MATHS

BOOKS - KC SINHA ENGLISH

SINE AND COSINE FORMULA - FOR BOARDS

Solved Examples

1. If in any ΔABC, $A = 30^\circ$ and $B = 60^\circ$, then find $a : b : c$

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2. If in any ΔABC, $B = 60^\circ$ and $b : c = \sqrt{3} : \sqrt{2}$, then find A.

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3. If in ΔABC, $a = 3, b = 5, c = 7$ find the greatest angle.

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4. If in a $\triangle ABC, a = \frac{1}{\sqrt{6}-\sqrt{2}}, b = \frac{1}{\sqrt{6}+\sqrt{2}}, C = 60^\circ$, then prove that $c = \frac{\sqrt{3}}{2}$.

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5. In any ΔABC, prove that : $a^2 + b^2 + c^2 = 2(bc\cos A + ca\cos B + ab\cos C)$.

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6. In any ABC, prove that: $a(b\cos C - os B) = b^2 - c^2$

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7. In any ΔABC, prove that $(a-b)^2\cos^2\left(\frac{C}{2}\right)+(a+b)^2\sin^2\left(\frac{C}{2}\right)=c^2$.

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8. If in any $\Delta ABC, a:b:c=4:5:6$, prove that the greatest angle is doule the smalles angle`

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9. The sides of a tringle are 8 cm, 10 cm and 12 cm. Prove that the greatest angle is double of the smalest angle.

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10. In any parallelogram if a and b are the length of the two non-parallel sides, θ is the angle measure between these two sides and d is the length

of the diagonal that has a common vertex with sides a and b, then show that the measure of d can be given be : $d^2 = a^2 + b^2 + 2ab\cos x$

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11. With usual notations, if in a triangle $ABC \frac{b+c}{11} = \frac{c+a}{12} = \frac{a+b}{13}$, then prove that: $\frac{\cos A}{7} = \frac{\cos B}{19} = \frac{\cos C}{25}$

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12. If in a triangle $ABC, \angle C = 60^0$, then prove that $\frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c}$.

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13. Find the unknown parts of the $\triangle ABC$, if $a = \sqrt{3}+1, b = \sqrt{3}-1$ and $C = 60^\circ$

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14. In any ABC, prove that:

$(b+c)\cos A+(c+a)\cos B+(a+b)\cos C=a+b+c$

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15. In any ΔABC, prove that :

$$\frac{\cos A}{b\cos C+c\cos B}+\frac{\cos B}{c\cos A+a\cos C}+\frac{\cos C}{a\cos B+b\cos A}=\frac{a^2+b^2+c}{2abc}$$

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16. In any ABC, prove that: $2\left\{b\frac{\cos^2 C}{2}+os^2\frac{B}{2}\right\}=a+c+b$

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17. In any ABC, prove that: $2\left\{a\frac{\sin^2 C}{2}+c\frac{\sin^2 A}{2}\right\}=a+c-b$

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18. In any triangle ABC prove that: $\sin\left(\frac{B-C}{2}\right)=\left(\frac{b-c}{a}\right)\frac{\cos A}{2}$

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19. In any ΔABC, prove that

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

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20. In any ΔABC, prove that

$$a\sin(B-C)+b\sin(C-A)+c\sin(A-B)=0$$

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21. In any triangle ABC, prove that following:

$$a(\sin B-\sin C)+b(\sin C-\sin A)+c(\sin A-\sin B)=0$$

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22. In any ΔABC, prove that

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

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23. In any ΔABC, prove that $\frac{\sin B}{\sin C}=\frac{c-a\cos B}{b-a\cos C}$

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24. In any ΔABC, prove that : $\left(\frac{a-b}{c}\right)=\frac{\tan\left(\frac{A}{2}\right)-\tan\left(\frac{B}{2}\right)}{\tan\left(\frac{A}{2}\right)+\tan\left(\frac{B}{2}\right)}$

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25. If in ΔABC, $\frac{\tan A-\tan B}{\tan A+\tan B}=\frac{c-b}{c}$, prove that : $A=60^0$.

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26. If a^2, b^2, c^2 are in A.P., prove that $\cot A, \cot B, \cot C$ are in $A\dot{P}$.

