MATHS

BOOKS - ARIHANT MATHS (ENGLISH)

PROPERTIES AND SOLUTION OF TRIANGLES

Examples

1. Find the angles of the triangle whose sides are $3+\sqrt{3}, 2\sqrt{3} \text{ and } \sqrt{6}$.

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2. 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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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. The sides of a triangle are three consecutive natural numbers and its largest angle is twice the smalles one. Determine the sides of the triangle.

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5. In the triangle ABC, lines OA, OB and OC are drawn so that angles OAB, OBC and OCA are each equal to ω, prove that $\cot\omega = \cot A + \cot B + \cot C$

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6. Solve

$b\cos^2\frac{C}{2}+c\cos^2\frac{B}{2}$ in terms of k, where k is permeter of the ΔABC.

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7. In a $\Delta ABC, c\cos^2\frac{A}{2}+a\cos^2\frac{C}{2}=\frac{3b}{2}$, then a, b, c are in

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8. In a $\Delta ABC, a=2b \text{ and } |A-B|=\frac{\pi}{3}$. Determine the $\angle C$.

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9. In a $\Delta ABC,$ the tangent of hald the difference of two angle is one-third the tangent of half the sum of the angle. Determine the ratio of the sides opposite to the angles.

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

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11. Consider the following statements concerning a ΔABC

(i) The sides a,b,c and area of triangle are rational.

(ii) $a, \tan\frac{B}{2}, \tan\frac{C}{2}$

(iii) $a, \sin A \sin B, \sin C$ are rational .

Prove that $(i) \Rightarrow (ii) \Rightarrow (iii) \Rightarrow (i)$

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12. Prove that $\frac{r_1 - r}{a} + \frac{r_2 - r}{b} = \frac{c}{r_3}$

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13. If in a triangle $r_1 = r_2 + r_3 + r$, prove that the triangle is right angled

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14. In any ΔABC, prove the following : $r_1 = r\cot\left(\frac{B}{2}\right)\cot\left(\frac{C}{2}\right)$

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15. In a right angles triangle, prove that $r + 2R = s$.

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16. The exradii r_1, r_2 and r_3 of $\triangle ABC$ are in H.P. Show that its sides $a, bandc$ are in $A\dot{P}$.

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17. Find the ratio of the circum-radius and the inradius of ΔABC, whose sides are in the ratio $4:5:6$.

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18. Find the ratio of $IA:IB:IC$, where I is the incentre of ΔABC.

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19. If the sides of a triangle are in GP and its largest angle is twice tha smallset then the common ratio r satisfies the inequality

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20. The equation $ax^2 + bx + c = 0$, where a,b,c are the side of a ΔABC, and the equation $x^2 + \sqrt{2}x + 1 = 0$ have a common root. Find measure for $\angle C$.

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21. In triangle ABC, if $\cot A, \cot B, \cot C$ are in $A\dot{P};$ then a^2, b^2, c^2 are in __________ progression.

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22. Find the Side of pedal triangle and Circum-Radius of pedal Triangle ?

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23. Find the ratio of the circum-radius and the inradius of ΔABC, whose sides are in the ratio $4:5:6$.

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24. In a triangle ABC I_1, I_2, I_3 are excentre of triangle then show that $II_1 . II_2 . II_3 = 16R^2 r$.

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25. Prove that the locus of a point that is equidistant from both axis is y=x.

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26. If g, h, k denotes the side of a pedal triangle, then prove that

$$\frac{g}{a^2} + \frac{h}{b^2} + \frac{k}{c^2} = \frac{a^2 + b^2 + c^2}{2abc}$$

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27. If x, y, z are respectively perpendiculars from the circumcentre on the sides of the ΔABC, the value of $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} - \frac{abc}{4xyz} =$

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28. If O, H and G represents circum centre, orthocentre and centroid respectively, then show

$HG : GO = 2 : 1.$ We have,

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29. In ΔABC it is given distance between the circumcentre (O) and orthocentre (H) is $R\sqrt{1 - 8\cos A \cos B \cos C}$. If Q is the midopoint of OH, then AQ is

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30. Find the distance between the circumcentre and the incentre of the ΔABC.

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32. If the area of the circle is A_1 and the area of the regular pentagon inscribed in the circle is A_2, then find the ratio $\frac{A_1}{A_2}$.

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33. The area of a cyclic quadrilateral ABCD is $\frac{\left(3\sqrt{3}\right)}{4}$. The radius of the circle circumscribing cyclic quadrilateral is 1. $IfAB = 1, BD = \sqrt{3}$, then find BC. CD.

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34. A regular pentagon and a regular decagon have the same perimeter, prove that their areas are as $2 : \sqrt{5}$.

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35. If the sides of a cyclic quadrilateral are 3,3,4,4, show that a circle be inscribed in it.

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36. The two adjacent sides of a cyclic quadrilateral are $2and5$ and the angle between them is 60^0. If the area of the quadrilateral is $4\sqrt{3}$, find the remaining two sides.

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37. If a,b,c,d are the side of a quadrilateral, then find the the minimuym value of $\frac{a^2+b^2+c^2}{d^2}$

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38. In any triangle ABC, the sides are 6 cm, 10 cm and 14 cm. Then the triangle is obtuse angled with the obtuse angle equal to

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39. If a, b and A are given in a triangle and c_1, c_2 are possible values of the third side, then prove that $c_1^2 + c_2^2 - 2c_1c_2 \cos 2A = 4a^2 \cos^2 A$

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41. Two hagstaffs stand on a horizontal plane. A and B are two points on the line joining their feet and between them. The angles of elevation of the tops of the flagstaffs as seen from A are 30° and60° and as seen from B are 60° and 45°. If AB is 30 m, then the distance between the flagstaffs is

A. $30+15\sqrt{3}$

B. $45+15\sqrt{3}$

C. $60-15\sqrt{3}$

D. $60+15\sqrt{3}$

Answer: A::C

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42. In a cubical hall $ABCDPQRS$ with each side $10m$, G is the centre of the walls $BCRQ$ and T is the midpoint of the side AB, the angle of elevation of G at the Point T is

A. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

B. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

C. $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$

D. $\cot^{-1}\left(\frac{1}{\sqrt{3}}\right)$

Answer: A::C

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43. Each side of an equilateral triangle subtends an angle of 60° at the top of a tower h m high located at the centre of the triangle. If a is the length of each side of the triangle, then

A. $3a^2 = 2h^2$

B. $2a^2 = 2h^2$

C. $a^2 = 3h^2$

D. $3a^2 = h^2$

Answer: A::B::C

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44. If $\frac{\tan^2(\pi - A)}{4} + \frac{\tan^2(\pi - B)}{4} + \frac{\tan^2(\pi - C)}{4} = 1$, then ABC is equilateral (b) isosceles (c) scalene (d) none of these

A. equilateral

B. isosceles

C. scalene

D. None of these

Answer: A::B::C

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45. In $\Delta ABC, a^2 + c^2 = 2002b^2$ then $\frac{\cot A + \cot C}{\cot B}$ is equal to

A. $\frac{1}{2001}$

B. $\frac{2}{2001}$

C. $\frac{3}{2001}$

D. $\frac{4}{2001}$

Answer: B

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46. In $\Delta ABC, \quad \text{if} \quad AC = 8, BC = 7$ and D lies between A and B such that $AD = 2, BD = 4,$ then the length CD equals

A. $\sqrt{46}$

B. $\sqrt{48}$

C. $\sqrt{51}$

D. $\sqrt{75}$

Answer: A

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47. In a triangle ABC, if $(a+b+c)(a+b-c)(b+c-a)(c+a-b)=\frac{8a^2b^2c^2}{a^2+b^2+c^2}$ then the triangle is

A. isosceles

B. right angled

C. equilateral

D. obtuse angled

Answer: A::B::C::D

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48. Consider a ΔABC and let a, b and c denote the lengths of the sides opposite to vertices A, B and C, repectively. if $a=1, b=3$ and $C=60^\circ$, then $\sin^2$ B is equal to

A. $\frac{27}{28}$

B. $\frac{3}{28}$

C. $\frac{81}{28}$

D. $\frac{1}{3}$

Answer: B

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49. In $\Delta ABC, \quad \text{if} \quad \cos A+\sin A-\frac{2}{\cos B+\sin B}=0$, then $\frac{a+b}{c}$ is equal to

A. $\sqrt{2}$

B. 1

C. $\frac{1}{\sqrt{2}}$

D. $2\sqrt{2}$

Answer: A

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50. In a triangle ABC, if $\angle A = 30^\circ, b = 10$ and $a = x$, then the values of x for which there are 2 possible triangles is given by(All symbols used have usual meaning in a triangle.)

A. (a)$5 < x < 10$

B. (b)$x < \frac{5}{2}$

C. (c)$\frac{5}{3} < x < 10$

D. (d)$\frac{5}{2} < x < 10$

Answer: A::B

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51. In a $\Delta ABC, AB = AC, P$ and Q are points on AC and AB respectively such that $CB = BP = PQ = QA$. if $\angle AQP = \theta$, then $\tan^2 \theta$ is a root of the equation

A. $y^3 + 21y^2 - 35y - 12 = 0$

B. $y^3 - 21y^2 + 35y - 12 = 0$

C. $y^3 - 21y^2 + 35y - 7 = 0$

D. $12y^3 - 35y^2 + 35y - 12 = 0$

Answer: A::B::C

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52. The angle of elevation of the top of a tower a point A due south of it is 30° and from a point B due west of it is 45° .If the height of the tower is 100 meters ,then find the distance AB.

A. 150 m

B. 200 m

C. 173.2 m

D. 141.4 m

Answer: A::B

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53. An aeroplane flying horizontally 1 km above the ground is observed at an elevation of $60o$. After 10 seconds, its elevation is observed to be $30o$. Find the speed of the aeroplane in km/hr.

A. 240

B. $240\sqrt{3}$

C. $60\sqrt{3}$

D. None of these

Answer: A::B::C::D

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54. In ΔABC, the ratio $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$ is not always equal to

(All symbols used have usual meaning in a triangle.)

A. 2R, where R is the circumradius

B. $\frac{abc}{2\Delta}$, where Δ is the area of the triangle

C. $\frac{2}{3}\left(a^2+b^2+c^2\right)^{\frac{1}{2}}$

D. $\frac{(abc)^{\frac{2}{3}}}{(h_1h_2h_3)^{\frac{1}{3}}}$

Answer: A::B::C::D

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55. Let ABCD be a cyclic quadrilateral such that $AB=2, BC=3, \angle B=120^\circ$ and area of quadrilateral $=4\sqrt{3}$. Which of the following is/are correct ?

A. The value of $(AC)^2$ is equal to 19

B. The sum of all positive value of product AC. BD I is equal to 35

C. The sum of all posible value of $(AD)^2$ is equal to 29

D. The value of $(CD)^2$ can be 4

Answer: B

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56. In a triangle ABC, which of the following quantities denote the area of the triangles $\frac{a^2 - b^2}{2} \frac{\sin A \sin B}{\sin(A - B)}$

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57. Consider the system of equations

$\sin x \cos 2y = (a^2 - 1)^2 + 1, \cos x \sin 2y = a + 1$

The number of values of $x \in [0, 2\pi]$, when the system has solution for permissible values of a, is/are

A. $\left(\frac{-\pi}{2}, \frac{-\pi}{2}\right)$

B. $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$

C. $\left(\frac{3\pi}{2}, \frac{-\pi}{2}\right)$

D. $\left(\frac{-\pi}{2}, \frac{3\pi}{2}\right)$

Answer: A::B::C::D

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58. In a triangle ABC, let $2a^2 + 4b^2 + c^2 = 2a(2b + c)$, then which of the following holds good?

A. $\cos B = \frac{-7}{8}$

B. $\sin(A - C) = 0$

C. $\frac{r}{r_1}=\frac{1}{5}$

D. $\sin A : \sin B : \sin C = 1 : 2 : 1$

Answer: A::B::C

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59. In AABC, angle A, B and C are in the ratio 1:2:3, then which of the following is (are) correct? (All symbol used have usual meaning in a triangle.)

A. Circum-radius of $\Delta ABC = c$

B. $a : b : c = 1 : \sqrt{3} : 2$

C. Permimeter of $\Delta ABC = 3 + \sqrt{3}$

D. Area of $\Delta ABC = \frac{\sqrt{3}}{8} c^2$

Answer: A::B::C

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60. If the length of tangents from A, B, C to the incircle of ΔABC are $4, 6, 8$ then which of the following is(are) correct? (All symbols used have usual meaning in a triangle.

A. Area of $\Delta ABC is 12\sqrt{6}$

B. r_1, r_2, r_3 are in HP

C. a,b,c are in AP

D. $r = \frac{4\sqrt{6}}{3}$

Answer: B

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61. In triangle ABC, let b = 10, c = $10\sqrt{2}$ and R = $5\sqrt{2}$ then which of the following are correct

A. Area of triangle ABC is 50.

B. Distance between orthocentre and circumcetre iss $5\sqrt{2}$.

C. Sum of circum-radius and in-radius of $\triangle ABC$ is equal to 10.

D. Length of internal angle bisector of $\angle ABC$ of ΔABC is $\frac{5}{2\sqrt{2}}$.

Answer: A::B::C

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62. Let 'l' is the length of median from the vertex A to the side BC of a ΔABC. Then

A. $4l^2 = 2b^2 + 2c^2 - a^2$

B. $4l^2 = b^2 + x^2 + 2bc\cos A$

C. $4l^2 = a^2 + 4bos A$

D. $4l^2 = (2s - a)^2 - 4bc\sin^2\frac{A}{2}$

Answer: A::B::C::D

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63. If a right angled ΔABC of maximum area is inscribed within a circle of radius R, then (δ representes area of ΔABC and r, r_1, r_2, r_3 represent in-radius and ex-radii, and s is the semi-perimeter of ΔABC, then

A. $\Delta = R^2$

B. $\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} = \frac{\sqrt{2}+1}{R}$

C. $r = (\sqrt{2} - 1)R$

D. $s = (1 + \sqrt{2})R$

Answer: A,B,C,D

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64. Statement I In a ΔABC, if $a < b < c$ and r is inradius and r_1, r_2, r_3 are the exradii opposite to angle A,B,C respectively, then $r < r_1 < r_2 < r_3$.

Statement II For, $\Delta ABC r_1 r_2 + r_2 r_3 + r_3 r_1 = \frac{r_1 r_2 r_3}{r}$

A. Statement I is True, Statement II is True, Statement II is a correct explanation for Statement I.

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: A::B::C::D

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65. Statement I If the sides of a triangle are 13, 14 15 then the radius of in circle =4

Statement II In $a\Delta ABC, \Delta=\sqrt{s(s-a)(s-b)(s-c)}$where $s=\frac{a+b+c}{2}$ and $r=\frac{\Delta}{s}$

A. Statement I is True, Statement II is True, Statement II is a correct explanation for Statement I.

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: A::B::D

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66. Statement I In $a\Delta ABC$, $\sum \frac{\cos^2 \frac{A}{2}}{a}$ has the value equal to $\frac{s^2}{abc}$.

