)}{\cancel{s(s-a)}\,bc}} \cdot \sqrt{\dfrac{(s-a)(s-b)}{ab}}}{\sqrt{\dfrac{(s-a)(s-c)}{ac}}}$

$$= \frac{2(s-b)}{b}$$

$$= \frac{2s-2b}{b}$$

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

$$= \frac{2b-b}{b} = 1$$ Ans: A

11 Let a be the side of an equilateral $\triangle$le

x be the side of regular hexagon

Given $3a = 6x$

$\Rightarrow a = 2x \rightarrow (1)$

Ratio of Areas $= \frac{\sqrt{3}}{4}a^2 : 6 \times \frac{\sqrt{3}}{4}x^2$

$= \cancel{a^2 : 6}$

$= (2x)^2 : 6x^2$

$= 4 : 6$

$= 2 : 3$ Ans: C

Please Note: In the Key, Q.No: changed

JEE ADVANCED LEVEL

12. Given $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$

$\Rightarrow \frac{\cos A}{2R\sin A} = \frac{\cos B}{2R\sin B} = \frac{\cos C}{2R\sin C}$

$\Rightarrow \cot A = \cot B = \cot C$

$\Rightarrow A = B = C$

$\triangle ABC$ is an equilateral triangle

Given $a = 2$ cm

Area $= \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \cdot 2^2 = \sqrt{3}$ Ans. A, B

13. Let $\triangle ABC$ be an equilateral triangle.

let $a = b = c = 1$ unit

We have, $s = \frac{a+b+c}{2} = \frac{3}{2}$

$\therefore \Delta = \frac{\sqrt{3}}{4}$, $R = \frac{1}{\sqrt{3}}$

Now, $\cot\frac{A}{2} + \cot\frac{B}{2} + \cot\frac{C}{2}$

$= \cot 30^\circ + \cot 30^\circ + \cot 30^\circ = 3 \times \sqrt{3} = 3\sqrt{3}$

Now, $\frac{s^2}{\Delta} = \frac{\left(\frac{3}{2}\right)^2}{\left(\frac{\sqrt{3}}{4}\right)} = \frac{9}{4} \times \frac{4}{\sqrt{3}} = 3\sqrt{3}$

Also, $\frac{(a+b+c)^2}{abc} \cdot R$

$= \frac{(1+1+1)^2}{1 \cdot 1 \cdot 1} \cdot \frac{1}{\sqrt{3}} = \frac{9}{\sqrt{3}} = 3\sqrt{3}$

Ans. A, C

14. Statement I:

$4s(s-a)(s-b)(s-c) = a^2b^2$

$\Rightarrow 2\sqrt{s(s-a)(s-b)(s-c)} = ab$

$\Rightarrow 2\Delta = ab$

$\Rightarrow \Delta = \frac{1}{2}ab = \frac{1}{2} \times$ base $\times$ height

$\triangle ABC$ is a right angled triangle (True)

Statement II;

Let $f(x) = \sin x$

We have,

$$\frac{1}{3} f(A) + \frac{1}{3} f(B) + \frac{1}{3} f(C) \le f\left[\frac{1}{3}(A+B+C)\right]$$

$$\le f(60^\circ)$$

$$\le \sin 60^\circ$$

$$\le \frac{\sqrt{3}}{2}$$

This inequality is achieved, when

$A = B = C = \frac{\pi}{3}$

Hence, $\triangle ABC$ is an equilateral $\triangle$le (True)

Ans. A

15 Statement I; Given, the angles of $\triangle ABC$ are in A.P.

(Common difference = 0)

Let $A = B = C = 60^\circ$

Now, $\cos A + \cos B + \cos C$

$= \cos 60^\circ + \cos 60^\circ + \cos 60^\circ$

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

Statement II; In $\triangle ABC$, Given A, B, C are in A.P and $\cos A + \cos B + \cos C = 2$, which is not possible for any angles of $\triangle ABC$

(False)

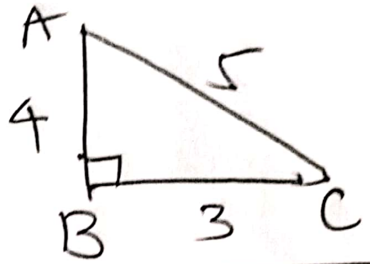
Ans. B

16. Given $a=2,\ b=4,\ C=60^\circ$

$$c^2 = a^2+b^2-2ab\cos C$$
$$= 4+16-2\cdot 2\cdot 4\cdot \frac{1}{2}$$
$$= 12$$
$$\therefore c = \sqrt{12}$$

Ans: C

17.