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27. Problem on sine rule Type:-1(i) In a ΔABC ; If $a = 2; b = 3$ and $\sin A = \frac{2}{3}$;find $\angle B$ (ii) In a ΔABC; the angle of a triangle are in AP ; It is being given that $b : c = \sqrt{3} : \sqrt{2}$

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28. In any triangle ABC, prove that: $\frac{\sin(B-C)}{\sin(B+C)} = \frac{b^2 - c^2}{a^2}$

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29. In any ΔABC, prove that

$$a^3\cos(B-C)+b^3\cos(C-A)+c^3\cos(A-B)=3abc$$

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30. For any triangle ABC, prove that

$$\frac{b^2-c^2}{a^2}\sin 2A+\frac{c^2-a^2}{b^2}\sin 2B+\frac{a^2-b^2}{c^2}\sin 2C=0$$

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31. In any triangle ABC, prove that:

$$a^3\sin(B-C)+b^3\sin(C-A)+c^3\sin(A-B)=0$$

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32. In any ΔABC, prove that :

$$a\cos A+b\cos B+c\cos C=2a\sin B\sin C$$

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33. For any triangle ABC, prove that $(b^2 - c^2)\cot A + (c^2 - a^2)\cot B + (a^2 - b^2)\cot C = 0$

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34. In a triangle ABC, if $a\cos A = b\cos B$, show that the triangle is either isosceles or right angled.

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35. In any triangle, if $\frac{a^2 - b^2}{a^2 + b^2} = \frac{\sin(A - B)}{\sin(A + B)}$, then prove that the triangle is either right angled or isosceles

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36. In ΔABC, $a = 3, b = 5, c = 6$, find the value of : $\sin\left(\frac{A}{2}\right)$

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37. In ΔABC, $a = 3, b = 5, c = 6$, find the value of : $\cos\left(\frac{A}{2}\right)$

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38. In ΔABC, $a = 3, b = 5, c = 6$, find the value of : $\tan\left(\frac{A}{2}\right)$

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39. In ΔABC, $a = 3, b = 5, c = 6$, find the value of : $\cot\left(\frac{A}{2}\right)$

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40. In any ΔABC, prove that $(a+b-c)\cot\left(\frac{B}{2}\right) = (a-b+c)\cot\left(\frac{C}{2}\right)$

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41. If in ΔABC, $(a+b+c)(b+c-a) = abc$, find the condition of a

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42. In any ΔABC, prove that: $\frac{a+b-c}{a+b+c} = \tan\left(\frac{A}{2}\right)\tan\left(\frac{B}{2}\right)$

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43. In any ABC , prove that: $2\left\{a\frac{\sin^2 C}{2} + c\frac{\sin^2 A}{2}\right\} = a+c-b$

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44. In any ΔABC, prove that $\cot\left(\frac{A}{2}\right)+\cot\left(\frac{B}{2}\right)+\cot\left(\frac{C}{2}\right)=\frac{a+b+c}{b+c-a}\cot\left(\frac{A}{2}\right)$

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45. Show that in any triangle ABC, $(a+b+c)\left(\tan\left(\frac{A}{2}\right)+\tan\left(\frac{B}{2}\right)\right)=2c\cot\left(\frac{C}{2}\right)$

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46. In any triangle ABC, show that : $2a\sin\left(\frac{B}{2}\right)\sin\left(\frac{C}{2}\right)=(b+c-a)\sin\left(\frac{A}{2}\right)$

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47. In any triangle ABC, show that : $2a\cos\left(\frac{B}{2}\right)\cos\left(\frac{C}{2}\right)=(a+b+c)\sin\left(\frac{A}{2}\right)$

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48. In ΔABC, $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P. prove that $\text{cosec}^2\frac{A}{2}, \text{cosec}^2\frac{B}{2}, \text{cosec}^2\frac{C}{2}$ are also in A.P.

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49. In any $\Delta ABC, \angle B = 90^\circ$, prove that $\tan\frac{A}{2} = \sqrt{\frac{b-c}{b+c}}$

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50. In ΔABC, if $\angle C = 90^0$, then prove that $\tan\left(\frac{A}{2}\right) = \sqrt{\frac{c-b}{c+b}} = \frac{a}{b+c}$

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51. Find the area of ΔABC if : $a = 6, b = 8, C = 30^0$

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52. In a ΔABC, if $a = 18, b = 24, c = 30$, find the area of ΔABC

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53. In any ΔABC, prove that $\Delta = \dfrac{b^2 + c^2 - a^2}{4 \cot A}$.

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54. In any ΔABC, prove that $b^2 \sin 2C + c^2 \sin 2B = 2bc \sin A = 4\Delta$.

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55. Prove that in ΔABC,

$$\frac{(a+b+c)^2}{a^2+b^2+c^2} \Rightarrow \frac{\cot \frac{A}{2} + \cot \frac{B}{2} + \cot \frac{C}{2}}{\cos A + \cot B + \cot C}$$

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56. In any ΔABC, If $\cot\frac{A}{2}, \cot\frac{B}{2}, \cot\frac{C}{2}$ are in AP, then a, b, c are in

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57. If $a\cos^2\left(\frac{C}{2}\right)+c\cos^2\left(\frac{A}{2}\right)=\frac{3b}{2}$. To prove: $\cot\left(\frac{A}{2}\right), \cot\left(\frac{B}{2}\right), \cot\left(\frac{C}{2}\right)$ are in A.P.

