MATHS

BOOKS - VIKRAM PUBLICATION (ANDHRA PUBLICATION)

PROPERTIES OF TRIANGLES

Solved Problems

1. In ΔABC, if $a = 3, b = 4$ and $\sin A = \frac{3}{4}$, find angle B.

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2. If the lengths of the sides of a triangle are 3 , 4,5 find the circumradius of the triangle .

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3. If a=6 , b=5 ,c=9 then angle A .

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4. If ΔABC, show that $\sum (b+c)\cos A = 2s$.

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5. If the sides of a triangle are 13,14,15 , then find circum diameter .

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6. In ΔABC, if $(a+b+c)(b+c-a) = 3bc$, then A=

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7. If a = 4, b =5 , c = 7 , find $\cos\frac{B}{2}$

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8. Find b $\cos^2\frac{C}{2} + c\cos^2\frac{B}{2}$

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9. If $\tan.\frac{A}{2} = \frac{5}{6}$ and $\tan.\frac{C}{2} = \frac{2}{5}$ then determine the relation between a, b,c

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10. If $\cot.\frac{A}{2} = \frac{b+c}{a}$ find angle B

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11. If $\tan. \frac{C-A}{2} = k \cot. \frac{B}{2}$ then find k .

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12. In ΔABC show that $\frac{b^2-c^2}{a^2} = \frac{\sin(B-C)}{\sin(B+C)}$

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13. $a^2 \cot A + b^2 \cot B + c^2 \cot C \frac{abc}{R}$

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14. In ΔABC prove that $(b-c)^2 \cos^2 . \frac{A}{2} + (b+c)^2 \sin^2 . \frac{A}{2} = a^2$

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15. Prove that $a(b\cos C - c\cos B) = b^2 - c^2$

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16. Show that $\frac{c - b\cos A}{b - c\cos A} = \frac{\cos B}{\cos C}$

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17. In ΔABC, if $\frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c}$ then show that $C = 60^\circ$

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18. If $a = (b - c)\sec\theta$, then prove that $\tan\theta = \frac{2\sqrt{bc}}{b-c}\frac{\sin A}{2}$.

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19. In ΔABC show that $(a+b+c)\left(\tan.\frac{A}{2} + \tan.\frac{B}{2}\right) = 2\cot.\frac{C}{2}$

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20. $b^2\sin 2C + C^2\sin 2B = 2b\sin A$

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21. Prove that $\cot A + \cot B + \cot C = \frac{a^2 + b^2 + c^2}{4 \triangle}$.

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22. Show that $a \cos^2 \frac{A}{2} + b \cos^2 \frac{B}{2} + c \cos^2 \frac{C}{2} = s + \frac{\Delta}{R}$.

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23. In a ΔABC if $a \cos A = b \cos B$ the prove that triangle is either isosceles or right angled .

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24. If $\frac{\cot A}{2} : \cot \frac{B}{2} : \cot \frac{C}{2} = 3 : 5 : 7$ then show that $a : b : c = 6 : 5 : 4$.

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

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26. IF p_1, p_2, p_3 are the lengths of the altitudes of a triangle from the vertices A,B,C then $1/p_2^1+1/p_2^2+1/p_3^2=$

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27. The angle of elevation of the toop point P of the vertical tower PQ of height h from a point A 45° and from a point B is 60°, where B is a point at a distance 30 meters from the point A

measured along the line AB which makes an angle 30° with AQ . Then the height of the tower is.

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28. Two trees A and B are on the same side of a river. From a point C in the river the distances of the trees A and B are 250 m and 300 m respectively. IF the angle C is 45°, the distance the trees is

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29. In ΔABC, prove that $\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}=\frac{1}{r}$.

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30. Show that $rr_1r_2r_3 = \Delta^2$

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31. In an equilateral triangle , find $\frac{r}{R}$

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32. If the perimeter of a triangle is 12 unit and it in radius is 1 unit, then its area is

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33. Show that $rr_1 = (s-b)(s-c)$

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34. $\frac{a\cos A + b\cos B + c\cos C}{a+b+c} =$

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35. If $\Delta = 6$ sq. cm , s=1.5 cm find 'r'

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36. Show that $rr_1 \cot. \frac{A}{2} = \Delta.$

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37. In $\Delta ABC, \quad \text{if} \quad a = 13, b = 14, c = 15,$ then $r_1 =$

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38. If $rr_2 = r_1 r_3,$ then find B.

