MATHS

BOOKS - RD SHARMA MATHS (ENGLISH)

SINE AND COSINE FORMULAE AND THEIR APPLICATIONS

Others

1. Two boats leave a place at the same time. One travels 56 km in the direction N 40° E, while the other travels 48 km in the direction S 80° E. What is the distance between the boats?

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2. In any triangle ABC, prove that: $a^3\cos(B-C)+b^3\cos(C-A)+c^3\cos(A-B)=3abc$

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3. 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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4. 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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5. If in a triangle ABC, $\cos A + 2\cos B + \cos C = 2$ prove that the sides of the triangle are in AP

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6. 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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7. Prove that $b(c\cos A - a\cos C) = c^2 - a^2$

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8. $2(bc\cos A + ca\cos B + ab\cos C) = a^2 + b^2 + c^2$

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

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

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11. 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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12. In any ABC, prove that:

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

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13. In any ABC, prove that:

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

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14. For any triangle ABC, prove that $a(b\cos C - c\cos B) = b^2 - c^2$

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15. In a ΔABC, if $a = 2, \angle B = 60^0 and \angle C = 75^0$, then $b =$ (a)$\sqrt{3}$ (b) $\sqrt{6}$ (c) $\sqrt{9}$ (d) $1 + \sqrt{2}$

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16. 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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17. In any triangle ABC , 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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18. 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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19. For any triangle ABC, prove that $a\cos A+b\cos B+\cos C=2a\sin B\sin C$

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20. In any triangle ABC, prove that: $(b-c)\cot\left(\frac{A}{2}\right)+(c-a)\cot\left(\frac{B}{2}\right)+(a-b)\cot\left(\frac{C}{2}\right)$ =0

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

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22. 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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23. If in triangle the angles are in the ratio as $1:2:3$, prove that the corresponding sides are $1:\sqrt{3}:2$.

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24. In the sides of a triangle are in the ratio $1:\sqrt{3}:2$, then the measure of its greatest angle is (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{2}$ (d) $\frac{2\pi}{3}$

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

B. $\frac{\pi}{2}$

C. $\frac{\pi}{3}$

D. $2\frac{\pi}{3}$

Answer: B

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25. In any triangle ABC, prove that:

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

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26. The angles of a triangle ABC are in $A\dot{P}$ and it is being given that $b : c = \sqrt{3} : \sqrt{2}$, find $\angle A$.

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

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28. In a ABC , if $a = 3, b = 5 and c = 7, f \in d \cos A, \cos B and \cos C.$

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29. A particle just clears a wall of height b at distance a and strikes the ground at a distance c from the point of projection. The angle of projection is (1) $\frac{\tan^{-1} b}{ac}$ (2) 45^o (3) $\frac{\tan^{-1}(bc)}{a(c-a)}$ (4) $\frac{\tan^{-1}(bc)}{a}$

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30. A person observes the angle of elevation of the peak of a hill from a station to be α. He walks c metres along a slope inclined at the angle β and finds the angle of elevation of the peak of the hill to be γ.Show that the height of the peak above the ground is $\frac{c \sin \alpha \sin(\gamma - \beta)}{\sin(\gamma - \alpha)}$

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31. If in a triangle ABC, $\frac{2\cos A}{a}+\frac{\cos B}{b}+\frac{2\cos C}{c}=\frac{a}{bc}+\frac{b}{ca}$, then prove that the triangle is right angled.

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32. In a triangle ABC, if $\cos A=\frac{\sin B}{2\sin C}$, show that the triangle is isosceles.

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33. In any ΔABC, prove that: $\frac{\cos A}{b\cos C+c\cos B}+\frac{\cos B}{c\cos A+a\cos C}+\frac{\cos C}{a\cos B+b\cos A}=\frac{a^2+b^2+c$

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34. In any ΔABC, $\sum a(\sin B-\sin C)=$ (a) $a^2+b^2+c^2$ (b) a^2 (c) b^2 (d) 0

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35. In a ΔABC , if$\sin A and \sin B$ are the roots of the equation $c^2x^2 - c(a+b)x + ab = 0$, then find $\angle C$.

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36. In any ABC, prove that: $\Delta = \frac{a^2 - b^2}{2} \frac{\sin A \sin B}{\sin(A - B)}$

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37. In any triangle ABC, prove that:$\Delta = \frac{b^2 + c^2 - a^2}{4 \cot A}$.

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38. In a triangle $ABC, a = 4, b = 3, \angle A = 60^0$ then c is root of the equation $c^2 - 3c - 7 = 0$ (b) $c^2 + 3c + 7 = 0$ (c) $c^2 - 3c + 7 = 0$ (d)

$c^2 + 3c - 7 = 0$

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39. In any ABC, $2(bc\cos A + ca\cos B + ab\cos C)$ =`

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40. In any ABC , the value of $2ac\sin\left(\frac{A-B+C}{2}\right)$ is (a)$a^2 + b^2 - c^2$ (b) $c^2 + a^2 - b^2$ (c) $b^2 - c^2 - a^2$ (d) $c^2 - a^2 - b^2$

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41. In a ABC , if $(c + a + b)(a + b - c) = ab$, then the measure of angel C is $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$ (c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{2}$

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42. If any triangle ABC, 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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43. In a right angled triangle ABC, write the value of

$$\sin^2 A+\sin^2 B+\sin^2 C$$

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44. Prove that,

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

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45. In a ABC, if $\cos C=\frac{\sin A}{2\sin B}$, prove that the triangle is isosceles.