Statement II in $a\Delta ABC$, $\cos \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}$

$\cos \frac{\beta}{2} = \sqrt{\frac{(s-a)(s-c)}{ac}}$, $\cos \frac{c}{2} = \sqrt{\frac{(s-a)(s-b)}{ab}}$

A. Statement I is True, Statement II is True, Statement II is a correct explanation for Statement I.

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: C

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67. If $side(a) = 4$ then area of the equilateral triangle ΔABC is equal to

A. a) $\frac{3\sqrt{2}}{2}$

B. b) 3

C. c) $4\sqrt{3}$

D. d) $3\sqrt{2}$

Answer: A::B::C::D

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68. In triangle ABC let tanA=1, tanB= 2, tanC=3 and c= 3, The radius of the circle circumscribing the triangle ABC, is equal to

A. $\frac{\sqrt{10}}{2}$

B. $\sqrt{5}$

C. $\sqrt{10}$

D. $\frac{\sqrt{5}}{2}$

A. $\frac{\sqrt{10}}{2}$

B. $\sqrt{5}$

C. $\sqrt{10}$

D. $\frac{\sqrt{5}}{2}$

Answer: A::B::C::D

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69. Let Δ denote the area of the ΔABC and Δp be the area of its pedal triangle. If $\Delta = k\Delta p$, then k is equal to

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70. If sinx=1, then x is equal to

A. $\frac{\pi}{9}$

B. $\frac{2\pi}{9}$

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

D. None of these

Answer: B

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71. If the sum of squares of two sides is equal to square of third side then ΔABC is

A. Equilateral

B. Isosceless

C. Scalene

D. Right angled

Answer: D

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72. Which of the following is true?

A. $Bc > AC$

B. $AC = AB$

C. $AC > AB$

D. $BC = AC$

Answer: A::C::D

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73. If l, m, n denote the side of a pedal triangle, then $\frac{l}{a^2} + \frac{m}{b^2} + \frac{n}{c^2}$ is equal to

A. (a) $\frac{a^2 + b^2 + c^2}{a^3 + b^3 + c^2}$

B. (b) $\frac{a^2 + b^2 + c^2}{2abc}$

C. (c) $\frac{a^3+b^3+c^3}{abc(a+b+c)}$

D. (d) $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}$

Answer: B

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74. If R be circum-radius of $a\Delta,$ then circum-radius of a pedal Δ is

A. R

B. $\frac{2R}{3}$

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

D. $\frac{R}{2}$

Answer: D

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75. The in-radius of pedal Δ of a ΔABC is

A. $\frac{R}{2}$

B. $R \sin A \sin B \sin C$

C. $2R \cos A \cos B \cos C$

D. $4R \sin \frac{A}{2} \sin \frac{b}{2} \sin \frac{C}{2}$

Answer: A::B::C::D

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76. In a triangle ABC, if $r_1 + r_3 + r = r_2$, then find the value of $\left(\sec^2 A + \csc^2 B - \cot^2 C\right)$,

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77. In ΔABC, let $b = 6, c = 10$ and $r_1 = r_2 + r_3 + r$ then find area of ΔABC.

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78. Consider on obtuse angle triangles with side 8 cm, 15 cm and $\times$ cm (largest side being 15 cm). If $\times$ is an integer, then find the number of possible triangels.

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79. letABC be a right angled triangle at C. If the inscribed circle touches the side ABat D and $(AD)(BD)=11,$ then find the area of triangle $ABC.$.

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80. Consider a ΔABC and let a,b, and c denote the leghts of the sides opposite to vertices A,B and C, respectively. Suppose $a=2, b=3, c=4$ and H be the orthocentre. Find $15(HA)^2$.

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81. In a triangle ABC, the internal angle bisector of $\angle ABC$ meets AC at K. If $BC=2, CK=1 \text{ and } BK=\frac{3\sqrt{2}}{2}$, then find the length of side AB.

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82. Triangle ABC has $AC=13, AB=15 \text{ and } BC=14$. Let $'O'$ be the circumcentre of the ΔABC. If the length of perpendicular from the point $'O'$ on BC can be expressed as a rational $\frac{m}{n}$ in the lowest form then find $(m+n)$.

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83. Two sides of a tariangle are given by the roots of the equation $x^2-2\sqrt{3}x+2=0$. The angle between the sides is $\frac{\pi}{3}$. Find the perimeter of Δ.

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84. If in $\Delta ABC, \angle A = 90^\circ$ and c, sin B cos B are rational numbers, then show a and b are rational .

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85. If the sides of a ΔABC are in AP and a is the smallest sie, then cos A equals

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86. If A, B and C are angles of a triangle such that $\angle A$ is obtuse, then show tan B $\tan C < 1$.

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87. If A is the area and $2s$ is the sum of the sides of a triangle, then $A \leq \frac{s^2}{4}$ (b) $A \leq \frac{s^2}{3\sqrt{3}}$ $2R \sin A \sin B \sin C$ (d) $noneofthese$

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88. In a triangle, if $r_1 > r_2 > r_3$, then show $a > b > c$.

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89. D is midpoint of BC in ΔABC such that AD and AC are perpendicular, Show that $\cos A \cos C = \frac{2(c^2 - a^2)}{3ac}$

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90. 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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91. If in a triangle of base 'a', the ratio of the other two sides is r (<1).Show that the altitude of the triangle is less than or equal to $\frac{ar}{1-r^2}$

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93. Prove m:n theorem in a ΔABC, a point D is taken on side BC such that BD:DC is m:n. Then prove that(1)$(m+n)\cot\theta = m\cot\alpha - n\cot\beta$ (2) $(m+n)\cot\theta = n\cot B - m\cot C$

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94. The base of a triangle is divided into three equal parts. If t_1, t_2, t_3 are the tangents of the angles subtended by these parts at the opposite vertex, prove that $\left(\frac{1}{t_1}+\frac{1}{t_2}\right)\left(\frac{1}{t_2}+\frac{1}{t_3}\right)=4\left(1+\frac{1}{t22}\right)$.

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95. Prove that the triangle ABC is equilateral if $\cot A+\cot B+\cot C=\sqrt{3}$

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96. 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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97. The sides of a triangle are in AP. If the angles A and C are the greatest and smallest angle respectively, then $4(1-\cos A)(1-\cos C)$ is equal to

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98. perpendiculars are drawn from the angles $A, BandC$ of an acute-angled triangle on the opposite sides, and produced to meet the circumscribing circle. If these produced parts are α, β, γ , respectively, then show that $\frac{a}{\alpha}+\frac{b}{\beta}+\frac{c}{\gamma}=2(\tan A+\tan B+tanC)$.

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99. If $a=\cos\theta+i\sin\theta,\ b=\cos\phi+i\sin\phi,\ c=\cos\psi+i\sin\psi$ and $\frac{a}{b}+\frac{b}{c}+\frac{c}{a}=2$ then $\sin(\theta-\phi)+\sin(\phi-\psi)+\sin(\psi-\theta)$ equals

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100. The product of the sines of the angles of a triangle is p and the product of their cosines is q. Show that the tangents of the angles are the roots of the equation $qx^3 - px^2 + (1+q)x - p = 0$.

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101. Given the base of a triangle, the opposite angle A, and the product k^2 of the other two sides, show that it is not possible for a to be less than $2k\frac{\sin A}{2}$

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102. 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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103. Let $1 < m < 3$. In a triangle ABC , if $2b = (m+1)$ a & $\cos A = \frac{1}{2}\sqrt{\frac{(m-1)(m+3)}{m}}$ prove that the are two values to the third side, one of which is m times the other.

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104. In any ΔABC, if D be any points of the base BC such that $\frac{BD}{DC} = \frac{m}{n}$ and $\angle ABD = \alpha, \angle DAC = \beta, \angle CDA = \theta$ and $AD = x$ then prove that

$(m+n)^2 . x = (m+n)\left(mb^2 + nc^2\right) - mna^2$

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105. ABCD is a trapezium such that $AB \mid \mid CDandCB$ is perpendicular to them. If $\angle ADB = \theta, BC = p, andCD = q$, show that $AB = \frac{\left(p^2 + q^2\right)\sin\theta}{p\cos\theta + q\sin\theta}$

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106. In a triangle ABC, prove that $\frac{\cot\left(\frac{A}{2}\right)+\cot\left(\frac{B}{2}\right)+\cot\left(\frac{C}{2}\right)}{\cot A+\cot B+\cot(C)}=\frac{(a+b+c)^2}{a^2+b^2+c^2}$

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107. If the sides of a triangle are in A.P., and its greatest angle exceeds the least angle by α, show that the sides are in the ratio $1+x:1:1-x$, , where $x=\sqrt{\frac{1-\cos\alpha}{7-\cos\alpha}}$

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108. In a ABC, if $\frac{\tan A}{2}, \frac{\tan B}{2}, \frac{\tan C}{2} are \in A\dot{P};$ then show that $\cos A, \cos B, \cos C$ are in $A\dot{P}\cdot$

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109. If a,b,c are in HP, then prove that $\sin^2\frac{A}{2}, \sin^2\frac{B}{2}, \sin^2\frac{C}{2}$ are also in HP.

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110. If r_1, r_2, r_3 are the ex-radii of ΔABC, then prove that

$$\frac{bc}{r_1}+\frac{ca}{r_2}+\frac{ab}{r_3}=2R\left[\left(\frac{a}{b}+\frac{b}{a}\right)+\left(\frac{b}{c}+\frac{c}{b}\right)+\left(\frac{c}{a}+\frac{a}{c}\right)-3\right]$$

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111. If r and R are radii of the incircle and circum-circle of ΔABC, then prove that :

$$8rR\{\cos^2 A/2+\cos^2 B/2+\cos^2 C/2\}$$

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

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112. Prove that

$$r_1^2 + r_2^2 + r_3^3 + r^2 = 16R^2 - a^2 - b^2 - c^2.$$

where r= in radius, R = circumradius,, r_1, r_2, r_3 are ex-radii.

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113. 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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114. In a cyclic quadrilateral ABCD, prove that $\tan^2 \frac{B}{2} = \frac{(s-a)(s-b)}{(s-c)(s-d)}, a, b, c,$ and d being the lengths of sides ABC, CD and DA respectively and s is semi-perimeter of quadrilateral.

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115. If x,y,z are perpendicular from circum centre of the sides of the ΔABC respectively. Prove that $\frac{a}{z}+\frac{b}{y}+\frac{c}{z}=\frac{abc}{4xyz}$

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116. The circle inscribed in the triangle ABC touches the side BC, CA and AB in the point A_1B_1 and C_1 respectively. Similarly the circle inscribed in the $\Delta A_1B_1C_1$ touches the sieds in A_2, B_2, C_2 respectively and so on. If $A_nB_nC_n$ be the nth Δ so formed, prove that its angle are

$\frac{\pi}{3}-(2)^{-n}\left(A-\frac{\pi}{3}\right), \frac{\pi}{3}-(2)^{-n}\left(B-\frac{\pi}{3}\right), \frac{\pi}{3}-(2)^{-n}\left(C-\frac{\pi}{3}\right).$

Hence prove that the triangle so formed is ultimately equilateral.

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117. In a $\Delta ABC,$ prove that:

$$2r \leq \frac{a\cot A+b\cot B+c\cot C}{3} \leq R$$

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118. If Δ is the area of a triangle with side lengths a, b, and c, then show that $\Delta \leq \frac{1}{2}\sqrt{(a+b+c)abc}$. Also show that equality occurs in the above inequality if and only if $a = b = c$

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SOLVED EXAMPLES

1. Match the statements of Column I with valuwe of Column II.

Column I	Column II
(A) In a triangle ABC if $a^4 - 2(b^2 + c^2)a^2 + b^2 + b^2c^2 + c^4 = 0$, then $\angle A$	p. 30°
(B) In a triangle ABC, If $a^4 + b^4 + c^4 = a^2b^2 + 2b^2c^2 + 2c^2a^2$, then $\angle C$ is	q. 60°
(C) In a triangle ABC, If $a^4 + b^4 + c^4 + 2a^2c^2 = 2a^2b^2 + 2b^2c^2$, then $\angle B$ is	r. 90°
	s. 120°
	t. 150°

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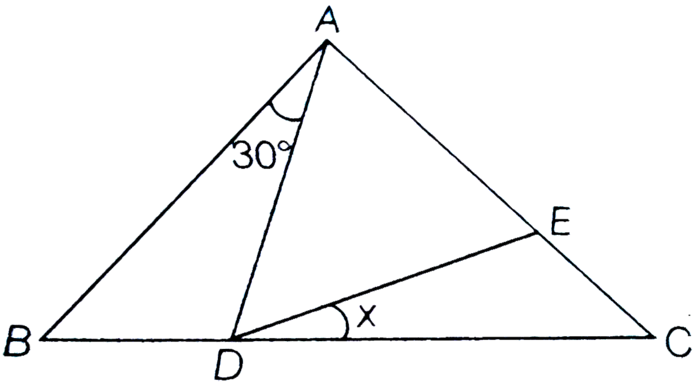
Exercise For Sesssion 1

1. In the given figure,if $AB = AC, \angle BAD = 30^\circ$ and $AE = AD,$ then x is equal to



A. 15°

B. 10°

C. $12\frac{1}{2}$

D. $7\frac{1}{2}$

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2. In $\Delta ABC, a = 4, b = 12 \text{ and } B = 60^\circ$, thn the vlaue of sin A is

A. $\frac{1}{2\sqrt{3}}$

B. $\frac{1}{3\sqrt{2}}$

C. $\frac{2}{\sqrt{3}}$

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

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3. Let ABC be a triangle such that $\angle A = 45^\circ, \angle B = 75^\circ$, then $a + c\sqrt{2}$ is equal to

A. (a) 0

B. (b) b

C. (c) 2b

D. (d) $-b$

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4. If the angles A, B, C of ΔABC are in A.P. and $b : c = \sqrt{3} : \sqrt{2}$, show that $A = 75^\circ$.

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

B. $\frac{\pi}{4}$

C. $\frac{5\pi}{12}$

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

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5. If $\cot\frac{A}{2} = \frac{b+c}{a}$, then ΔABC is

A. (a) Isosceles

B. (b) Equilateral

C. (c) Right angled

D. (d) None of these

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6. 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.