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39. In ΔABC , show that the sides a, b, c are in A.P ., if and only if r_1, r_2, r_3 are in H.P

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40. If $A = 90^\circ,$ show that $2(r + R) = b + c$

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41. If $(r_2 - r_1)(r_3 - r_1) = 2r_2r_3.$ show that $A = 90^\circ$

$\left(1 - \frac{r_1}{r_2}\right)\left(1 - \frac{r_1}{r_3}\right) = 2$, show that $A = 90^\circ$

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42. $\frac{r_1(r_2+r_3)}{\sqrt{r_1r_2+r_2r_3+r_1r_3}} =$

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43. Show that $\frac{1}{r^2}+\frac{1}{r_1^2}+\frac{1}{r_2^2}+\frac{1}{r_3^2}=\frac{a^2+b^2+c^2}{\Delta^2}$

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44. Prove that $\sum(r+r_1)\tan\left(\frac{B-C}{2}\right)=0$

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45. In $\triangle ABC$ prove that $\frac{r_1}{bc}+\frac{r_2}{ca}+\frac{r_3}{ab}=\frac{1}{r}-\frac{1}{2R}$.

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46. If r : R $r_1 = 2:5:12$ then $\angle A =$

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47. Prove that

$r + r_3 + r_1 - r_2 = 4R\cos B$

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48. If A, A_1, A_2, A_3 are the areas of incircle and ex-circle of a triangle respectively then prove that $\frac{1}{\sqrt{A_1}} + \frac{1}{\sqrt{A_2}} + \frac{1}{\sqrt{A_3}} = \frac{1}{\sqrt{A}}$

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49. Show that $(r_1 + r_2)\sec^2\frac{C}{2} = (r_2 + r_3)\sec^2\frac{A}{2}(r_3 + r_1)\sec^2\frac{B}{2}$.

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50. In ΔABC, if AD , BE , CF are the perpendiculars drawn from the vertices A, B, C to the opposite sides, shot that

$$\frac{1}{AD} + \frac{1}{BE} + \frac{1}{CF} = \frac{1}{r} \text{ and } (ii)AD.\,BE.\,CF = \frac{(abc)^2}{8R^3} = \frac{8\Delta^3}{abc}$$

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51. In ΔABC, if AD , BE , CF are the perpendiculars drawn from the vertices A, B, C to the opposite sides, shot that

$$\frac{1}{AD} + \frac{1}{BE} + \frac{1}{CF} = \frac{1}{r} \text{ and } (ii)AD.\,BE.\,CF = \frac{(abc)^2}{8R^3} = \frac{8\Delta^3}{abc}$$

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52. In a ΔABC if $r_1 = 8, r_2 = 12, r_3 = 24$ find a,b,c.

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53. Show that $\frac{ab - r_1 r_2}{r_3} = \frac{bc - r_2 r_3}{r_1} = \frac{ca - r_3 r_1}{r_2}$

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Textual Exercises Exercise 10 A I

1. In ΔABC, $\sum a(\sin B - \sin C)$

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2. In ΔABC, if $a = \sqrt{3} + 1, B = 30^\circ, C = 45^\circ$, then c=

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3. If a =2 , b = 3 c=4 then find cos A .

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4. If a = 26, b = 30 , cos C = $\frac{63}{65}$ then C=

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5. If the angles are in the ratio 1: 5: 6, then find the ratio of its sides .

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6. Show that $2(\mathrm{bc}\cos A + \mathrm{ca}\cos B + \mathrm{ab}\cos C) = a^2 + b^2 + c^2$.

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7. Prove that $\frac{a^2 + b^2 - c^2}{c^2 + a^2 - b^2} = \frac{\tan B}{\tan C}$

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

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9. Prove that $(b - a\cos C)\sin A = a\cos A\sin C$

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10. IF 4,5 are two sides of a triangle and the included angle is 60°, then its area is

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11. Find b $\cos^2 \frac{C}{2} + c\cos^2 \frac{B}{2}$

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12. If $\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$, then show that ΔABC is equilateral.