$\therefore \angle B = 90^\circ$

Ans. C

18. Let $\triangle ABC$ is an equilateral $\triangle$le with $A=B=C=60^\circ$, $a=b=c=1$ unit

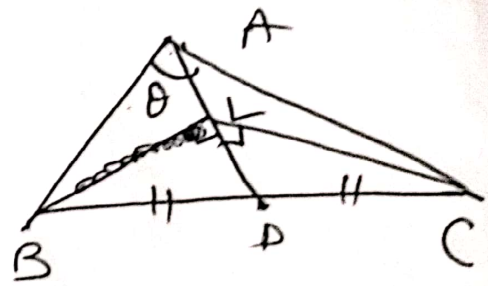
Now, $a^2+b^2+c^2 = 1^2+1^2+1^2 = 3$

Now, $4\Delta(\cot A+\cot B+\cot C)$

$$= 4\cdot\frac{\sqrt{3}}{4}\left(\cot 60^\circ+\cot 60^\circ+\cot 60^\circ\right)$$
$$= \sqrt{3}\left(3\times\frac{1}{\sqrt{3}}\right) = 3$$

Ans. A

19. We know,



$$\tan^2\left(\frac{A-B}{2}\right) = \frac{1-\cos(A-B)}{1+\cos(A+B)}$$
$$= \frac{1-\frac{4}{5}}{1+\frac{4}{5}}$$

$= \frac{1}{9}$

$\therefore \tan\left(\frac{A-B}{2}\right) = \frac{1}{3}$

$\therefore \tan\left(\frac{A-B}{2}\right) = \frac{a-b}{a+b} \cot\left(\frac{C}{2}\right)$

$\Rightarrow \frac{1}{3} = \frac{6-3}{6+3} \cdot \cot\left(\frac{C}{2}\right)$

$\longrightarrow \cot\left(\frac{C}{2}\right) = 1$

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

$\Rightarrow C = \frac{\pi}{2}$

$\therefore \triangle ABC$ is an right angle triangle

Ans B

20 Ar $\triangle ABC = \frac{1}{2} \times 6 \times 3$

$= 9$

Ans. A

21 $AD^2 = 3^2 + 3^2$

$= 18$

$\therefore AB = 3\sqrt{2}$

Ans: C

22 Given $\cos A + \sin A - \frac{2}{\cos B + \sin B} = 0$

$\Rightarrow \cos A + \sin A = \frac{2}{\cos B + \sin B}$

$\Rightarrow (\cos A + \sin A)(\cos B + \sin B) = 2$

$\Rightarrow \cos A \cos B + \cos A \sin B + \sin A \cos B + \sin A \sin B = 2$

$\Rightarrow \cos(A-B)+\sin(A+B)=2$

One of the possibility is

$A-B=0$

$A+B=90^\circ$

Solving $\Rightarrow A=45^\circ, \quad B=45^\circ \Rightarrow C=90^\circ$

Now, $\left(\frac{a+b}{c}\right)^4=\left(\frac{2R\sin A+2R\sin B}{2R\sin C}\right)^4$

$=\left(\frac{\sin A+\sin B}{\sin C}\right)^4$

$=\left(\frac{\sin 45^\circ+\sin 45^\circ}{\sin 90^\circ}\right)^4$

$=(\sqrt{2})^4=4.$ Ans. 4

---

23 Given $a+b-c=2$; $2ab-c^2=4$

Now $2ab-c^2=2^2$

$\Rightarrow 2ab-c^2=(a+b-c)^2$

$\Rightarrow 2ab-c^2=a^2+b^2+c^2+2ab-2bc-2ca$

$\Rightarrow a^2+c^2-2ac+b^2+c^2-2bc=0$

$\Rightarrow (a-c)^2+(b-c)^2=0$

$\Rightarrow a-c=0$ & $b-c=0$

$\Rightarrow a=b=c$

$\triangle ABC$ is an equilateral $\triangle$le

Now $a+b-c=2$

$\Rightarrow a+a-a=2$

$\Rightarrow a=2.$

$(\text{Area of } \triangle ABC)^2 = \left(\frac{\sqrt{3}}{4} a^2\right)^2$

$= \left(\frac{\sqrt{3}}{4} \cdot 2^2\right)^2$

$= 3$ Ans. 3

---

23. NOTE: To solve all these problems, let us Consider $\triangle ABC$ is an equilateral triangle, with $a=b=c=1$ unit

$\Delta = \frac{\sqrt{3}}{4}$ and $S = \frac{1+1+1}{2} = \frac{3}{2}$, $R = \frac{1}{\sqrt{3}}$

a) $a^2 \sin 2C + c^2 \sin 2A = 1^2 \sin 120^\circ + 1^2 \sin 120^\circ$

$= \frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{2} = \sqrt{3}$

Now, $4\Delta = 4 \times \frac{\sqrt{3}}{4} = \sqrt{3}$ (p)

b) $R^2(\sin 2A + \sin 2B + \sin 2C) = \left(\frac{1}{\sqrt{3}}\right)^2 \cdot 3 \times \sin 120^\circ = \frac{\sqrt{3}}{2}$