A. Right angled or isosceles

B. Right angled and isosceles

C. Equiliateral

D. None of these

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7. In any triangle ABC, prove that:
$$\frac{a^2\sin(B-C)}{\sin B+s\in C}+\frac{b^2\sin(C-A)}{\sin C+s\in A}+\frac{c^2\sin(A-B)}{\sin A+s\in B}=0$$

A. $a+b+c$

B. $a+b-c$

C. $a-b+c$

D. 0

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8. In any ΔABC, is $2\cos B=\frac{a}{c}$, then the triangle is

A. right angled

B. equilateral

C. isosceles

D. None of these

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9. Prove that $\frac{(a+b+c)(b+c-a)(c+a-b)(a+b-c)}{4b^2c^2}=\sin^2$

A. $\cos^2 A$

B. $\sin^2 A$

C. $\cos A \cos B \cos C$

D. None of these

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10. If a $\cos A = b \cos B,$ then the triangle is

A. Isosceles

B. Right angled

C. Isosceles or right angled

D. Right angled isosceles

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11. In $\Delta ABC, (a+b+c)(b+c-a)=kbc$ if

A. $lamd<0$

B. $\lambda>0$

C. $0<\lambda<4$

D. $\lambda<4$

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12. If : $a=9, b=8 \text{ and } c=x$ satisfies 3 cos C = 2, then : x =

A. $x = 5$

B. $x = 6$

C. $x = 4$

D. $x = 7$

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13. In $\Delta ABC, \quad \text{if} \quad \sin^2 A + \sin^2 B = \sin^2 C$, then the triangle is

A. equilateral

B. isosceles

C. right angled

D. None of these

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14. The lengths of the sides of a triangle are $\alpha-\beta, \alpha+\beta$ and $\sqrt{3\alpha^2+\beta^2}, (\alpha>\beta>0)$. Its largest angle is

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

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

C. $\frac{3\pi}{4}$

D. $\frac{5\pi}{6}$

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15. In any triangle ABC, prove that: $\frac{1+\cos(A-B)\cos C}{1+\cos(A-C)\cos B}=\frac{a^2+b^2}{a^2+c^2}$

A. $\frac{a^2+b^2}{a^2+c^2}$

B. $\frac{b^2+c^2}{b^2-c^2}$

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

D. None of these

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16. If the sides of a triangle ABC are in AP and 'a' is the smallest side, then express cos A in term of b and c.

A. $\frac{3c-4b}{2c}$

B. $\frac{3c-4b}{2b}$

C. $\frac{4c-3b}{2c}$

D. None of these

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17. In a $\Delta ABC, a^2\cos 2B+b^2\cos 2A+2ab\cos(A-B)=$

A. (a)a^2

B. (b)c^2

C. (c)b^2

D. (d)$a^2 + b^2$

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18. In any ΔABC, $2[bc \cos A + ca \cos B + ab \cos C] =$

A. $a^2 + b^2 + c^2$

B. $a^2 + b^2 - c^2$

C. $a^2 - b^2 + c^2$

D. $a^2 - b^2 + c^2$

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19. In a ΔABC, $\tan\frac{1}{2}(A+B).\cot\frac{1}{2}(A-B)$ is equal to

A. $\frac{a-b}{a+b}$

B. $\frac{a+b}{c}$

C. $\frac{a+b}{a-b}$

D. $\frac{a-b}{2(a+b)}$

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20. If in a ΔABC, $b=\sqrt{3}$, $c=1$ and $B-C=90^\circ$, then $\angle A$ is

A. 30°

B. 45°

C. 75°

D. 15°

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Exercise For Sesssion 2

1. If in a triangle $ABC, (s-a)(s-b)=s(s-c),$ then angle C is equal to

A. 90°

B. 45°

C. 30°

D. 60°

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2. 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 (A) A.P, (b)G.P., (c)H.P., (d)NONE OF THESE

A. AP

B. GP

C. HP

D. None of these

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3. In any ΔABC, $\dfrac{\tan\frac{A}{2} - \tan\frac{B}{2}}{\tan\frac{A}{2} + \tan\frac{B}{2}}$ is equal to:

A. (a) $\dfrac{a-b}{a+b}$

B. (b) $\dfrac{a-b}{c}$

C. (c) $\dfrac{a-b}{a+b+c}$

D. (d) $\dfrac{c}{a+b}$

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4. Prove that $bc\cos^2.\ \frac{A}{2} + ca\cos^2.\ \frac{B}{2} + ab\cos^2.\ \frac{C}{2} = s^2$

A. $(s-a)^2$

B. $(s-b)^2$

C. $(s-c)^2$

D. s^2

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5. In a $\Delta ABC, \quad \text{if} \quad \cos A + \cos C = 4\sin^2\left(\frac{B}{2}\right),$ then a,b,c are in

A. AP

B. GP

C. HP

D. None of these

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6. In a $\triangle ABC$, if $b^2 + c^2 = 3a^2$, then $\cot B + \cot C - \cot A$ is equal to

A. 1

B. $\sqrt{3}$

C. 2

D. None of these

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7. In any ΔABC, $\left(\frac{b-c}{a}\right)\cos^2\left(\frac{A}{2}\right) + \left(\frac{c-a}{b}\right)\cos^2\left(\frac{b}{2}\right) + \left(\frac{a-b}{2}\right)\cos^2\left(\frac{C}{2}\right)$ is equal

A. $\frac{b^2 - c^2}{a^2}$

B. $\frac{c^2 - a^2}{b^2}$

C. $\frac{a^2 - b^2}{c^2}$

D. 0

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8. In a ΔABC, the tangent of hald the difference of two angle is one-third the tangent of half the sum of the angle. Determine the ratio of the sides opposite to the angles.

A. $2:3$

B. $1:3$

C. $2:1$

D. $3:4$

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9. If in a triangle $a\cos^2.\frac{C}{2}+c\cos^2.\frac{A}{2}=\frac{3b}{2}$, then find the relation between the sides of the triangles

A. AP

B. GP

C. HP

D. AGP

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10. In the adjacent figure 'P' is any interior point of the equilateral triangle ABC is side length 2 unit . If x_a, x_b and x_c represent the distance of P from the sides BC, CA and AB respectively then $x_a+x_b+x_c$ is equal to

A. 6

B. $\sqrt{3}$

C. $\frac{\sqrt{3}}{2}$

D. $2\sqrt{3}$

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11. If $c^2 = a^2 + b^2$, then prove that $4s(s-a)(s-b)(s-c) = a^2b^2$

A. s^4

B. b^2c^2

C. c^2a^2

D. a^2b^2

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12. The number of possible $\angle ABC$ in which $BC = \sqrt{11}cm, CA = \sqrt{13}cm$ and $A = 60^\circ$ is

A. 0

B. 1

C. 2

D. None of these

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13. If two sides a, b and the $\angle A$ be such that the sum of two values of the third side is

A. $b^2 - a^2$

B. $2b \cos A$

C. $2b \sin A$

D. $\dfrac{b-c}{b+c}$

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14. If in a $\Delta ABC, \sin A = \sin^2 B$ and $2\cos^2 A = 3\cos^2 B,$ then the ΔABC is

A. right angled

B. obtuse angled

C. isosceles

D. equilateral

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15. If a $\cos A = b\cos B,$ then the triange is

A. (a)equliateral

B. (b)right angled

C. (c)isosceles

D. (d)isosceles or right angled

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16. Point D,E are taken on the side BC of an acute angled triangle ABC,, such that $BD = DE = EC$. If $\angle BAD = x, \angle DAE = y$ and $\angle EAC = z$ then the value of $\frac{\sin(x+y)\sin(y+z)}{\sin x \sin z}$ is ______

A. 1

B. 2

C. 4

D. None of these

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17. If the base angles of triangle are $22\frac{1}{2} and 112\frac{1}{2}$, then prove that the altitude of the triangle is equal to $\frac{1}{2}$ of its base.

A. half the base

B. the base

C. twice the base

D. four times the base

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18. In a $\Delta ABC, a = 1$ and the perrimeter is six times the AM of the since of the angles.The measure of $\angle A$ is

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

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

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

D. $\frac{\pi}{4}$

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

A. 1

B. 3

C. 0

D. $\frac{1}{2}$

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20. The product of the sines of the angles of a triangle is p and the product of their cosines is q. Show that the tangents of the angles are

the roots of the equation $qx^3 - px^2 + (1+q)x - p = 0$.

A. $qx^2 - px^2 + (1+q)x - p = 0$

B. $px^3 - qz^2 + (1-p)x - q = 0$

C. $(1+q)x^3 - px^2 + qx - p = 0$

D. None of these

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Exercise For Sesssion 3

1. The side of a triangle are 22 cm, 28 cm, and 36 cm So, find the area of a the circumscribed circle.

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2. If the lengths of the side of a triangle are 3,4 and 5 units, then find the circum radius R.

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3. In an equliateral triangle of side $2\sqrt{3}$ cm. The find circum-radius.

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4. If $8R^2 = a^2 + b^2 + c^2$. then prove that the Δ is right angled.

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5. In a ΔABC, show that $2R^2 \sin A \sin B \sin C = \Delta$.

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6. In a ΔABC, show that $\dfrac{a\cos A+b\cos B+c\cos C}{a+b+c}=\dfrac{r}{R}$

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7. If the sides of a triangle are in the ratio $3:7:8$, then find $R:r$

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8. In an equilateral triangle show that the in-radius and the circum-radius are connected by $r=\dfrac{R}{2}$.

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9. In any ΔABC, find $\sin A+\sin B+\sin C$.

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10. In any ΔABC, show that $\cos A + \cos B + \cos C = \left(1 + \frac{r}{R}\right)$.

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11. Prove that $\frac{r_1 - r}{a} + \frac{r_2 - r}{b} = \frac{c}{r_3}$

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12. Prove that $r_1 r_2 + r_2 r_3 + r_3 r_1 = \frac{1}{4}(a + b + c)^2$

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13. Show that $(r_1 + r_2)(r_2 + r_3)(r_3 + r_1) = 4Rs^2$

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14. If $r_1 + r_2 + r = r_3$, then show that Δ is right angled.

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15. In an equilateral triangle, the inradius, circumradius, and one of the exradii are in the ratio

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16. Show that $\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\left(\frac{1}{r_2}+\frac{1}{r_3}\right)\left(\frac{1}{r_3}+\frac{1}{r_1}\right)=\frac{64R^3}{a^2b^2c^2}$

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17. The exradii $r_1, r_2, \text{ and } r_3$ of ΔABC are in H.P. show that its sides a, b, and c are in A.P.

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18. In a $\Delta ABC,$ show that $r_1 \cdot r_2 \cdot r_3 \cdot r = \Delta^2.$

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19. If l_1, l_2, l_3 are respectively the perpendicular from the vertices of a triangle on the opposite side, then show that $l_1 l_2 l_3 = \frac{a^2 b^2 c^2}{8R^3}$.

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20. If the angle opf a triangle are in the ratio $1:2:3,$ then show that the sides opposite to the respective angle are in the ratio $1:\sqrt{3}:2$.

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21. Show that, $4Rr \cos\frac{A}{2} \cos\frac{B}{2} \cos\frac{C}{2} = \Delta$

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22. If in $\Delta ABC, (a-b)(s-c)=(b-c)(s-a)$, prove that r_1, r_2, r_3 are in A.P.

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23. In a triangle ABC,if $\frac{1}{r_1^2}+\frac{1}{r_2^2}+\frac{1}{r_3^2}+\frac{1}{r^2}=$

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24. Prove that $(r_1-r)(r_2-r)(r_3-r)=4Rr^2$

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25. Show that $\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\left(\frac{1}{r_2}+\frac{1}{r_3}\right)\left(\frac{1}{r_3}+\frac{1}{r_1}\right)=\frac{64R^3}{a^2b^2c^2}$

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26. Prove that (r+r1)tan((B-C)/2)+(r+r2)tan((C-A)/2)+(r+r3)tan((A-B)/2)=0

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27. Show that $\frac{b-c}{r_1}+\frac{c-a}{r_2}+\frac{a-b}{r_3}=0$

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28. If the sides be a,b,c, than find $(r_1-r)(r_2+r_3)$.

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29. If a, b, c are in AP, then show that r_1, r_2, r_3 are in HP.

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30. In ΔABC with usual notation $\frac{r_1}{bc}+\frac{r_2}{ca}+\frac{r_3}{ab}$ is

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31. Show that $r_1 + r_2 = c\cot\left(\frac{C}{2}\right)$

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32. Show that $Rr(\sin A + \sin B + \sin C) = \Delta$

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33. Show that $16R^2 r r_1 r_2 r_3 = a^2 b^2 c^2$

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34. If in a triangle $\frac{r}{r_1} = \frac{r_2}{r_3}$, then

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Exercise For Sesssion 4

1. H is orthocenter of the triangle ABC, then AH is equal to :

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2. A circle touches two of the smaller sides of a $\Delta ABC(a < b < c)$ and has its centre on the greater side. Then, find the radius of the circle.

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

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4. If the altitudes of a triangle be 2,4,6, then find its in-radius.

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5. In a ΔABC, if $a=3, b=4, c=5$, then find the distance between its incentre and circumcentre.

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6. If the lengths of the perpendiculars from the vertices of a triangle ABC on the opposite sides are p_1, p_2, p_3 then prove that $\frac{1}{p_1}+\frac{1}{p_2}+\frac{1}{p_3}=\frac{1}{r}=\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}$.

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7. Prove that the distance between the circumcenter and the incenter of triangle ABC is $\sqrt{R^2-2Rr}$

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8. In ΔABC it is given distance between the circumcentre (O) and orthocentre (H) is $R\sqrt{1-8\cos A\cos B\cos C}$. If Q is the midopoint of OH, then AQ is

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9. In a triangle ABC, AD, BE and CF are the altitudes and R is the circum radius, then the radius of the circel DEF is

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10. If l, l_1, l_2 and l_3 be respectively the radii of the in-circle and the three escribed circles of a $\Delta ABC,$ then find $l_1 l_2 l_3 - l(l_1 l_2 + l_2 l_3 + l_1 l_3)$.

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Exercise For Sesssion 5

1. Find the sum of the radii of the circles, which are respectively inscribed and circumscribed about the a regular polygon of n sides.

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2. Find the radius of the circumscribing circle of a regular polygon of n sides each of length is a.

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3. If A, A_1, A_2, A_3 are the areas of the inscribed and escribed of a ΔABC, then

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4. A polygon of nine sides, each side of length 2, is inscribed in a circle. The radius of the circle is __________.

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5. The area of the circle and the area of a regular polygon of n sides and the perimeter of polygon equal to that of the circle are in the ratio of $\tan\left(\frac{\pi}{n}\right):\frac{\pi}{n}$ (b) $\cos\left(\frac{\pi}{n}\right):\frac{\pi}{n}$ $\frac{\sin\pi}{n}:\frac{\pi}{n}$ (d) $\cot\left(\frac{\pi}{n}\right):\frac{\pi}{n}$

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6. Let $A_1, A_2, A_3, \ldots, A_n$ be the vertices of an n-sided regular polygon such that $\frac{1}{A_1A_2}=\frac{1}{A_1A_3}+\frac{1}{A_1A_4}$. Find the value of n.