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Textual Exercises Exercise 10 A Ii

1. Prove that $a\cos A + b\cos B + c\cos C = 4R\sin A\sin B\sin C.$

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2. In Δ, $\sum a^3\sin(B-C) =$

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3. Show 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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4. Prove that $\frac{a}{bc} + \frac{\cos A}{a} = \frac{b}{ca} + \frac{\cos B}{b} = \frac{c}{ab} + \frac{\cos C}{c}$

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5. 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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6. If $C=60^\circ$, then show that $\frac{a}{b+c}+\frac{b}{c+a}=1$

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7. If $C=60^\circ$ then show that

$$\frac{b}{c^2-a^2}+\frac{a}{c^2-b^2}=0.$$

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8. In ΔABC if $a:b:c=7:8:9$, *then* $\cos A:\cos B:\cos C=$

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9. Show 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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10. Prove that $(b-a\cos C)\sin A=a\cos A\sin C$

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11. In ΔABC, $a\sin^2\frac{C}{2}+c\sin^2\frac{A}{2}$ in terms of s,a,b,c is

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12. If b +c =3a , then find the value of $\cot.\frac{B}{2}\cot.\frac{C}{2}$

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13. Show that $(b+c)\cos\left(\frac{B+C}{2}\right) = a\cos\left(\frac{B-C}{2}\right)$

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14. In ΔABC show $\frac{\beta^2 - \chi^2}{\alpha^2} = \sigma \ln u \frac{(B-X)}{(B+X)}$

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Textual Exercises Exercise 10 A Iii

1. Show that

$$\cot\frac{A}{2} + \cot\frac{B}{2} + \cot\frac{C}{2} = \frac{S^2}{\Delta}$$

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2. Prove that $\tan.\frac{A}{2}+\tan.\frac{B}{2}+\tan.\frac{C}{2}=\frac{bc+ca+ab-s^2}{\Delta}$

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3. $\frac{\cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}}{\cot A+\cot B+\cot C}=$

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4. In ΔABC, $\sum(a+b)\tan\left(\frac{A-B}{2}\right)=$

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5. $b-c/b+c\frac{\cot A}{2}+b+c/b-c\frac{\tan A}{2}=2\cos ec(B-C)$

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6. If $\sin\theta = \frac{a}{b+c}$ then show that $\cos\theta = \frac{2\sqrt{bc}}{b+c}\cos\left(\frac{A}{2}\right)$

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7. If $a = (b+c)\cos\theta, \quad$ then prove that $\sin\theta = \frac{2\sqrt{bc}}{b+c}\cos\left(\frac{A}{2}\right)$

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8. In ΔABC, $b\cos(C+\theta) + c\cos(B-\theta) =$

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9. If the angles of triangles ABC are in A.P. and b: c= $\sqrt{3}:\sqrt{2}$ then $\angle a =$

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10. If $\frac{a^2+b^2}{a^2-b^2}=\frac{\sin C}{\sin(A-B)}$, then S.T . ΔABC is either isoceles or right angled triangle .

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11. In ΔABC, if $\cos A+\cos B+\cos C=3/2$, then the triangle is

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12. If $\cos^2 A+\cos^2 B=\cos^2 C=1$ then show that ΔABC is right angled

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13. In a $\triangle ABC$ if $a^2 + b^2 + c^2 = 8R^2$ then show that $\triangle ABC$ is a right angled triangle.

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14. In ΔABC, if $\cot\frac{A}{2}, \cot\frac{B}{2}, \cot\frac{C}{2}$ are in A.P., then a,b,c are in

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15. If $\sin^2.\frac{A}{2} + \sin^2.\frac{B}{2} + \sin^2.\frac{C}{2}$ are in H.P , show that a , b, c are in H. P

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16. $C = 90^0$ అయితే, $(a^2 + b^2 / a^2 - b^2)\sin(A - B) = 1$ అని నిరూపించండి.

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17. $a^2 \sin 2C + c^2 \sin 2A =$

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18. A lamp post is sittuated at the middle point M of the side AC of a triangular plot ABC with BC=m CA =8 m and AB =9 m. Lamp post subleds an anlgle 15° at the point B. The height of the lamp post is

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19. Two ships leave a port at the same time . One goes 24km per hour in the direction $N45^\circ$ E and other travels 32km per hour in the direction $S75^\circ E$. Find the distance between the ships at the end of 3 hours

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20. A tree stands vertically on the slant of the hills From a point A on the ground 35 meters. Down the hill from the base of the tree , the angle of elevation of the top of the tree is 60°. If the angle of elevation of the foot of the tree A is 15°, then the height of the tree.