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58. If P_1, P_2 and P_3 are the altitudes of a triangle from vertices A, B and C respectively and Δ is the area of the triangle, then the value of $\frac{1}{P_1}+\frac{1}{P_2}-\frac{1}{P_3}=$

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Exercise

1. The ratio of angles in a triangle ABC is $2:3:7$ then prove that $a:b:c=\sqrt{2}:2:(\sqrt{3}+1)$

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2. If in ΔABC, $a=4$, $b=12$, $\angle B=30^0$, then find $\sin A$.

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3. In any ΔABC, prove that $\frac{\sin B}{\sin(B+C)}=\frac{b}{a}$

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4. In ΔABC,

If the two angles of a triangle are 30° and 45° and the included side is $(\sqrt{3}+1)$ cm, find the area of the triangle.

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5. The angle of a triangle are in the ratio $1:2:7$, prove that the ratio of the greatest side to the least side is $(\sqrt{5}+1):(\sqrt{5}-1)$.

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6. In ΔABC, if $c=3.4cm$, $A=25^0$, $B=85^0$, find a, b and angle C.

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7. Find the greatest angle of ΔABC if : $a=2, b=\sqrt{6}, c=\sqrt{3}+1$

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8. Find the greatest angle of ΔABC if : $a=m, b=n, c=\sqrt{m^2+mn+n^2}$

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9. In ΔABC, if $a = 25, b = 52$ and $c = 63$, find $\cos A$

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10. In a ΔABC, If $a = 18,\ b = 24,\ c = 30$, find the value of $\cos A,\ \cos B\ and\ \cos C$.

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11. In a ABC , if $\angle B = 60^0$, prove that $(a + b + c)(a - b + c) = 3ca$

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12. If the sides of a triangle are 3, 5, and 6, prove that the triangle is obtuse - angled triangle and find the obtuse angle.

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13. In any ΔABC, prove that : $\frac{b^2+c^2-a^2}{c^2+a^2-b^2}=\frac{\tan B}{\tan A}$

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14. In a triangle ABC, $a^4+b^4+c^4=2c^2\left(a^2+b^2\right)$ prove that $C=45^\circ$ or 135°

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15. In a ABC, prove the following : $\frac{c-b\cos A}{b-c\cos A}=\frac{\cos B}{\cos C}$

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16. In $\Delta ABC, a=4, b=6, c=8$, then find the value of $8\cos A+16\cos B+4\cos C$.

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17. For any triangle ABC, prove that $(b+c)\frac{\cos(B+C)}{2} = a\frac{\cos(B-C)}{2}$

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18. For any triangle ABC, prove that $\frac{a+b}{c} = \frac{\cos\left(\frac{A-B}{2}\right)}{\frac{\sin C}{2}}$

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19. For any triangle ABC, prove that $\frac{a-b}{c} = \frac{\sin\left(\frac{A-B}{2}\right)}{\cos\left(\frac{C}{2}\right)}$

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20. In any ΔABC, prove that : If $b+c = 2a\cos\left(\frac{B-C}{2}\right)$, then prove that $A = 60^0$.

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21. In any ΔABC, prove that :

$$(b^2-c^2)\cos 2A+(c^2-a^2)\cos 2B+(a^2-b^2)\cos 2C=0$$

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22. In any ΔABC, prove that

$$\frac{1+\cos(A-B)\cos C}{1+\cos(A-C)\cos B}=\frac{a^2+b^2}{a^2+c^2}$$

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23. In any ΔABC, prove that :

$$\frac{b^2-c^2}{\cos B+\cos C}+\frac{c^2-a^2}{\cos C+\cos A}+\frac{a^2-b^2}{\cos A+\cos B}=0$$

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24. In any triangle ABC, prove that:

$$\frac{a^2\sin(B-C)}{\sin B+s\in C}+\frac{b^2\sin(C-A)}{\sin C+s\in A}+\frac{c^2\sin(A-B)}{\sin A+s\in B}=0$$

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25. In any ΔABC, prove that : $\frac{b^2-c^2}{a^2}=\frac{\sin(B-C)}{\sin(B+C)}$

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26. In any ΔABC, prove that : $\tan\left(\frac{A}{2}+B\right)=\frac{c+b}{c-b}\tan\left(\frac{A}{2}\right)$

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27.