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7. If I_n is the area of $n-sided$ regular polygon inscribed in a circle of unit radius and O_n be the area of the polygon circumscribing the given circle, prove that $I_n=\frac{O_n}{2}\left(\sqrt{1+\left(\frac{2I_n}{n}\right)^2}\right)$

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Exercise For Sesssion 6

1. The area of a cyclic quadrilateral ABCD is $\frac{3\sqrt{3}}{4}$. The radius of the circle circumscribing cyclic quadrilateral is 1.If $AB = 1$ and $BD = \sqrt{3}$, then $BC \cdot CD$ is equal to

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2. If two adjacent sides of a cyclic quadrilateral aré 2 and 5 and the angle between them is 60°. If the third side is 3, then the remaining fourth side is (a) 2 (b) 3 (c) 4 (d) 5

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3. The ratio of the area of a regular polygon of n sides inscribed in a circle to that of the polygon of same number of sides circumscribing the same is $3 : 4$. Then the value of n is

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4. If A,B,C,D are the angles of quadrilateral, then find $\frac{\sum \tan A}{\sum \cot A}$.

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Exercise For Sesssion 7

1. In triangle $ABC, a:b:c = (1+x):1:(1-x)$ where $x \in (0,1)$ If $\angle A = \frac{\pi}{2} + \angle C$, then x equal to

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2. In a $\Delta ABC, 2s =$ perimeter and R = circumradius. Then, find $\frac{s}{R}$.

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3. If in a $\Delta ABC, \angle C = 90^\circ$, then the maximum value of $\sin A \sin B$ is

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4. If the area os a triangle is 81 square cm and its perimeter is 27 cm, then find its in-radius in centi-metres.

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5. In triangle ABC, if $r_1 = 2r_2 = 3r_3$, then $a : b$ is equal to

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6. The radius of the larger circle lying in the first quadrant and touching the line $4x + 3y - 12 = 0$ and the coordinate axes, is

A. (a) 5

B. (b) 6

C. (c) 7

D. (d) 8

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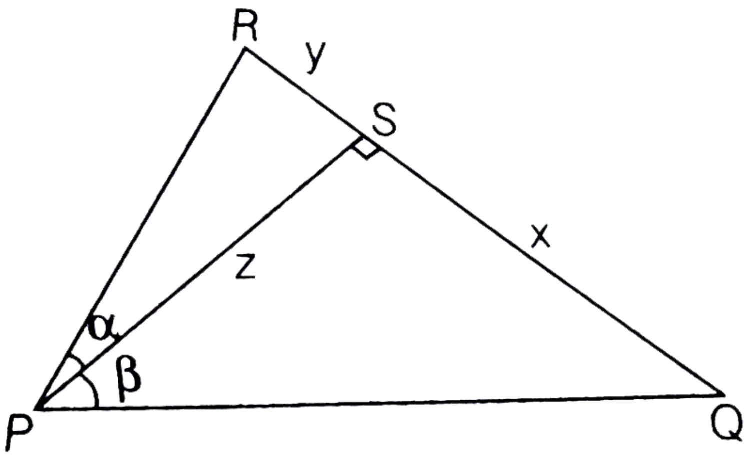
7. In a ΔPQR as show in figure given that $x : y : z : : 2 : 3 : 6,$ then find value of $\angle QPR$.



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8. In a ΔABC if $\frac{R}{r} \leq 2$, then show that the triangle is equilateral.

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9. If the angle of a righta angled triangle are in A.P. then the ratio of the in -radius and the perimeter, is

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10. If in a triangle $\left(1-\frac{r_1}{r_2}\right)\left(1-\frac{r_1}{r_3}\right)=2$ then the triangle is right angled (b) isosceles equilateral (d) none of these

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Exercise For Sesssion 8

1. If a tower subtends angles $\theta, 2\theta$ and 3θ at three points A,B,and C respectively, lying on the same side of a horizontal line through the foot of the tower, show that $\frac{AB}{BC}\frac{\cot\theta-\cot2\theta}{\cot2\theta-\cot3\theta}$.

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2. A person stands at a point A due south of a tower of height h and observes that its elevation is 60°. He then walks westwards towards B, where the elevation is 45°. At a point C on AB produced, show that if he find it to be 30°. OA, OB, OC are in GP.

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3. A train travelling on one of two intersecting railway lines, subtends at a certain station on the other line, an/ angle α when the front of the carriage reaches the junction and an angle β when the end of the carriage reaches it. Then, the two lines are inclined to each other at an angle θ, show that $2\cot\theta = \cot\alpha - \cot\beta \cot\alpha + \cot\beta$

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4. The angle of elevation of the top of the tower observed from each of three points A,B , C on the ground, forming a triangle is the same angle $\alpha.$ If R is the circum-radius of the triangle ABC, then find the height of the tower

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5. The length of the shadow of a pole inclined at 10° to the vertical towards the sun is 2.05 metres, when the elevation of the sun is 38°. The length of the pole is

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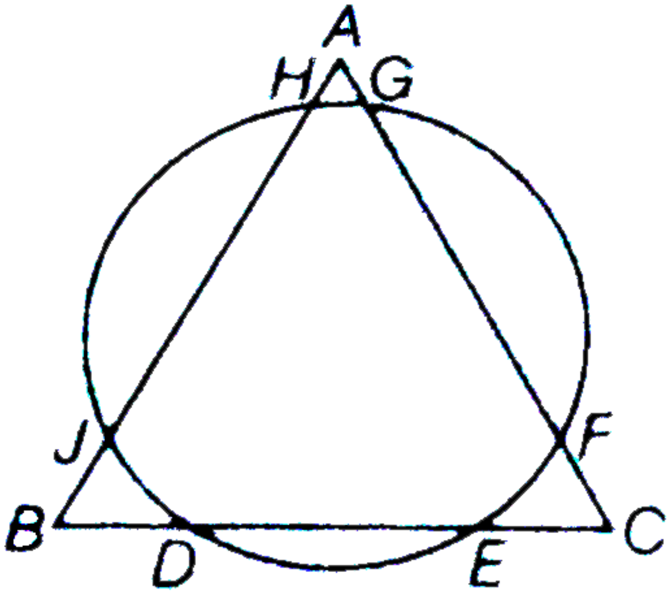
PROPERTIES AND SOLUTIONS OF TRIANGLES EXERSISE 1: SINGLE OPTION CORRECT TYPE QUESTIONS

1. In the adjoining figure, the circle meets the sides of an equilateral triangle at six points.



If $AG = 2, GF = 13, FC = 1$ and $HJ = 7,$ then DE equals to

A. $2\sqrt{22}$

B. $7\sqrt{3}$

C. 9

D. 10

Answer: A

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Exercise (Single Option Correct Type Questions)

1. In a ΔABC, if $a = 13, b = 14$ and $c = 15$, then $\angle A$ is equal to (All symbols used have their usual meaning in a triangle.)

A. $\sin^{-1}\frac{4}{5}$

B. $\sin^{-1}\frac{3}{5}$

C. $\sin^{-1}\frac{3}{4}$

D. $\sin^{-1}\frac{2}{3}$

Answer: A

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2. In a ΔABC, if $b = (\sqrt{3} - 1)a$ and $\angle C = 30^\circ$, then the value of (A-B) is equal to (All symbols used have usual meaning in the triangel.)

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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3. In $a\Delta ABC,$ if $\angle C = 105^{\circ}, \angle B = 45^{\circ}$ and length of side AC =2 units, then the length of th side AB is equal to

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $\sqrt{2}+1$

D. $\sqrt{3}+1$

Answer: C

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4. If P is a point on the altitude AD of the triangle ABC such the $\angle CBP = \frac{B}{3}$, then AP is equal to $2a\frac{\sin C}{3}$ (b) $2b\frac{\sin C}{3}$ (c) $2c\frac{\sin B}{3}$ (d) $2c\frac{\sin C}{3}$

A. $2a\sin\frac{C}{3}$

B. $2b\sin\frac{A}{3}$

C. $2c\sin\frac{B}{3}$

D. $2c\sin\frac{C}{3}$

Answer: C

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5. In ΔABC, if $2b = a + c$ and $A - C = 90^\circ$, then sin B equal

All symbols used have usual meaning in ΔABC.]

A. $\frac{\sqrt{7}}{5}$

B. $\frac{\sqrt{5}}{8}$

C. $\frac{\sqrt{7}}{4}$

D. $\frac{\sqrt{5}}{3}$

Answer: C

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6. Let ABC be a right triangle with length of side $AB = 3$ and hyotenus $AC = 5$. If D is a point on BC such that $\frac{BD}{DC} = \frac{AB}{AC}$, then AD is equal to

A. $\frac{4\sqrt{3}}{3}$

B. $\frac{3\sqrt{5}}{2}$

C. $\frac{4\sqrt{5}}{3}$

D. $\frac{5\sqrt{3}}{4}$

Answer: B

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7. Two medians drawn from the acute angles of a right angled triangle intersect at an angle $\frac{\pi}{6}$. If the length of the hypotenuse of the triangle is $3 units,$ then the area of the triangle (in sq. units) is $\sqrt{3}$ (b) 3 (c) $\sqrt{2}$ (d) 9

A. 3

B. $\frac{3\sqrt{5}}{2}$

C. $\sqrt{3}$

D. None of these

Answer: C

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8. If in a right angle $\Delta ABC, 4 \sin A \cos B - 1 = 0$ and tan A is finite, then

A. angles are in AP

B. angles are in GP

C. angles are in HP

D. None of these

Answer: A

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9. Let $A = \begin{bmatrix} a & b & c \\ p & q & r \\ 1 & 1 & 1 \end{bmatrix}$ and $B = A^2$

If

$(a-b)^2 + (p-q)^2 = 25, (b-c)^2 + (q-r)^2 = 36$ and $(c-a)^2 + (r-p$

then det B is

A. 192

B. 864

C. 2456

D. $25 \times 36 \times 47$

Answer: B

Watch Video Solution

10. If in a ΔABC, the incricle passing through the point of intersection of perpendicular bisector of sides BC, AB, then $4 \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}$ equal to

A. $\sqrt{2}$

B. $\sqrt{2}-1$

C. $\sqrt{2}+1$

D. $\frac{1}{2}$

Answer: B

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11. If two sides of a triangle are roots of the equation $x^2 - 7x + 8 = 0$ and the angle between these sides is 60^0 then the product of inradius and circumradius of the triangle is $\frac{8}{7}$ (b) $\frac{5}{3}$ (c) $\frac{5\sqrt{2}}{3}$ (d) 8

A. $\frac{8}{7}$

B. $\frac{5}{3}$

C. $\frac{5\sqrt{3}}{3}$

D. 8

Answer: B

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12. If median AD of a triangle ABC makes angle $\frac{\pi}{6}$ with side BC, then the valur of $(\cot B - \cot C)^2$ is equal to

A. 6

B. 9

C. 12

D. 15

Answer: C

Watch Video Solution

13. If the perimeter of the triangle formed by feet of altitudes of the triangle ABC is equal to four times the circumradius of ΔABC, then identify the type of ΔABC

A. isosceles triangle

B. equilateral triangle

C. right angled triangle

D. None of these

Answer: D

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14. In a triangle with one angle $\frac{2\pi}{3}$, the lengths of the sides form an A.P. If the length of the greatest side is 7 cm, the radius of the circumcircle of the triangle is

A. $\frac{7\sqrt{3}}{3}cm$

B. $\frac{5\sqrt{3}}{3}cm$

C. $\frac{2\sqrt{3}}{3}cm$

D. $\sqrt{3}cm$

Answer: A

Watch Video Solution

15. If the sides of a triangle ABC are in AP and 'a' is the smallest side, then express cos A in term of b and c.

A. $\frac{3c-4b}{2b}$

B. $\frac{3c-4b}{2c}$

C. $\frac{4c-3b}{2b}$

D. $\frac{4c-3b}{2c}$

Answer: D

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16. The product of the sines of the angles of a triangle is p and the product of their cosines is q. Show that the tangents of the angles are the roots of the equation $qx^3 - px^2 + (1+q)x - p = 0$.

A. $qx^2 - px^2 + (1-x)x - p = 0$

B. $qx^3 - px^2 - (1-q)x - p = 0$

C. $qx^3 - px^2 + (1+q)x - p = 0$

D. None of these

Answer: A

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17. Let C be incircle of ΔABC. If the tangents of lengths t_1, t_2 and t_3 are drawn inside the given triangle parallel to side a,b, and c, respectively, then $\frac{t_1}{a} + \frac{t_2}{b} + \frac{t_3}{c}$ is equal to

A. 0

B. 1

C. 2

D. 3

Answer: B

Watch Video Solution

18. If the sine of the angles of ΔABC satisfy the equation $c^3x^3 - c^2(a+b+c)x^2 + lx + m = 0$

(where a,b,c are the sides of ΔABC), then ΔABC is

A. A. always right angled for any l, m

B. B. right angled only when

$l = c(ab + bc + ca) = c\sum ab, m = -abc$

C. C. right angled only when $l = \frac{c\sum ab}{4}, m = -\frac{abc}{8}$

D. D. never right angled

Answer: B

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19. In triangle ABC, medians AD and CE are drawn $AD = 5, \angle DAC = \pi/8,$ and $\angle ACE = \pi/4,$ then the area of the triangle ABC is equal to

A. $\frac{50}{9}$

B. $\frac{25}{9}$

C. $\frac{25}{3}$

D. $\frac{27}{7}$

Answer: C

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20. In a triangle $ABC, a \geq b \geq c.$ If $\dfrac{a^3+b^3+c^3}{\sin^3 A+\sin^3 B+\sin^3 C}=8,$ then the maximum value of a $\sin^3 A+\sin^3 B+\sin^3 C$

A. $\dfrac{1}{2}$

B. 2

C. 8

D. 64

Answer: B

Watch Video Solution

21. In a δABC, a,c, A are given and b_1, b_2 are two values of third side b such that $b_2 = 2b_1$. Then, the value of sin A.

A. $\sqrt{\frac{9a^2 - c^2}{8a^2}}$

B. $\sqrt{\frac{9a^2 - c^2}{8c^2}}$

C. $\sqrt{\frac{9a^2 - c^2}{8b^2}}$

D. None of these

Answer: B

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22. In a triangle ABC, if $\cot A = (x^3 + x^2 + x)^{\frac{1}{2}}$, $\cot B = (x + x^{-1} + 1)^{\frac{1}{2}}$ and $\cot C = (x^{-3} + x$

then the triangle is

A. equilateral

B. isosceles

C. right angled

D. obtuse anguled

Answer: C

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23. In a $\Delta ABC, a, b, A$ are given and c_1, c_2 are two values of the third side c. The sum of the areas two triangles with sides a,b,c_1 and a, b, c_2 is

A. $\frac{1}{2}a^2 \sin 2A$

B. $\frac{1}{2}b^2 \sin 2A$

C. $b^2 \sin 2A$

D. None of these

Answer: A

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24. In ΔABC, if a = 10 and $b\cot B + c\cot C = 2(r+R)$ then the maximum area of ΔABC will be

A. 50

B. $\sqrt{50}$

C. 25

D. 5

Answer: C

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25. about to only mathematics

A. $16:1$

B. $1:16$

C. $8:1$

D. None of these

Answer: A

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26. Let a,b,c be the sides of a triangle. Now two of them are equal to $\lambda \varepsilon R$.