Now, $2\Delta = 2 \times \frac{\sqrt{3}}{4} = \frac{\sqrt{3}}{2}$ (q)

c) $c \cdot \cos^2 \frac{A}{2} + a \cdot \cos^2 \frac{C}{2} = 1 \cdot \cos^2 30^\circ + 1 \cdot \cos^2 30^\circ =$

$= \frac{3}{4} + \frac{3}{4} = \frac{3}{2} = S$ (r)

d) $a \cdot \sin^2 \frac{A}{2} + c \cdot \sin^2 \frac{A}{2} = 1 \cdot \sin^2 30^\circ + 1 \cdot \sin^2 30^\circ$

$= \left(\frac{1}{4}\right) + \frac{1}{4} = \frac{1}{2}$

$S - b = \frac{3}{2} - 1 = \frac{1}{2}$ (s)

Ans: p, q, r, s

25 a) $(a-b)^2 \cdot \cos^2\frac{C}{2} + (a+b)^2 \cdot \sin^2\frac{C}{2}$ (30)

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

$= \frac{1}{2}\left[a^2+b^2-2ab+a^2+b^2+2ab\right] + \cos C\left[a^2+b^2-2ab - a^2-b^2-2ab\right]$

$= \frac{1}{2}\left[2a^2+2b^2\right] \cancel{+} \cos C\left(-4ab\right)\Big]$

$= a^2+b^2-4ab\left(\frac{a^2+b^2-c^2}{2ab}\right)$

$= c^2 - (p)$

b) Consider $\triangle ABC$ is an equilateral triangle with side $a=b=c=1$.

$\frac{(1)^2-(1)^2}{1^2} \cdot \sin^2 A + \frac{1^2-1^2}{1^2} \sin^2 B = 0.$

option (s): $\frac{b^2-a^2}{4R} = \frac{1^2-1^2}{4R} = 0$ (s)

c) $\frac{1.1.\cos 60^\circ + 1.1.\cos 60^\circ + 1.1.\cos 60^\circ}{\cot 60^\circ + \cot 60^\circ + \cot 60^\circ} = \frac{\left(\frac{3}{2}\right)}{\left(\frac{3}{\sqrt{3}}\right)} = \frac{\sqrt{3}}{2}$

$= \cancel{9}2^\circ$ (r)

d) $\frac{\cos 60^\circ + \cos 60^\circ}{1+1} + \frac{\cos 60^\circ}{1} = \frac{1}{2} + \frac{1}{2} = 1 = \frac{1}{b}$ (q)

Ans: p, s, r, q

ADDITIONAL PRACTICE QUESTIONS

01. Let $a = 1$, $b = 2004$

let the third side be c, which is an integer

We have $a + b > c$

$\Rightarrow 1 + 2004 > c$

$\Rightarrow c < 2005 \rightarrow (1)$

Also $b - a < c$

$\Rightarrow 2004 - 1 < c$

$\Rightarrow 2003 < c \rightarrow (2)$

$\therefore (1), (2) \Rightarrow 2003 < c < 2005$

$\therefore c = 2004$

Perimeter $= a + b + c = 1 + 2004 + 2004$

$= 4009.$ Ans: B

02 $a \cos^2 \frac{C}{2} + c \cdot \cos^2 \frac{A}{2} = \frac{3b}{2}$

$\Rightarrow a \cdot \frac{s(s-c)}{ab} + c \cdot \frac{s(s-a)}{bc} = \frac{3b}{2}$