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46. Problem on sine rule Type:-2 (i)The angle of elevation of the top of the tower from a point A due South of the tower is α and from B due east of the tower is β. If $AB = d$ Show that the height of the tower is $\frac{d}{\sqrt{\cot^2\alpha + \cot^2\beta}}$ (ii) A tree stands vertically on a hill side which makes an angle of 15° with the horizontal. From a point on the ground 35m down the hill from the base of the tree ; the angle of elevation of the top of the tree is 60° .find the height of the tree ?

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47. $\frac{\sqrt{\sin A} - \sqrt{\sin B}}{\sqrt{\sin A} + \sqrt{\sin B}} = \frac{a + b - 2\sqrt{ab}}{a - b}$

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48. Let O be a point inside a triangle ABC such that $\angle OAB = \angle OBC = \angle OCA = \omega$, then show that:

$\cot\omega = \cot A + \cot B + \cot C$

$\cos ec^2\omega = \cos ec^2 A + \cos ec^2 B + \cos ec^2 C$

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49. The angle of elevation of the top of a tower from a point A due south of the tower is α and from B due east of tower is β. If $AB = d$, show that the height of the tower is $\frac{d}{\sqrt{\cot^2\alpha + \cot^2\beta}}$.

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50. $\frac{b\sec B + c\sec C}{\tan B + tanC} = \frac{c\sec C + a\sec A}{\tan C + tanA} = \frac{a\sec A + b\sec B}{\tan A + tanB}$.

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

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52.

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

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53. $\dfrac{\cos(2A)}{a^2}-\dfrac{\cos(2B)}{b^2}=\dfrac{1}{a^2}-\dfrac{1}{b^2}$

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54. In a $\Delta ABC,\quad$ if $\quad a=2,\ b=3\ and\ \sin A=\dfrac{2}{3}$ then find $\angle B$

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

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56. In any triangle ABC, prove that:

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

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57. 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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58. 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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59. In any triangle ABC, prove that: $\frac{b-c}{b+c}=\frac{\tan\left(\frac{B-C}{2}\right)}{\tan\left(\frac{B+C}{2}\right)}$

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

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61. A tree stands vertically on a hill side which makes an angle of 15^0 with the horizontal. From a point on the ground 35 m down the hill from the base of three, the angle of elevation of the top of the tree is 60^0 . Find the height of the tree.

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62. A person, standing on the bank of a river, observes that the angle subtended by a tree on the opposite bank is $60^0\cdot$ When he retreates 20m from the bank, he finds the angle to be $30^0\cdot$ Find the height of the tree and the breadth of the river.

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63. The angle of elevation of to be top point P of the vertical tower PQ of height h from poin A is 45^0 and from a point B, the angle of elevation is 60^0, where B is point at a distance d from the point A measured along the line AB which makes an angle 30^0 with AQ. Prove that $d = (\sqrt{3} - 1)h$.

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64. The elevation of a tower at a station A due North of it is α and at a station B due West of A is β . Prove that height of the tower is $\frac{AB \sin\alpha \sin\beta}{\sin^2\alpha - \sin^2\beta}$.

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65. If in a ΔABC, $\angle A = 45^0$, $\angle B = 60^0$, $and\ \angle C = 75^0$, find the ratio of its sides.

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66. If in any $\Delta ABC,\ \angle C = 105^0, \angle B = 45^0, a = 2,$ then find b.

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67. In $\Delta ABC,$ if $a = 18,\ b = 24\ and\ c = 30\ and\ \angle C = 90^0$ find $\sin A,\ \sin B\ and\ \sin C$.

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68. In any triangle ABC, prove that following : $\frac{a-b}{a+b} = \frac{\tan\left(\frac{A-B}{2}\right)}{\tan\left(\frac{A+B}{2}\right)}$

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

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70. In any triangle ABC, prove that following :

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

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71. In any triangle ABC, prove that following :

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

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

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

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

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75. In any triangle ABC, prove that following: $b\sin B-c\sin C=a\sin(B-C)$

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76. In any triangle ABC, prove that following: $a^2\sin(B-C)=\left(b^2-c^2\right)\sin A$

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77. 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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78. 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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79. In any triangle ABC, prove that following:

$$b\cos B + c\cos C = \text{a c o s}(B-C)$$

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80. In any triangle ABC, prove that following:

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

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81. In any triangle ABC, prove that following:

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

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82. In any triangle ABC, prove that following:

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

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83. In any triangle ABC, prove that following:

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

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84. In a ΔABC, if $\sin^2 A + \sin^2 B = \sin^2 C$, show that the triangle is right angled.