If the roots of the equation $x^2 + 2(a+b+c)x + 3\lambda(ab+bc+ca) = 0$ are real then

A. $\lambda < \frac{4}{3}$

B. $\lambda > \frac{5}{3}$

C. $\lambda \in \left(\frac{1}{3}, \frac{5}{3}\right)$

D. $\lambda \in \left(\frac{4}{3}, \frac{5}{3}\right)$

Answer: A

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27. In triangle ABC, if $P\dot{Q}, R$ divides sides$BC, AC,$ and $AB,$ respectively, in the ratio $k:1(\in \text{ or } der)$. If the ratio $\left(\frac{arEAPQR}{areaABC}\right)$ IS $\frac{1}{3}, thenk$ is equal to $\frac{1}{3}$ (b) 2 (c) 3 (d) none of these

A. $\frac{1}{3}$

B. 2

C. 3

D. None of these

Answer: B

Watch Video Solution

28. Let $f(x+y)=f(x).\,f(y)$ for all x and y $f(1)=2$ If in a triangle `ABC, a =f (3),b=f(1)+f (3), c=f (2)+f (3), then 2A is equal to

A. C

B. 2C

C. 3C

D. 4C

Answer: A

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29. In an ambiguoa ambiguous case of solving a triangleshen $a = \sqrt{5}, b = 2, \angle A = \frac{\pi}{6}$ and the two possible values of third side are c_1 and c_2, then

A. $|c_1 - c_2| = 2\sqrt{6}$

B. $|c_1 - c_2| = 4\sqrt{6}$

C. $|c_1 - c_2| = 4$

D. $|c_1 - c_2| = 6$

Answer: C

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30. If R_1 is the circumradius of the pedal triangle of a given triangle ABC, and R_2 is the circumradius of the pedal triangle of the pedal triangle formed, and so on $R_3, R_4....$, then the value of $\sum_{i=1}^{\infty} R_i$, where R (circumradius) of ΔABC is 5 is

A. 8

B. 10

C. 12

D. 15

Answer: B

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31. If in a triangle $\left(1 - \frac{r_1}{r_2}\right)\left(1 - \frac{r_1}{r_3}\right) = 2$ then the triangle is right angled (b) isosceles equilateral (d) none of these

A. right angled

B. isosceles

C. equilateral

D. None of these

Answer: A

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32. If the median AD of a triangle ABC makes an angle θ with side, AB, then $\sin(A-\theta)$ is equal to

A. $\frac{b}{c}\sin\theta$

B. $\frac{c}{b}\sin\theta$

C. $\frac{c}{b}\cos\theta$

D. None of these

Answer: B

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33. In a $\Delta ABC,$ angles A, B, C are in AP. If $f(x) = \lim_{A \to c} \frac{\sqrt{3 - 4\sin A \sin C}}{|A - C|}$, then f'(x) is equal to ....

A. 1

B. 2

C. 3

D. 4

Answer: A

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34. In $\Delta ABC, (a+b+c)(b+c-a) = kbc$ if

A. $\lambda < 0$

B. $\lambda > 6$

C. $0 < \lambda < 4$

D. $\lambda > 4$

Answer: C

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

A. either isosceles or right angled

B. only right angled

C. only isosceles triangle

D. None of the above

Answer: A

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36. In a $\Delta ABC,$ sides a,b,c are inAP and $\frac{2}{1!9!}+\frac{2}{3!7!}+\frac{1}{5!5!}=\frac{8^a}{(2b)!},$ then the maximum value of tan A tan B is equal to

A. $\frac{1}{2}$

B. $\frac{1}{3}$

C. $\frac{1}{4}$

D. $\frac{1}{5}$

Answer: B

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37. If a, b,c be the sides of a triangle ABC and if roots of equation $a(b-c)x^2+b(c-a)x+c(a-b)=90$ are equal then $\frac{\sin^2 A}{2}, \frac{\sin^2 B}{2}, \frac{\sin^2 C}{2}$ are in

A. (a)AP

B. (b)GP

C. (c)HP

D. (d)none of these

Answer: C

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38. The ratio of the area of a regular polygon of n sides inscribed in a circle to that of the polygon of same number of sides circumscribing the same is $3:4$. Then the value of n is

A. 6

B. 4

C. 8

D. 12

Answer: A

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39. In any triangle ABC $\sum \frac{\sin^2 A + \sin A + 1}{\sin A}$ is always greater than or equal

A. 9

B. 3

C. 27

D. None of these

Answer: C

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40. If the incircel of the triangle ABC, through it's circumcentre, then the $\cos A + \cos B + \cos C$ is

A. -2

B. $\sqrt{2}$

C. $-\sqrt{2}$

D. None of these

Answer: B

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41. The perimeter of a triangle ABC is saix times the arithmetic mean of the sines of its angles. If the side $a is 1$ then find angle A.

A. 30°

B. 60°

C. 90°

D. 120°

Answer: A

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42. If there are only two linear functions f and g which map $[1, 2] on [4, 6]$ and in a $\Delta ABC, c = f(1) + g(1)$ and a is the maximum valur of r^2, where r is the distance of a variable point on the curve $x^2 + y^2 - xy = 10$ from the origin, then sin A: sin C is

A. A. $1:2$

B. B. $2:1$

C. C. $1:1$

D. D. None of these

Answer: C

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43. A circle is inscribed in an equilateral triangle of side a. The area of any square inscribed in this circle is _____.

A. a^2

B. $\frac{a^2}{4}$

C. $\frac{a^2}{3}$

D. $\frac{a^2}{6}$

Answer: D

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44. In any triangle ABC, if sin A , sin B, sin C are in AP, then the maximum value of $\tan\frac{B}{2}$ is

A. $-\frac{1}{\sqrt{3}}$

B. $\frac{1}{\sqrt{3}}$

C. $\frac{1}{3}$

D. None of these

Answer: B

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45. In a $\Delta ABC, 2\cos A = \frac{\sin B}{\sin C}$ and $2^{\tan^2 B}$ is a solution of equation $x^2 - 9x + 8 = 0,$ then ΔABC is

A. equilateral

B. isosceles

C. scalene

D. right angled

Answer: A

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46. A triangle is inscribed in a circle. The vertices of the triangle divide the circle into three arcs of length $3, 4$ and 5 units. Then area of the triangleis equal to:

A. $\dfrac{9\sqrt{3}\left(1+\sqrt{3}\right)}{\pi^2}$ unit

B. $\dfrac{3\sqrt{3}\left(\sqrt{3}-1\right)}{\pi^2}$ sq unit

C. $\dfrac{9\sqrt{3}\left(1+\sqrt{3}\right)}{2\pi^2}$ sq unit

D. $\dfrac{9\sqrt{3}\left(\sqrt{3}-1\right)}{2\pi^2}$ sq unit

Answer: A

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47. If a,b and c arethe sides of a traiangle such that $b.\ c=\lambda^2,$ then the relation is a,λ and A is

A. $c \geq 2\lambda\sin\left(\dfrac{C}{2}\right)$

B. $b \geq 2\lambda\sin\left(\dfrac{A}{2}\right)$

C. $a \geq 2\lambda\sin\left(\dfrac{A}{2}\right)$

D. None of these

Answer: C

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48. In a triangle ABC, AD is the altitude from A. If $b > c$. $\angle C = 23^\circ$ and $AD = \frac{abc}{b^2 - c^2},$ then $\angle B =$

A. 110°

B. 113°

C. 120°

D. 130°

Answer: B

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49. In triangle $ABC, a = 5, b = 4$ and $\cos(A + B) = \frac{31}{32}$ In this triangle,$c =$

A. 3

B. 6

C. 7

D. 9

Answer: B

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50. In a ABC, if $AB = x, BC = x + 1, \angle C = \frac{\pi}{3}$, then the least integer value of x is 6 (b) 7 (c) 8 (d) none of these

A. 6

B. 7

C. 8

D. None of these

Answer: B

Watch Video Solution

51. In an equilateral triangle, three coins of radii 1 unit each are kept so that they touch each other and also the sides of the triangle. The area of the triangle is 2sqrt(3)(b)6+4sqrt(3)12+(7sqrt(3))/4(d)3+(7sqrt(3))/4`

A. $(4+2\sqrt{3})cm^2$

B. $\frac{1}{4}(12+7\sqrt{3})cm^2$

C. $\frac{1}{4}(48+7\sqrt{3})cm^2$

D. $(6+4\sqrt{3})cm^2$

Answer: D

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52. The sides of a triangle are in AP. If the angles A and C are the greatest and smallest angle respectively, then $4(1-\cos A)(1-\cos C)$ is equal to

A. a) $\cos A - \cos C$

B. b) $\cos A \cos C$

C. c) $\cos A + \cos C$

D. d) $\cos C - \cos A$

Answer: C

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53. If in ΔABC, $c(a+b)\cos\frac{B}{2} = b(a+c)\cos\frac{C}{2}$, the triangle is

A. isosceles

B. equilateral

C. right angled but not isosceles

D. right angled and isosceles

Answer: A

Watch Video Solution

54. In a triangle ABC , the line joining the circumcentre and incentre is parallel to BC, then Cos B + Cos C is equal to:

A. $\frac{3}{2}$

B. 1

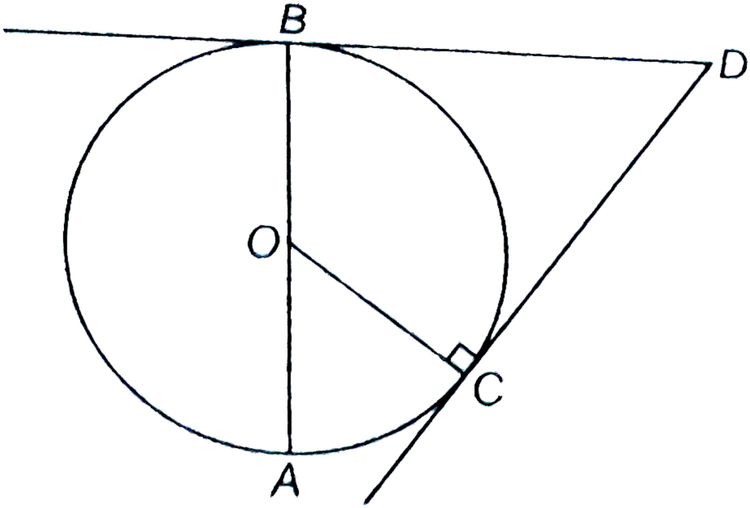
C. $\frac{3}{4}$

D. $\frac{1}{2}$

Answer: B

Watch Video Solution

55. In the given figure, AB is the diameter of the circle, centered at O. If $\angle COA = 60^{\circ}, AB = 2r, Ac = d \text{ and } CD = l,$ then l is equal to



A. $d\sqrt{3}$

B. $\dfrac{d}{\sqrt{3}}$

C. $3d$

D. $\dfrac{\sqrt{3}d}{2}$

Answer: A

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56. If in a $\Delta ABC, AD, BE$ and CF are the altitudes and R is the circumradius, then the radius of the circumcircle of ΔDEF is

A. 2R

B. R

C. $\frac{R}{2}$

D. None of these

Answer: C

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57. In a right angled triangle ABC, the bisector of the right angle C divides AB into segment x and y and $\tan\left(\frac{A-B}{2}\right)=t,$ then x:y is equal to

A. $(1+t):(1-t)$

B. $(1-t):(t+1)$

C. $1:(1+t)$

D. $(1-t):1$

Answer: A

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58. A variable triangle ABC is circumscribed about a fixed circle of unit radius. Side BC always touches the circle at D and has fixed direction. If B and C vary in such a way that $(BD).(CD)=2,$ then locus of vertex A will be a straight line

A. (a)parallel to side BC

B. (b)right angle to side BC

C. (c)making and angle $\frac{\pi}{6}$ with BC

D. (d)making an angle $\sin^{-1}\left(\frac{2}{3}\right)$ with BC

Answer: A

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59. A tower of height b subtends an angle at a point 0 on the ground level through the foot of the tower and at a distance a from the foot of

the tower. A pole mounted on the top of the tower also subtends an equal angle at O. The height of the pole is

A. $b\left(\frac{a^2 - b^2}{a^2 + b^2}\right)$

B. $b\left(\frac{a^2 + b^2}{a^2 - b^2}\right)$

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

D. $a\left(\frac{a^2 + b^2}{a^2 - b^2}\right)$

Answer: B

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60. A balloon is observed simultaneously from three points A, B and C on a straight road directly under it. The angular elevation at B is twice and at C is thrice that at A. If the distance between A and B is 200 metres and the distance between B and C is 100 metres, then find the height of balloon above the road.

A. 50 m

B. $50\sqrt{3}m$

C. $50\sqrt{2}m$

D. None of these

Answer: D

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61. Avertical pole consists of two parts , the lower part being one third of the wole .At a point in the horizontal plane through the base of the pole and distance 2 m from it, the upper part of the pole subtends an angle whose tangent is 1/2 .Find the possible height of the place .

A. 100 gt

B. 120 ft

C. 150 ft

D. None of these :

Answer: B

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Exercise (More Than One Correct Option Type Questions)

1. If area of $\Delta ABC(\Delta)$ and angle C are given and if c opposite to given angle is minimum, then

A. $a = \sqrt{\frac{2\Delta}{\sin C}}$

B. $b = \sqrt{\frac{2\Delta}{\sin C}}$

C. $a = \frac{4\Delta}{\sin C}$

D. $b = \frac{4\Delta}{\sin^2 C}$

Answer: A

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2. If Δ represents the area of acute angled triangle ABC, then $\sqrt{a^2b^2-4\Delta^2}+\sqrt{b^2c^2-4\Delta^2}+\sqrt{c^2a^2-4\Delta^2}=$ (a) $a^2+b^2+c^2$ (b) $\frac{a^2+b^2+c^2}{2}$ (c) $ab\cos C+bc\cos A+ca\cos B$ (d) $ab\sin C+bc\sin A+ca\sin B$

A. $a^2+b^2+c^2$

B. $\frac{a^2+b^2+c^2}{2}$

C. $ab\cos C+bc\cos A+ca\cos B$

D. $ab\sin C+bc\sin A+ca\sin B$

Answer: C

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3. In ΔABC, the value of $c\cos(A-\theta)+a\cos(C+\theta)=$

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4. In ΔABC, If $a = 4, b = 3$ and $COS(A - B) = \frac{3}{4}$, then

A. measure of $\angle A$ is $\frac{\pi}{2}$

B. measuere of $\angle Bis \frac{\pi}{2}$

C. $\cot \frac{C}{2} = \sqrt{7}$

D. circumradius of $\Delta ABCis \frac{2}{7^{1/14}}$

Answer: B::C::D

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5. If in ΔABC, $a = 5, b = 4$ and $\cos(A - B) = \frac{31}{32}$, then

A. A. The perimeter of ΔABC equals $\frac{15}{2}$

B. B. The radius of circle inscribed in ΔABC equals $\frac{\sqrt{7}}{2}$

C. C. The measure of $\angle C$ equals $\cos^{-1} \frac{1}{8}$

D. D. The value of $R(b^2 \sin 2C + c^2 \sin 2B)$ equal 120

Answer: B::C::D

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6. In which of the following situations, it is possible to have $a\Delta ABC$?