$\Rightarrow s(s-c) + s(s-a) = \frac{3b^2}{2}$

$\Rightarrow 2s^2 - s(a+c) = \frac{3b^2}{2}$

$\Rightarrow 2s^2 - s(2s - b) = \frac{3b^2}{2}$

$= sb = \frac{3b^2}{2}$

$\Rightarrow 2sb = 3b^2$

$\Rightarrow (a+b+c)\, b^2 = 3b^2$

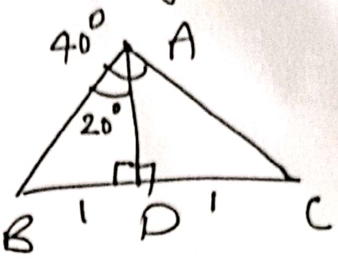
$\Rightarrow a + c = 2b$

$\Rightarrow a, b, c$ are in A.P

Ans. A

03 Given a regular polygon of 9 sides is inscribed in an equilateral triangle

We have $\theta = \frac{360^\circ}{9} = 40^\circ$



In the diagram

AB = radius of the circle

$\sin 20^\circ = \frac{BD}{AB} \Rightarrow \sin 20^\circ = \frac{1}{AB}$

$\Rightarrow AB = \operatorname{cosec} 20^\circ$

$= \operatorname{cosec} \frac{\pi}{9}$

Ans. A

---

04 Let $\triangle ABC$ be an equilateral triangle, with each side 1 unit

$\therefore\ a = b = c = 1$ unit

$\therefore\ (b-c)\cot\frac{A}{2} + (c-a)\cot\frac{B}{2} + (a-b)\cot\frac{C}{2}$

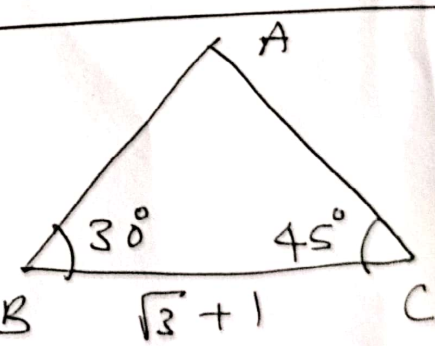
$= (1-1)\cot\frac{A}{2} + (1-1)\cot\frac{B}{2} + (1-1)\cot\frac{C}{2} = 0$

Ans: D

---

05 Let $B = 30^\circ$, $C = 45^\circ$

$a = BC = \sqrt{3}+1$



clearly, $A = 105^\circ$

We have, $\frac{a}{\sin A} = 2R$

$\Rightarrow \frac{\sqrt{3}+1}{\sin 105^\circ} = 2R$

$\Rightarrow 2R = \frac{(\sqrt{3}+1)}{\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right)}$

$\Rightarrow R = \sqrt{2}.$

Now, $\frac{b}{\sin B} = 2R$

$\Rightarrow \frac{b}{\sin 30^\circ} = 2\sqrt{2}$

$\Rightarrow b = \sqrt{2}$

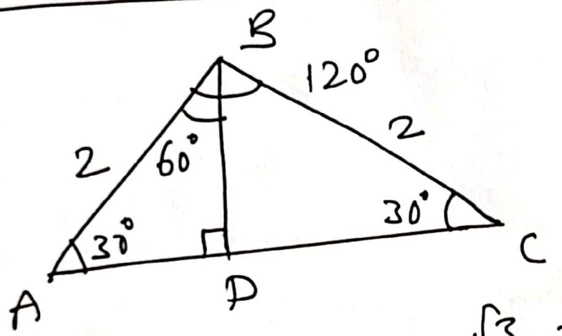
Now, Ar $\triangle ABC = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \cdot (\sqrt{3}+1)(\sqrt{2}) . \sin 45^\circ$

$= \frac{\sqrt{3}+1}{2}$

Ans: A

06



$\sin 60^\circ = \frac{AD}{AB} \Rightarrow \frac{\sqrt{3}}{2} = \frac{AD}{2}$

$\Rightarrow AD = \sqrt{3}$

$\therefore b = AC = 2AD = 2\sqrt{3}$

Ar. $\triangle ABC = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \cdot 2 \cdot 2\sqrt{3} \sin 30^\circ$

$= 2\sqrt{3} \times \frac{1}{2} = \sqrt{3}$

Ans. B

07 Given $\sin \frac{A}{2} . \cos \frac{B}{2} = \left(\frac{a+c-b}{2c}\right) K$

$\Rightarrow \sqrt{\frac{(s-b)(s-c)}{bc} \cdot \frac{s(s-b)}{ac}} = \frac{(2s-2b)}{2c} . K$

$$\Rightarrow \frac{s-b}{c}\sqrt{\frac{s(s-c)}{ab}} = \frac{s-b}{c}\cdot K$$

$$\Rightarrow \quad K = \cos\frac{C}{2}$$

Ans. D

08 Given $\frac{2\cos A}{a} + \frac{\cos B}{b} + \frac{2\cos C}{c} = \frac{a}{bc} + \frac{b}{ca}$

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

$$\Rightarrow \quad a^2 = b^2+c^2$$

$\Rightarrow$ $\triangle ABC$ is a right angle triangle with $\angle A = 90^\circ$

Ans. D

09 Statement I: Conceptual (True)

Statement II: Conceptual (True)

Ans. A

$\Longrightarrow$ THE END $\Leftarrow$.