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85. The upper part of a tree broken over by the wind makes an angle of 30^0 with the ground and the distance from the root to the point where the top of the tree touches the ground is 15m. Using sine rule, fine the height of the tree.

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86. If the sides of a ΔABC are $a = 4,\ b = 6\ and\ c = 8,$ show that $4\cos B + 3\cos C = 2.$

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

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88. In any ΔABC, prove that:

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

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89. In any ΔABC, prove that:

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

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90. In a ΔABC, prove that:

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

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91. In a ΔABC, prove that:

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

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92. In any ΔABC prove that $a\cos A+b\cos B+c\cos C=\frac{8\Delta^2}{abc}$.

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93. Two ships leave port at the same time. One goes 24 km per hour in the direction $N\,45^0E$ and other travels 32 km per hour in the direction $S75^0E$. Find the distance between the ships at the end of 3 hours.

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94. A lamp post is situated at the middle point M of the side AC of a triangular plot of ABC with $BC = 7m,\ CA = 8\ and\ AB = 9m$. Lamp post subtends an angle of 15^0 at the point B. determine the height of the lamp post.

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95. Two trees, A and B are on the same side of a river. From a point C in the river the distance of trees A and B are 25 m and 300 m respectively. If the angle C is 45^0 , find the distance between the trees $(use\ \sqrt{2} = 1.\ 44)$

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96. In a ABC, prove the following : In a $\Delta ABC,$ if $a = 5,\ b = 6\ and\ C = 60^0,$ show that its area is $\frac{15\sqrt{3}}{2}$ sq.units.

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97. In a ΔABC, prove the following : $If\ a = \sqrt{2},\ b = \sqrt{3}\ and\ c = \sqrt{5}$, show that its area is $\frac{1}{2}\sqrt{6}$ sq. units.

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98. In a ΔABC, prove the following : The sides of a triangle area $a = 5,\ b = 6\ and\ c = 8$, show that $8\cos A + 16\cos B + 4c\cos C = 17.$

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99. 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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100. In a ΔABC, prove the following : $c\left(a\cos B - b\cos A\right) = a^2 - b^2.$

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101. In a ΔABC, prove the following :

$$\left(c^2-a^2+b^2\right)\tan A=\left(a^2-b^2+c^2\right)\tan B=\left(b^2-c^2+a^2\right)\tan C$$

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

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103. In a ΔABC, prove the following :

$$a(\cos B+\cos C-1)+b(\cos C+\cos A-1)+c(\cos A+\cos B-1)=0$$

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104. In a ΔABC, prove the following :

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

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105. In a ΔABC, prove the following : $a^2 = (b+c)^2 - 4bc\cos^2\left(\frac{A}{2}\right).$

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106. In a ΔABC, prove the following :

$4\left(bc\cos^2\left(\frac{A}{2}\right) + ca\cos^2\left(\frac{B}{2}\right) + ab\cos^2\left(\frac{C}{2}\right)\right) = (a+b+c)^2$

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107. In a ΔABC, prove that ,

$\sin^3 A\cos(B-C) + \sin^3 B\cos(C-A) + \sin^3 C\cos(A-B) = 3\sin A\sin$

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108. In any $\Delta ABC, \frac{b+c}{12} = \frac{c+a}{13} = \frac{a+b}{15}$, then prove that $\frac{\cos A}{2} = \frac{\cos B}{7} = \frac{\cos C}{11}$.

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109. If in a $\Delta ABC, \cos^2 A + \cos^2 B + \cos^2 C = 1$, prove that the triangle is right angled.

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110. Two ships leave a port at the same time. One goes 24 km/hr in the direction $N38^0 E \, and$ other travels 32 km/hr in the direction $S52^0$ E. Find the distance between the ships at the end of 3 hrs.

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111. Find the area of the triangle ΔABC in which $a = 1,\ b = 2\ and\ \angle c = 60^0$.

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112. In a ΔABC, if $b = \sqrt{3},\ c = 1\ and\ \angle A = 30^0$, then find a

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113. In a ΔABC, if $\cos A = \dfrac{\sin B}{2\sin C}$, then show that $c = a$.

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114. In a ΔABC, if $b = 20,\ c = 21\ and \sin A = \dfrac{3}{5}$ find a.

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115. In ΔABC, if $a = 8,\ b = 10,\ c = 12\ and\ C = \lambda A$, find the value of λ.

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116. If the sides of a triangle are proportional to $2,\ \sqrt{6}\ and\ \sqrt{3} - 1$, find the measure of its greatest angle.

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117. If in a $\Delta\ ABC$, $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$, then find the measures of angles $A,\ B,\ C$.

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118. If any triangle ABC, find the value of $a\sin(B - C) + b\sin(C - A) + c\sin(A - B)$.

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119. In a triangle ABC, the value of cosA/sinBsinC + cosB/sinCsinA + cosC/sinAsinB

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