(All symbols used have usual meaning in a triangle)

A. (a)$(a+c-b)(a-c+b)=4bc$

B. (b)$b^2\sin 2C+\cos^2\sin 2B=ab$

C. (c)$a=3, b=5, c=7 \text{ and } C=\frac{2\pi}{3}$

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

Answer: B::C

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7. In a triangle ABC, let BC = 1, AC=2 and measure of $\angle C$ is 30°. Which of the following statement(s) is (are) correct?

A. (a) $2\sin A=\sin B$

B. (b) Length of side AB equals $5 - 2\sqrt{3}$

C. (c) measure of $\angle A$ is less than 30°

D. (d) Circumradius of $\triangle ABC$ is equal to length of side AB

Answer: A::C::D

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8. Let one angle of a triangle be 60º, the area of triangle is $10\sqrt{3}$and perimeter is 20 cm. Ifa>b> c where a, b and e denote lengths of sides opposite to vertices A, B and C respectively, then which of the following is (are) correct?

A. (a)Inradius of triangle is $\sqrt{3}$

B. (b)Length of longest side of triangle is 7

C. (c)Circum-radius of triangles is $\frac{7}{\sqrt{3}}$

D. (d)Radius of largest escribed circle is $/12$

Answer: A::C

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9. In a triangle ABC, if $a = 4, b = 8, \angle C = 60^\circ$, then which of the following relations is (are) correct? [Note: All symbols used have usual meaning in triangle ABC.]

A. (a)The area of $\Delta ABC is 8\sqrt{3}$

B. (b)The value of $\sum \sin^2 A = 2$

C. (c)Inradius of trianlgle $ABC is \frac{2\sqrt{3}}{3+\sqrt{3}}$

D. (d)The length of internal angle bisector of $\angle C is \frac{4}{\sqrt{3}}$.

Answer: A::B

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10. Given an isoceles triangle with equal side of length b and angle $\alpha < \pi / 4$, then

the inradius r is given by

A. $R = \frac{1}{2} b \cos e c \alpha$

B. $\Delta = 2b^2 \sin 2\alpha$

C. $r = \frac{b \sin 2\alpha}{2(1 + \cos \alpha)}$

D. $OI \left| \frac{b \cos\left(\frac{3\alpha}{2}\right)}{2 \sin \alpha \left(\frac{\alpha}{2}\right)} \right|$

Answer: A::C::D

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11. There can exist a triangle ABC satisfying the conditions :

A. $\tan A + \tan B + \tan C = 0$

B. $\frac{\sin A}{2} = \frac{\sin B}{3} = \frac{\sin C}{7}$

C. $(a+b)^2 = c^2 + ab$ and $\sqrt{2}(\sin A + \cos A) = \sqrt{3}$

D.

$$\sin A + \sin B = \left(\frac{\sqrt{3}+1}{2}\right)\cos A \cos B = \frac{\sqrt{3}}{4} = \frac{\sqrt{3}}{4} = \sin A \sin B$$

Answer: C::D

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12. Let a,b,c be the sides of triangle whose perimeter is P and area is A, then

A. $p^3 \leq 27(b+c-a)(c+a-b)(a+b-c)$

B. $p^2 \leq 3(a^2+b^2+c^2)$

C. $a^2+b^2+c^2 \geq 4\sqrt{3}A$

D. $p^4 \leq 25 < A$

Answer: B::C

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13. If in $\Delta ABC, A = 90^\circ$ and c, sin B and cos B are rational number, then

A. a is rational

B. a is irrational

C. b is rational

D. b is irational

Answer: A::C

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14. Let 'l' is the length of median from the vertex A to the side BC of a ΔABC. Then

A. $4l^2 = 2b^2 + 2c^2 - a^2$

B. $4l^2 = b^2 + c^2 + 2bc \cos A$

C. $4l^2 = b^2 + 4bc \cos A$

D. $4l^2 - (2s - a)^2 - 4bc\sin^2\left(\frac{A}{2}\right)$

Answer: A::B::C::D

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15. If A, A_1, A_2 and A_3 are the areas of the inscribed and escribed circles of a triangle, prove that $\frac{1}{\sqrt{A}} = \frac{1}{\sqrt{A_1}} + \frac{1}{\sqrt{A_2}} + \frac{1}{\sqrt{A_3}}$

A. (a) $\sqrt{A_1} + \sqrt{A_2} + \sqrt{A_3} = \sqrt{\pi}(r_1 + r_2 + r_3)$

B. (b) $\frac{1}{\sqrt{A_1}} + \frac{1}{\sqrt{A_2}} + \frac{1}{\sqrt{A_3}} = \frac{1}{\sqrt{A}}$

C. (c) $\frac{1}{\sqrt{A_1}} + \frac{1}{\sqrt{A_2}} + \frac{1}{\sqrt{A_3}} = \frac{s^2}{\sqrt{\pi r_1 r_2 r_3}}$

D. (d) $\sqrt{A_1} + \sqrt{A_2} + \sqrt{A_3} = \sqrt{\pi}(4R + r)$

Answer: A::B::C::D

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16. If a, b, A be given in a triangle and c_1 and c_2 be two possible value of the third side such that $c_1^2 + c_1c_2 + c_2^2 = a^2$, then a is equal to

A. (a)30°

B. (b)60°

C. (c)90°

D. (d)120°

Answer: B::C

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17. D,E and F are the middle points of the sides of the triangle ABC, then

A. centroid of the triangle DEF is the same as that of ABC

B. orthocentre of the triangle DEF is the circumcentre of ABC

C. orthocentre of the triangle DEF is the incentre of ABC

D. centroid of the triangle DEF is not the same as that of ABC

Answer: A::B

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18. The sides of ABC satisfy the equation $2a^2 + 4b^2 + c^2 = 4ab + 2ac$ Then a) the triangle is isosceles b) the triangle is obtuse c) $B = \cos^{-1}\left(\frac{7}{8}\right)$ d) $A = \cos^{-1}\left(\frac{1}{4}\right)$

A. the triangle is isosceles

B. the triangle is obtuse

C. $B = \cos^{-1}\left(\frac{7}{8}\right)$

D. $A = \cos^{-1}\left(\frac{1}{4}\right)$

Answer: A::C::D

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19. If Δ represents the area of acute angled triangle ABC, then $\sqrt{a^2b^2-4\Delta^2}+\sqrt{b^2c^2-4\Delta^2}+\sqrt{c^2a^2-4\Delta^2}=$ (a) $a^2+b^2+c^2$ (b) $\frac{a^2+b^2+c^2}{2}$ (c) $ab\cos C+bc\cos A+ca\cos B$ (d) $ab\sin C+bc\sin A+ca\sin B$

A. $(a^2+b^2+c^2$

B. $\frac{a^2+b^2+c^2}{2}$

C. $ab\cos C+bc\cos A+ca\cos B$

D. $ab\sin C+bc\sin A+ca\sin B$

Answer: B::C

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20. In triangle, ABC if $2a^2b^2+2b^2c^2=a^2+b^4+c^4$, then angle B is equal to 45^0 (b) 135^0 120^0 (d) 60^0

A. 45°

B. 135°

C. 120°

D. 60°

Answer: A::B

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21. If H is the orthocentre of triangle ABC, R = circumradius and $P = AH + BH + CH$, then

A. $p = 2(R + r)$

B. max, of P is 3R

C. min. of P is 3R

D. $P = 2(R - r)$

Answer: A::B

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22. If inside a big circle exactly $n(n \leq 3)$ small circles, each of radius r, can be drawn in such a way that each small circle touches the big circle and also touches both its adjacent small circles, then the radius of big circle is $r\left(1+\cos ec\frac{\pi}{n}\right)$ (b) $\left(\frac{1+\frac{\tan\pi}{n}}{\frac{\cos\pi}{\pi}}\right)$ $r\left[1+\cos ec\frac{2\pi}{n}\right]$ (d) $\frac{r\left[s\in\frac{\pi}{2n}+\frac{\cos(2\pi)}{n}\right]^2}{\frac{\sin\pi}{n}}$

A. $r\left(1+\cos ec\frac{\pi}{n}\right)$

B. $\left(\frac{1+\tan\frac{\pi}{n}}{\cos\frac{\pi}{n}}\right)$

C. $r\left[1+\cos ec\frac{2\pi}{n}\right]$

D. $\frac{r\left[\sin\frac{\pi}{2n}+\cos\frac{2\pi}{n}\right]^2}{\sin{'}\frac{\pi}{n}}$

Answer: A::D

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23. If in triangle ABC, a, c and angle A are given and $c \sin A < a < c$, then (b_1 and b_2 are values of b)

A. $b_1 + b_2 = 2c \cos A$

B. $b_1 + b +_2 = c \cos A$

C. $b_1 b_2 = c^2 - a^2$

D. $b_1 b_2 = c^2 + a^2$

Answer: A::C

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Exercise (Statement I And Ii Type Questions)

1. In a triangle ABC, $a^3 + b^3 + c^3 = c^2(a + b + c)$ (All symbol used have usual meaning in a triangle.) Statement-1: The value of $\angle C = 60^\circ$. Statement-2: ΔABC must be equilateral.

A. (a)Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. (b)Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. (c)Statement I is correct but Statement II is incorrect

D. (d)Statement I is correct but Statement I is incorrect

Answer: C

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2. Let a = 6, b = 3 and $\cos(A - B) = \frac{4}{5}$

Value of $\sin A$ is equal to

A. Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. Statement I is correct but Statement II is incorrect

D. Statement I is correct but Statement I is incorrect

Answer: D

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3. Statement I: If in a triangle $ABC, \sin^2 A + \sin^2 B + \sin^2 C = 2,$ then one of the angles must be 90°.

Statement II: In any triangle ABC $\cos 2A + \cos 2B + \cos 2C = -1 - 4\cos A \cos B \cos C$

A. (a) Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. (b) Both Statement I and Statement II are correct but Statement II is not the correct explanation of Statement I

C. (c) Statement I is correct but Statement II is incorrect

D. (d) Statement II is correct but Statement I is incorrect

Answer: A

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4. Statement I: If A, B, C, D are angles of a cyclic quadrilateral then $\sum \sin A = 0.$

Statement II: If A, B, C, D are angles of cyclic quadrilateral then $\sum \cos A = 0.$

A. (a) Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. (b) Both Statement I and Statement II are correct but Statement II is not the correct explanation of Statement I

C. (c) Statement I is correct but Statement II is incorrect

D. (d) Statement II is correct but Statement I is incorrect

Answer: D

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5. Statement I In any triangle ABC, the square of the length of the bisector AD is $bc\left(1-\frac{a^2}{(b+c)^2}\right)$.

Statement II In any triangle ABC length of bisector AD is $\frac{2bc}{(b+c)}\cos\left(\frac{A}{2}\right)$.

A. (a)Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. (b)Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. (c)Statement I is correct but Statement II is incorrect

D. (d)Statement I is correct but Statement I is incorrect

Answer: A

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6. All the notations used in statemnt I and statement II are usual.

Statement I: In triangle ABC, if $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$. then value of $\frac{r_1 + r_2 + r_3}{r}$ is equal to 9.

Statement II: In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$, where R is circumradius.

A. a) Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. b) Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. c) Statement I is correct but Statement II is incorrect

D. d) Statement II is correct but Statement I is incorrect

Answer: A

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7. Statement I In a triangle ABC if $\tan A : \tan B : \tan C = 1 : 2 : 3,$ then $A = 45^\circ$

Statement II If $p : q : r = 1 : 2 : 3,$ then $p = 1$

A. A. Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. B. Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. C. Statement I is correct but Statement II is incorrect

D. D. Statement I is correct but Statement I is incorrect

Answer: C

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8. Statement I: In any right angled triangle $\frac{a^2 + b^2 + c^2}{R^2}$ is always equal to 8.

Statement II: $a^2 = b^2 + c^2$

A. a) Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. b) Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. c) Statement I is correct but Statement II is incorrect

D. d) Statement I is incorrect but Statement II is correct

Answer: A

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9. Statement I perimeter of a regular pentagon inscribed in a circle with centre O and radius a cm equals $10a\sin 36^\circ$ cm.

Statement II Perimeter of a regular polygon inscribed in a circle with centre O and radius a cm equals $(3n-5)\sin\left(\frac{360^\circ}{2n}\right)cm$, then it is n sided, where $n \geq 3$.

A. (a)Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. (b)Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. (c)Statement I is correct but Statement II is incorrect

D. (d)Statement I is correct but Statement I is incorrect

Answer: C

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10. Statement I In any triangle ABC

$a\cos A + b\cos B + c\cos C \leq s.$

Statement II In any triangle ABC

$\sin\left(\frac{A}{2}\right)\sin\left(\frac{B}{2}\right)\sin\left(\frac{C}{2}\right) \leq \frac{1}{8}$

A. Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. Statement I is correct but Statement II is incorrect

D. Statement I is correct but Statement I is incorrect

Answer: A

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11. Statement I In a ΔABC, if $\cos^2\frac{A}{2}+\cos^2\frac{B}{2}+\cos^2\frac{C}{2}=y\left(x^2+\frac{1}{x^2}\right)$ then the maximum value of $y is \frac{9}{8}$.

Statement II In a ΔABC, $\sin\frac{A}{2}.\sin\frac{B}{2}\sin\frac{C}{2}\leq\frac{1}{8}$

A. Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I

B. Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I

C. Statement I is correct but Statement II is incorrect

D. Statement I is correct but Statement I is incorrect

Answer: A

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Exercise (Passage Based Questions)

1. R is circumradii of $\Delta ABC, H$ is orthocentre, R_1, R_2, R_3 are circumradii of ΔAHB, ΔBHC. If AH produced meet the circumradii of ABC at M and intersect BC at L,

$\angle AHB = 180^\circ - C$

$$\frac{c}{\sin(180^\circ - C)} = 2R_1$$
$$\frac{c}{\sin C} = 2R_1$$

$R_1 = R$

Area of ΔAHB

A. a. 2R cos A cos B cos C

B. b. R^2 cos A cos B cos C

C. c. $2R^2$ cos A cos B sin C

D. d. None of the above

Answer: C

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2. Let ABC to be an acute triangle with $BC = a, CA = b$ and $AB = c$, where $a \ne b \ne c.$ From any point 'p' inside $\Delta ABC \le tB, E, F$ denot foot of perpendiculars form 'p' noto the sides, BC, CA and AB, respectively. Now, answer the following equations.