$a^2\left(\cos^2 B-\cos^2 C\right)+b^2\left(\cos^2 C-\cos^2 A\right)+c^2\left(\cos^2 A-\cos^2 B\right)=0\,.$

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28. If $A=2B$, then prove that either $c=b$ or $a^2=b(c+b)$

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29. In any ΔABC, prove that :

$$\frac{\cos A}{a}+\frac{a}{bc}=\frac{\cos B}{b}+\frac{b}{ca}=\frac{\cos c}{c}+\frac{c}{ab}$$

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30. In a ΔABC the angles A, B, C are in A.P. show that

$$2\cos\frac{A-C}{2}=\frac{a+c}{\sqrt{(a^2-ac+c^2)}}$$

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31. In any ΔABC, prove that

$$\frac{\cos 2A}{a^2}-\frac{\cos 2B}{b^2}=\frac{1}{a^2}-\frac{1}{b^2}$$

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32. In any ΔABC, prove that :

$$(b^2 - c^2)\sin^2 A + (c^2 - a^2)\sin^2 B + (a^2 - b^2)\sin^2 C = 0$$

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33. In any triangle ABC, prove that following:

$$\frac{a^2\sin(B-C)}{\sin A} + \frac{b^2\sin(C-A)}{\sin B} + \frac{c^2\sin(A-B)}{\sin C} = 0$$

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34. In a ΔABC, if median AD is perpendicular to AB, the $\tan A + 2\tan B$ is equal to

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35. In a ΔABC, If $\tan\frac{A}{2}, \tan\frac{B}{2}, \tan\frac{C}{2}$ are in A.P. then $\cos A, \cos B, \cos C$ are in

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36. If $\frac{\sin A}{\sin C} = \frac{\sin(A-B)}{\sin(B-C)}$, prove that a^2, b^2, c^2 are in A.P.

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37. If in ΔABC, $a = 15, b = 36, c = 39$, find $\tan\left(\frac{A}{2}\right)$

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38. In a ΔABC, if $a = 18, b = 24, c = 30$, find : $\tan\left(\frac{A}{2}\right), \tan\left(\frac{B}{2}\right), \tan\left(\frac{C}{2}\right)$

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39. In any ΔABC, prove that : $\frac{b-c}{a}\cos^2\left(\frac{A}{2}\right) + \frac{c-a}{b}\cos^2\left(\frac{B}{2}\right) + \frac{a-b}{c}\cos^2\left(\frac{C}{2}\right) = 0$

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40. Prove the questions :

$$1 - \tan.\frac{A}{2}\tan.\frac{B}{2} = \frac{2c}{(a+b+c)}$$

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41. In any ABC, prove that:

$$2(bosA + ca\cos B + ab\cos C) = a^2 + b^2 + c^2$$

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42. In any ΔABC, prove that :

$$\frac{\cos^2\left(\frac{A}{2}\right)}{a} + \frac{\cos^2\left(\frac{B}{2}\right)}{b} + \frac{\cos^2\left(\frac{C}{2}\right)}{c} = \frac{s^2}{abc}$$

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43. In ABC, $\left(\cot\left(\frac{A}{2}\right)+\cot\left(\frac{B}{2}\right)\right)\left(a\sin^2\left(\frac{B}{2}\right)+b\sin^2\left(\frac{A}{2}\right)\right)=$

(a) $\cot C$ (b) $\text{ccot}\, C$ (c) $\cot\left(\frac{C}{2}\right)$ (d) $\text{ccot}\left(\frac{C}{2}\right)$

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44. In ΔABC, prove that:

$$\frac{\tan A}{2}\cdot\frac{\tan B}{2}\cdot\frac{\tan C}{2}=\sqrt{\left(1-\frac{a}{s}\right)\left(1-\frac{b}{s}\right)\left(1-\frac{c}{s}\right)}$$

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45. If in $a\Delta ABC$, $\sin A, \sin B, \sin C$ are in A.P., show that $3\tan,\frac{A}{2}\tan,\frac{C}{2}=1$

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46. Prove that $(b+c-a)\left(\cot.\frac{B}{2}+\cot.\frac{C}{2}\right)=2a\cot.\frac{A}{2}$

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47. Prove that $(b+c-a)\left(\cot.\frac{B}{2}+\cot.\frac{C}{2}\right)=2a\cot.\frac{A}{2}$

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48. In a ΔABC, in the sum of two sides is $\sqrt{3}$ times their difference and the included angle is 60^0, find the difference of the remaining angles.

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49. If in ΔABC, the difference of two angles is 60^0 and the remaining angle is 30^0, then find the ratio of the sides opposite to first two angles.

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50. Find the area of ΔABC if : $a=18, b=24, C=30$

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51. The side of a triangle are in A.P. Its area is $\frac{3}{5}$ the of an equilateral triangle of the same perimeter. Show that the sides are in the proportion $3:5:7$.

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52. The sides of a quadrilateral are 3, 4, 5 and 6 cms. The sum of a pair of opposite angles is 120^0. Show that the area of the quadrilateral is $3\sqrt{30}$ sq.cm.

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