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21. The upper$3/4^{th}$ portion of a vertical pole subtends an angle $\tan^{-1}(3/5)$ at a point in the horizontal plane through its foot

and at a distance 40 m from the foot . Given that the vertical pole is at a height less than 100m from the gound ,find its height .

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22. AB is vertical pole with B at ground level and A at the top. A man finds that the angle of elevation of the point A from a certain point C on the ground is 60°. He moves away from the pole along the line BC to a point D such that CD =7 m. From D the angle of elevation of the point A is 45° then the hight of the pole is

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23. Let an object be placed at some height h cm and let P and Q two points of observation which are at a distance 10 cm a part on a line inclined at angle 15° to the horizontal. If the angles of

elevation of the object from P and Q are 30° and 60° respectively then find h.

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Textual Exercises Exercise 10 B I

1. Express $\sum r_1 \cot. \frac{A}{2}$ interms of s .

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2. In ΔABC Prove that

$a \cot A + b \cot B + c \cot C = 2(R + r)$

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3. Prove that

$r_1 + r_2 + r_3 - r = 4R$

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4. Prove that

$r + r_2 + r_1 - r_3 = 4R\cos C$

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5. If $r_1 + r_2 = r_3 - r$ then show that $\lfloor C = 90^\circ$

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Textual Exercises Exercise 10 B Ii

1. Prove that $4(r_1r_2 + r_2r_3 + r_3r_1) = (a + b + c)^2$

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2. Prove that $\left(\frac{1}{r} - \frac{1}{r_1}\right)\left(\frac{1}{r} - \frac{1}{r_2}\right)\left(\frac{1}{r} - \frac{1}{r_3}\right) = \frac{abc}{\Delta^3} = \frac{4R}{r^2s^2}$

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3. Show that $r(r_1 + r_2 + r_3) = ab + bc + ca - s^2$.

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4. $\frac{r_1}{(s-b)(s-c)} + \frac{r_2}{(s-c)(s-a)} + \frac{r_3}{(s-a)(s-b)} = \frac{3}{r}$

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5. $(r_1 + r_2)\tan\frac{c}{2} = (r_3 - r)\cot\frac{c}{2} = c$

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6. $r_1 r_2 r_3 = r^3 \cot^2\frac{A}{2}\cot^2\frac{B}{2}\cot^2\frac{C}{2}$

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Textual Exercises Exercise 10 B Iii

1. In ΔABC Prove that

$$\cos A + \cos B + \cos C = 1 + \frac{r}{R}$$

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2. In ΔABC prove that $\cos^2.\frac{A}{2}+\cos^2.\frac{B}{2}+\cos^2.\frac{C}{2}=2+\frac{r}{2R}$

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3. In ΔABC Prove that

$$\sin^2\frac{A}{2}+\sin^2\frac{B}{2}+\sin^2\frac{C}{2}=1-\frac{r}{2R}$$

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4. $(r_2+r_3)\sqrt{\frac{rr_1}{r_2r_3}}=a$

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5. In ΔABC, $r_1r_2\sqrt{\left[\frac{4R-r_1-r_2}{r_1+r_2}\right]}=$

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6. In ΔABC, $r_1^2 + r_2^2 + r_3^2 + r^2 =$

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7. If p_1, p_2, p_3 are the lengths of the altitudes from the vertices A,B,C of ΔABC to the opposite sides respectively then prove that $\frac{1}{p_1} + \frac{1}{p_2} + \frac{1}{p_3} = \frac{1}{r}$

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8. If p_1, p_2, p_3 are the lengths of the altitudes from the vertices A,B,C of ΔABC to the opposite sides respectively then prove that $\frac{1}{p_1} + \frac{1}{p_2} - \frac{1}{p_3} = \frac{1}{r_3}$

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9. If p_1, p_2, p_3 are the lengths of the altitudes from the vertices A,B,C of ΔABC to the opposite sides respectively then prove that $p_1 p_2 p_3 = \frac{(abc)^2}{8R^3} = \frac{8\Delta^3}{abc}$

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10. In a $\triangle ABC$ if $a = 13, b = 14, c = 15$ then S.T $R = \frac{65}{8}, r = 4, r_1 = \frac{21}{2}, r_2 = 12, r_3 = 14.$

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11. If $r_1 = 2, r_2 = 3, r_3 = 6$ and $r = 1,$ prove that a=3,b=4 and c=5.

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