If ΔDEF is equilateral, then 'P'

A. the incircle of ΔABC

B. line of intternal angle bisectors from A, B and C

C. arcs of 3 circles

D. None of the above

Answer: C

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3. Let ABC to be an acute triangle with $BC = a, CA = b$ and $AB = c$, where $a \ne b \ne c$. From any point 'p' inside $\Delta ABC \le tB, E, F$ denot foot of perpendiculars form 'p' noto the sides, BC, CA and AB, respectively. Now, answer the following equations.

If ΔDEF is equilateral, then 'P'

A. $x = 4$ or $x + yy = 7$ or $4x = 3y$

B. $x = 4$ or $x^2 + y^2 = 4x + 4y$

C. $3(x^2 + y^2) + 196 = 49(x + y)$

D. None of the above

Answer: C

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4. Let ABC to be an acute triangle with $BC = a, CA = b$ and $AB = c$, where $a \neq b \neq c$. From any point 'p' inside $\Delta ABC \leq tB, E, F$ denot foot of perpendiculars form 'p' noto the sides, BC, CA and AB, respectively. Now, answer the following equations.

If ΔDEF is equilateral, then 'P'

A. coincides with incentre of ΔABC

B. coincides with orthocentre of ΔABC

C. lies on padal Δ of ΔABC

D. None of the above

Answer: D

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5. In an acute angled triangle ABC, let AD, BE and CF be the perpendicular opposite sides of the triangle. The ratio of the product of the side lengths of the triangles DEF and ABC, is equal to

A. A. $\dfrac{3(abc)^{\frac{1}{3}}}{4(a+b+c)}$

B. B. $\dfrac{1}{4}$

C. C. $\cos A \cos B \cos C$

D. D. $\sin\left(\dfrac{A}{2}\right)\sin\left(\dfrac{B}{2}\right)\sin\left(\dfrac{C}{2}\right)$

Answer: C

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6. In an acute angle ΔABC, let AD, BE and CF be the perpendicular from A, B and C upon the opposite sides of the triangle. (All symbols used have usual meaning in a tiangle.)

The orthocentre of the ΔABC, is the

A. centroid of the ΔDEF

B. circum-centre of the ΔDEF

C. incentre of the ΔDEF

D. orthocentre of the ΔDEF

Answer: C

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7. In an acute angle $\Delta ABC,$ let AD, BE and CF be the perpendicular from A, B and C upon the opposite sides of the triangle. (All symbols used have usual meaning in a tiangle.)

The circum-radius of the ΔDEF can be equal to

A. $\frac{abc}{8\Delta}$

B. $\frac{a}{4\sin A}$

C. $\frac{R}{2}$

D. $\frac{r}{8}\cos ec\frac{A}{2}\cos ec\frac{B}{2}\cos ec\frac{C}{2}$

Answer: A::B::C::D

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8. Let a,b, c are the sides opposite to angles A, B , C respectively in a $\Delta ABC \tan\frac{A-B}{2}=\frac{a-b}{a+b}\cot\frac{C}{2}$ and $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$,

If $a=6, b=3$ and $\cos(A-B)=\frac{4}{5}$

Angle C is equal to

A. $\frac{\pi}{4}$

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

C. $\frac{3\pi}{4}$

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

Answer: B

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9. Let a,b, c are the sides opposite to angles A, B , C respectively in a $\Delta ABC \tan\frac{A-B}{2}=\frac{a-b}{a+b}\cot\frac{C}{2}$ and $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$,

If $a=6, b=3$ and $\cos(A-B)=\frac{4}{5}$

Area of the trianlge is equal to

A. 8

B. 9

C. 10

D. 11

Answer: B

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10. Let a,b, c are the sides opposite to angles A, B , C respectively in a $\Delta ABC \tan\frac{A-B}{2}=\frac{a-b}{a+b}\cot\frac{C}{2}$ and $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$,

If $a=6, b=3$ and $\cos(A-B)=\frac{4}{5}$

Valus of sin A is equal to

A. $\frac{1}{\sqrt{5}}$

B. $\frac{2}{\sqrt{5}}$

C. $\frac{1}{2\sqrt{5}}$

D. $\frac{1}{\sqrt{3}}$

Answer: B

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11. When any two sides and one of the opposite acute angle are given, under certain additional conditions two triangles are possible. The case when two triangles are possible is called the ambiguous case.

In fact when any two sides and the angle opposite to one of them are given either no triangle is posible or only one triangle is possible or two triangles are possible.

In the ambiguous case, let a,b and $\angle A$ are given and c_1, c_2 are two values of the third side c.

On the basis of above information, answer the following questions

Two different triangles are possible when

A. $b \sin A < a$

B. $b \sin A < a \text{ and } b > a$

C. $b \sin A < a \text{ and } b < a$

D. $b\sin A < a$ and $a = b$

Answer: B

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12. When any two sides and one of the opposite acute angle are given, under certain additional conditions two triangles are possible. The case when two triangles are possible is called the ambiguous case.

In fact when any two sides and the angle opposite to one of them are given either no triangle is posible or only one triangle is possible or two triangles are possible.

In the ambiguous case, let a,b and $\angle A$ are given and c_1, c_2 are two values of the third side c.

On the basis of above information, answer the following questions

The difference between two values of c is

A. A. $2\sqrt{(a^2 - b^2)}$

B. B. $\sqrt{(a^2 - b^2)}$

C. C. $2\sqrt{(a^2 - b^2 \sin^2 A)}$

D. D. $\sqrt{(a^2 - b^2 \sin^2 A)}$

Answer: B

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13. When any two sides and one of the opposite acute angle are given, under certain additional conditions two triangles are possible. The case when two triangles are possible is called the ambiguous case.

In fact when any two sides and the angle opposite to one of them are given either no triangle is posible or only one triangle is possible or two triangles are possible.

In the ambiguous case, let a,b and $\angle A$ are given and c_1, c_2 are two values of the third side c.

On the basis of above information, answer the following questions

The value of $c_1^2 - 2c_1c_2 \cos 2A + c_2^2$ is

A. A. $4a \cos A$

B. B. $4a^2 \cos A$

C. C. $4a \cos^2 A$

D. D. $4a^2 \cos^2 A$

Answer: D

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14. Consider a triangle ABC, where c,y,z are the length of perpendicular drawn from the vertices of the triangle to the opposite sides a,b, c respectively. Let the letters R, rS, Δ denote the circumradius, inradius semi-perimeter and area of the triangle respectively.

If $\frac{bx}{c} + \frac{cy}{a} + \frac{az}{b} = \frac{a^2 + b^2 + c^2}{k}$, then the value of k is

A. R

B. S

C. 2R

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

Answer: C

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15. Consider a triangle ABC, where c,y,z are the length of perpendicular drawn from the vertices of the triangle to the opposite sides a,b, c respectively. Let the letters R, rS, Δ denote the circumradius, inradius semi-perimeter and area of the triangle respectively.

If $\cot A + \cot B + \cot C = k\left(\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}\right)$, then the value of k is

A. R^2

B. rR

C. Δ

D. $a^2 + b^2 + c^2$

Answer: C

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16. Consider a triangle ABC, where c,y,z are the length of perpendicular drawn from the vertices of the triangle to the opposite sides a,b, c respectively. Let the letters R, rS, Δ denote the circumradius, inradius semi-perimeter and area of the triangle respectively.

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

is equal to

A. $\frac{R}{r}$

B. $\frac{S}{R}$

C. 2

D. 6

Answer: D

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17. AL, BM and CN are perpendicular from angular points of a triangle ABC on the opposite sides BC, CA and AB respectively. Δ is the area of triangle

ABC, (r) and R are the inradius and circumradius.

If perimeters of ΔLMN and $\Delta ABC an \lambda$ and μ, then the value of $\frac{\lambda}{\mu}$ is

A. $\frac{r}{R}$

B. $\frac{R}{r}$

C. $\frac{rR}{\Delta}$

D. $\frac{\Delta}{rR}$

Answer: B

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18. AL, BM and CN are perpendicular from angular points of a triangle ABC on the opposite sides BC, CA and AB respectively. Δ is the area of triangle ABC, (r) and R are the inradius and circumradius.

If area of ΔLMN is Δ', then the value of $\frac{\Delta'}{\Delta}$ is

A. $2 \sin A \sin B \sin C$

B. $2 \cos A \cos B \cos C$

C. $\sin A \sin B \sin C$

D. $\cos A \cos B \cos C$

Answer: D

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PROPERTIES AND SOLUTIONS OF TRIANGLES EXERCISE 5: MATCHING TYPE QUESTIONS

1. Match the statement of Colume I with values of Column II.

	Column I	Column II
(A)	In a ΔABC, let $\angle C = \frac{\pi}{2}$, r = inradius, R = circumradius then $2(r+R)$	(p) $a+b+c$
(B)	If l, m, n are perpendicular drawn from the vertices of triangle having sides a, b and c then $\sqrt{2R\left(\frac{bl}{c}+\frac{cm}{a}+\frac{an}{b}\right)+2ab+2bc+2ca}$	(q) $a-b$

(C) In a ΔABC, $R(b^2 \sin 2C + c^2 \sin 2B)$ equals	(r) $a + b$
(D) In a right angle triangle ABC, $\angle C = \frac{\pi}{2}$, then $4R \sin \frac{A+B}{2} \sin \frac{(A-B)}{2}$	(s) abc

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2. Match the statement of Column I with the values of Column II.

Column I	Column II
(A) In a triangle ABC $(c-a)^2 = b^2 - ac$ and $\cos B + \sin C = \frac{3}{2}$	(p) $A = 30^\circ$
(B) A, B, C are in A.P. and $C = 3A$	(q) $B = 60^\circ$
(C) The length of the bisector of angle $B = \frac{\sqrt{3ca}}{(c+a)}$ and $a = b$	(r) $C = 90^\circ$
(D) $\frac{1}{a+b} + \frac{1}{b+c} = \frac{3}{a+b+c}$	(s) $A = B = C = 60^\circ$

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3. Match the statement of Column I with values of Column II

Column I		Column II	
(A)	In a ΔABC, if $2a^2 + b^2 + c^2 = 2ac + 2ab$, then	(p)	ΔABC is equilateral triangle
(B)	In a ΔABC, if $a^2 + b^2 + c^2 = \sqrt{2}b(c + a)$, then	(q)	ΔABC is right angled triangle
(C)	In a ΔABC, if $a^2 + b^2 + c^2 = bc + ca\sqrt{3}$, then	(r)	ΔABC is scalane triangle
		(s)	ΔABC is scalane right angled triangle
		(t)	Angles B, C, A are in AP

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Exercise (Single Integer Answer Type Questions)

1. If in $\Delta ABC, \angle C = \frac{\pi}{8}, a = \sqrt{2}$ and $b = \sqrt{2 + \sqrt{2}}$ then find the measure of angle A (in degree).

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2. If in $ABC, A=\frac{\pi}{7}, B=\frac{2\pi}{7}, C=\frac{4\pi}{7}$ then $a^2+b^2+c^2$ must be R^2

(b) $3R^2$ (c) $4R^2$ (d) $7R^2$

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3. In a $\Delta ABC, P$ and Q are the mid-points of AB and AC respectively. If O is the circumcentre of the $\Delta ABC,$ then the value of $\left(\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta OPQ}\right)\cot B \cot C$ equal to

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4. With usual notation in $\Delta ABC,$ the numerical value of $\left(\frac{a+b+c}{r_1+r_2+r_3}\right)\left(\frac{a}{r_1}+\frac{b}{r_2}+\frac{c}{r_3}\right)$ is

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5. ABC is a triangle and D is the middle point of BC. If AD is perpendicular to AC, then prove that $\cos A . \cos C = \frac{2(c^2 - a^2)}{3ac}$

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6. The rational number which equals the number 2.357 with recurring decimal is $\frac{2355}{1001}$ b. $\frac{2379}{997}$ c. $\frac{2355}{999}$ d. none of these

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7. In triangle $ABC, r = \frac{R}{6}$ and $r_1 = 7r$. Then the measure of angle A =

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8. In a $\Delta ABC,$ the maximum value of $120\left(\frac{\sum a\cos^2\left(\frac{A}{2}\right)}{a+b+c}\right)$ must be

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9. The sides of a triangle are three consecutive natural numbers and its largest angle is twice the smalles one. Determine the sides of the triangle.

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10. In $\Delta ABC, \angle C = 2\angle A,$ and $AC = 2BC,$ then the value of $\frac{a^2 + b^2c^2}{R^2}$ (where R is circumradius of triangle) is ______

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11. If a, b and A are given in a triangle and c_1, c_2 are possible values of the third side, then prove that $c_1^2 + c_2^2 - 2c_1c_2 \cos 2A = 4a^2 \cos^2 A$

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12. In ΔABC, a=5, b=4, c=3. G is the centroid of triangle. If R_1 be the circum radius of triangle GAB then the value of $\frac{a}{65}R_1^2$ must be

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13. A triangle ABC is inscribed in a circle with centre at O, The lines $AO, BOandCO$ meet the opposite sides at $D, E, andF$, respectively. Prove that $\frac{1}{AD}+\frac{1}{BE}+\frac{1}{CF}=\frac{a\cos A+b\cos B+osC}{\triangle}$

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14. In a triangle $ABC, a \geq b \geq c$. If $\frac{a^3+b^3+c^3}{\sin^3 A+\sin^3 B+\sin^3 C}=8$, then the maximum value of a $\sin^3 A+\sin^3 B+\sin^3 C$

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15. In a cyclic quadrilateral PQRS, PQ= 2 units, QR= 5 units, RS=3 units and $\angle PQR = 60^0$, then what is the measure of SP?

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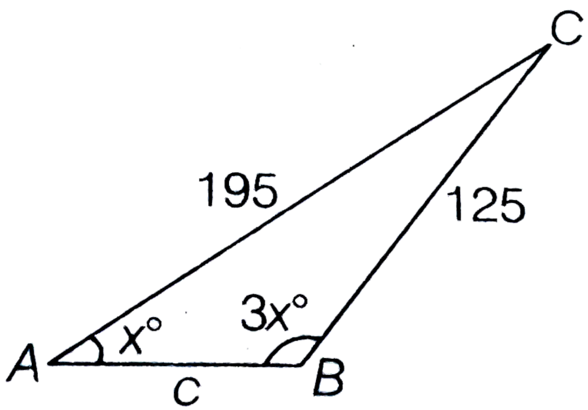
PROPERTIES AND SOLUTIONS OF TRIANGLES EXERCISE 6 : SINGLE INTEGER ANSWER TYPE QUESTIONS

1. In the figure as shown find the number of digits in the length of AB.



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Exercise (Subjective Type Questions)

1. In a ΔABC, the angles A and B are two values of θ satisfying $\sqrt{3}\cos\theta + \sin\theta = k$, where $|K| < 2$, then show triangles is obtuse angled.

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2. In an obtuse angled triangle, the obtuse angle is $\frac{3\pi}{4}$ and the other two angles are equal to two values of θ satisfying $a\tan\theta + b\sec\theta = c$, where $|b| \leq \sqrt{a^2 + c^2}$, then $a^2 - c^2$ is equal to

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3. If in triangle $ABCa, b, candangle A$ are given and `csinA

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4. If P is a point on the altitude AD of the triangle ABC such the $\angle CBP = \frac{B}{3}$, then AP is equal to $2a\frac{\sin C}{3}$ (b) $2b\frac{\sin C}{3}$ (c) $2c\frac{\sin B}{3}$ (d) $2c\frac{\sin C}{3}$

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5. If R denotes circumradius, then in ΔABC, $\frac{b^2 - c^2}{2aR}$ is equal to

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6. In $\Delta ABC, A = \frac{2\pi}{3}, b - c = 3\sqrt{3}cm$ and area of $\Delta ABC = \frac{9\sqrt{3}}{2}cm^2$, then BC =

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7. If $\Delta = a^2 - (b-c)^2$, Δ is the area of the ΔABC then $\tan A = ?$

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8. In a $\Delta ABC, B = 90^\circ, AC = h$ and the length of perpendicular from B to AC is p such that $h = 4p$. If $AB < BC$, then measure $\angle C$.

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9. If in a $\Delta ABC, \sin^3 A + \sin^3 B + \sin^3 C$

$= 3 \sin A. \sin B. \sin C$, then find the valueof determinant

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}.$$

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10. In a triangle ABC, if the sides a,b,c, are roots of $x^3 - 11x^2 + 38x - 40 = 0$, then find the value of

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

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11. If the sides a, b, c are in A.P., prove that $(\tan)\frac{A}{2} + (\tan)\frac{c}{2} = \frac{2}{3}(\cot)\frac{B}{2}$.

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12. The sides of a triangle are in A.P. and its area is $\frac{3}{5}$ th of an equilateral triangle of the same perimeter. Find the greatest angle of the triangle

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13. If AD, BE and CF are the medians of a ΔABC, then evaluate $\left(AD^2 + BE^2 + CF^2\right) : \left(BC^2 + CA^2 + AB^2\right)$.

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14. Let AD be a median of the ΔABC. If AE and AF are medians of the triangle ABD and ADC, respectively, and BD=a/2 AD = $m_1, AE = m_2, AF = m_3, \text{ then } a^2/8$ is equal to

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15. In ΔABC, If $x = \tan\left(\frac{B-C}{2}\right)\tan\left(\frac{A}{2}\right), y = \tan\left(\frac{C-A}{2}\right)\tan\left(\frac{B}{2}\right), z = \tan\left(\frac{A-}{2}\right.$

, then $x + y + z$ (in terms of x, y, z only) is

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16. ΔABC is equilateral triangle of side a. P lies on AB such that A is midpoint of PB. If r_1 is inradius of PAC and r_2 is ex radius of PBC opposite to P, then $r_1 + r_2 =$

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17. The base of a triangle is divided into three equal parts. If $\theta_1, \theta_2, \theta_3$ be thw angles subtended by these parts at the vertex, then prove that

$(\cot\theta_1 + \cot\theta_2)(\cot\theta_2 + \cot\theta_3) = 4\cos ec^2\theta_2$

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18. If the circumradius of a triangle is $\frac{54}{\sqrt{1463}}$ and the sides are in G.P with common ratio $\frac{3}{2}$. then find the sides of the triangle.

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19. If the angle at the vertex of an isosceles triangle having the maximum area for the given length of the median to one of its equal sides, is x then $5\cos x$ is equal to

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20. In an acute angle triangle ABC, AD, BE and CF are the altitudes, then $\frac{EF}{a} + \frac{FD}{b} + \frac{DE}{c}$ is equal to -

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21. Let P be the point inside that ΔABC. Such that $\angle APB = \angle BPC = \angle CPA$. Prove that $PA + PB + PC = \sqrt{\frac{a^2 + b^2 + c^2}{2} + 2\sqrt{3}\Delta}, wherea, b, c\Delta$ are the sides and the area of ΔABC.

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PROPERTIES AND SOLUTIONS OF TRIANGLES EXERCISE 7 : SUBJECTIVE TYPE QUESTIONS

1. A hexagon is inscribed in a circle of radius r. Two of its sides have length 1, two have length 2 and the last two have length 3. Prove that r is a root of the equation $2r^3 - 7r - 3 = 0$.

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2. Prove that $a^2 + b^2 + c^2 + 2abc < 2,$ where a,b,c are the sides of triangle ABC such that $a + b + c = 2.$

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3. A polygon of n sides, inscribed in a circle, is such that its sides subtend angle $2\alpha, 4\alpha, \ldots, 2n\alpha$ at the centre of the circles. Prove that its area A_1, is to the area A_2 of the regular polygon of n iseds inscribed in the same circle, as $\sin n\alpha : n \sin \alpha$.

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4. $A_1, A_2, A_3, \ldots, A_n$ is a regular polygon of n side circumscribed about a circle of centre O and radius 'a'. P is any point distanct 'c' from O. Show that the sum of the squares of the perpendiculars from P on the sides of the polygon is n $\left(a^2 + \frac{c^2}{2}\right)$.

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5. Show that in any $\Delta ABC, a^3 \cos 3B + 3a^2 b \cos(2B - A) + 3ab^2 \cos(B - 2A) + b^3 \cos 3A =$

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6. If in a $\Delta ABC, \frac{a \cos A + b \cos B + c \cos C}{a \sin B + b \sin C + c \sin A} = \frac{a + b + c}{9R}$, then prove that Δ is equilateral.

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7. In ΔABC, $'h'$ is the length of altitude drawn from vertex A on the side BC. Prove that:

$2(b^2 + c^2) \geq 4h^2 + a^2$. Also, discuss the case when equality holds true.

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8. An equilateral triangle PQR is circumscribed about a given ΔABC. Prove that the maximum area of ΔPQR is $2\Delta + \frac{a^2+b^2+c^2}{2\sqrt{3}}\Big)$. Where a,b,c are the sides of $\Delta ABC an \Delta$ is its area.

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9. In a scalene acute ΔABC, it is known that line joining circumentre and prthocentre is parallel to BC. Prove that the angle $A \in \left(\frac{\pi}{3}, \frac{\pi}{2}\right)$.

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10. Two circle, that sum of whose radii is 'a' are placed in the same plane with their distance '2a' apart. An endless string is fully stretched so as partly to surround the circle and to cross between them, prove that length of string is $\left(\frac{4\pi}{3} + 2\sqrt{3}\right)a$.

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Exercise (Questions Asked In Previous 13 Years Exam)

1. In a triangle XYZ, let x, y, z be the lengths of sides opposite to the angles X, Y, Z, respectively, and 2s = x + y + z. If $\frac{s-x}{4}=\frac{s-y}{3}=\frac{s-z}{2}$ of incircle of the triangle XYZ is $\frac{8\pi}{3}$

A. (a)area of the ΔXYZ is $6\sqrt{6}$

B. (b)the radius of circum-circle of the $\Delta XYZ is \frac{35}{6}\sqrt{6}$

C. (c)$\sin\frac{X}{2}\sin\frac{Y}{2}\sin\frac{Z}{2}=\frac{4}{35}$

D. (d)$\sin^2\left(\frac{X+Y}{2}\right)=\frac{3}{5}$

Answer: A::C::D

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2. In a triangle the sum of two sides is x and the product of the same is y. If $x^2 - c^2 = y$ where c is the third side. Determine the ration of the in-radius and circum-radius

A. $\frac{3y}{2x(x+c)}$

B. $\frac{3y}{2c(x+c)}$

C. $\frac{3y}{4x(x+c)}$

D. $\frac{3y}{4c(x+c)}$

Answer: B

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3. Consider a triangle ABC and let $a, bandc$ denote the lengths of the sides opposite to vertices $A, B, andC$, respectively. Suppose $a = 6, b = 10,$ and the area of triangle is $15\sqrt{3}$. If $\angle ACB$ is obtuse and if r denotes the radius of the incircle of the triangle, then the value of r^2 is

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4. about to only mathematics

A. 16

B. 18

C. 20

D. 22

Answer: A::B

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5. Let PQR be a triangle of area Δ with $a = 2, b = 7/2$, and $c = 5/2$, where a, b and c are the lengths of the sides of the triangle opposite to the angles at P, Q and R, respectively. Then $\frac{2 \sin P - \sin 2P}{2 \sin P + \sin 2P}$ equals

A. $\frac{3}{4Detla}$

B. $\frac{45}{4\Delta}$

C. $\left(\frac{3}{4\Delta}\right)^2$

D. $\left(\frac{45}{4\Delta}\right)^5$

Answer: B::C::D

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6. If the angle $A, BandC$ of a triangle are in an arithmetic propression and if $a, bandc$ denote the lengths of the sides opposite to $A, BandC$ respectively, then the value of the expression $\frac{a}{c}\sin 2C + \frac{c}{a}\sin 2A$ is (a) $\frac{1}{2}$ (b) $\frac{\sqrt{3}}{2}$ (c) 1 (d) $\sqrt{3}$

A. $\frac{1}{2}$

B. $\frac{\sqrt{3}}{2}$

C. 1

D. $\sqrt{3}$

Answer: D

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7. Let ABC be a triangle such that $\angle ACB = \frac{\pi}{6}$ and let a , b and c denote the lengths of the side opposite to A, B ,and C respectively. The value(s) of x for which $a = x^2 + x + 1, b = x^2 - 1, \text{ and } c = 2x + 1$ is(are) $-(2 + \sqrt{3})$ (b) $1 + \sqrt{3}$ (c)$2 + \sqrt{3}$ (d) $4\sqrt{3}$

A. $-(2 + \sqrt{3})$

B. $1 + \sqrt{3}$

C. $2 + \sqrt{3}$

D. $4\sqrt{3}$

Answer: B

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8. A triangle ABC with fixed base BC , the vertex A moves such that $\cos B + \cos C = 4\frac{\sin^2 A}{2}$. If $a, bandc,$ denote the length of the sides of the triangle opposite to the angles $A, B, andC$, respectively, then (a) $b + c = 4a$ (b) $b + c = 2a$ (c)the locus of point A is an ellipse (d)the locus of point A is a pair of straight lines

A. $b + c = 4a$

B. $b + c = 2a$

C. locus of point A is an ellipes

D. locus of point A is a pair of straight line

Answer: B::C

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9. Let $ABCandABC'$ be two non-congruent triangles with sides $AB = 4, AC = AC' = 2\sqrt{2}$ and angle $B = 30^0$. The absolute value of the difference between the areas of these triangles is

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10. A straight line through the vertex P of a triangle PQR intersects the side QR at the points S and the cicumcircle of the triangle PQR at the point T. If S is not the center of the circumcircle, then $\frac{1}{PS}+\frac{1}{ST}<\frac{2}{\sqrt{QS\times SR}}$ $\frac{1}{PS}+\frac{1}{ST}>\frac{2}{\sqrt{QS\times SR}}$ $\frac{1}{PS}+\frac{1}{ST}<\frac{4}{QR}$ $\frac{1}{PS}+\frac{1}{ST}>\frac{4}{QR}$

A. $\frac{1}{PS}+\frac{1}{ST}<\frac{2}{\sqrt{QS\times SR}}$

B. $\frac{1}{PS}+\frac{1}{ST}>\frac{2}{\sqrt{QS\times SR}}$

C. $\frac{1}{PS}+\frac{1}{ST}<\frac{4}{QR}$

D. $\frac{1}{PS}+\frac{1}{ST}>\frac{4}{QR}$

Answer: D

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11. Consider the circle $x^2 + y^2 = 9$ and the parabola $y^2 = 8x$. They intersect at P and Q in first and fourth quadrant respectively. Tangents to the circle at P and Q intersect the x-axis at R and tangents at the parabola at P and Q intersect the x-axis at S.

A. 4

B. 3

C. $\frac{8}{3}$

D. 2

Answer: B

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12. Consider the circle $x^2 + y^2 = 9$ and the parabola $y^2 = 8x$. They intersect at P and Q in first and fourth quadrant respectively. Tangents to the circle at P and Q intersect the x-axis at R and tangents at the parabola at P and Q intersect the x-axis at S.

A. 5

B. $3\sqrt{3}$

C. $3\sqrt{2}$

D. $2\sqrt{3}$

Answer: B

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13. Consider the circle $x^2 + y^2 = 9$ and the parabola $y^2 = 8x$. They intersect at P and Q in first and fourth quadrant respectively. Tangents to the circle at P and Q intersect the x-axis at R and tangents at the parabola at P and Q intersect the x-axis at S.

A. $1 : \sqrt{2}$

B. $1 : 2$

C. $1 : 4$

D. $1 : 8$

Answer: C

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14. Internal bisector of $\angle A$ of triangle ABC meets side BC at D. A line drawn through D perpendicular to AD intersects the side AC at E and the side AB at F. If a, b, c represent sides of ΔABC, then

A. AE is HM of b and a

B. $AD = \frac{2bc}{b+c}\cos\frac{A}{2}$

C. $EF = \frac{4bc}{b+c}\sin\frac{A}{2}$

D. ΔAEF is isosceles

Answer: A::B::C::D

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15. One angle of an isosceles triangle is 120^0 and the radius of its incricel is $\sqrt{3}$. Then the area of the triangle in sq. units is $7 + 12\sqrt{3}$ (b) $12 - 7\sqrt{3}$ $12 + 7\sqrt{3}$ (d) 4π

A. $4\sqrt{3}$

B. $12 - 7\sqrt{3}$

C. $12 + 7\sqrt{3}$

D. None of the above

Answer: C

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16. In ΔABC, which one is true among the following ?

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

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

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

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

Answer: D

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17. Let a vertical tower AB have its end A on the level ground. Let C be the mid point of AB and P be a point on the ground such that $AP=2AB$. If $\angle BPC=\beta$, then $\tan\beta$ is equal to : $\frac{2}{9}$ (2) $\frac{4}{9}$ (3) $\frac{6}{7}$ (4) $\frac{1}{4}$

A. $\frac{6}{7}$

B. $\frac{1}{4}$

C. $\frac{2}{9}$

D. $\frac{4}{9}$

Answer: C

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18. ABCD is a trapezium such that AB and CD are parallel and $BC \perp CD$.

If $\angle ADB = \theta$, $BC = p$ and $CD = q$, then AB is equal to

A. $\dfrac{(p^2 + q^2)\sin\theta}{p\cos\theta + q\sin\theta}$

B. $\dfrac{p^2 + q^2\cos\theta}{p\cos\theta + q\sin\theta}$

C. $\dfrac{p^2 + q^2}{p^2\cos\theta + q^2\sin\theta}$

D. $\dfrac{(p^2 + q^2)\sin\theta}{(p\cos\theta + \sin\theta)^2}$

Answer: A

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19. For a regular polygon, let r and R be the radii of the inscribed and the cirumscribed circles, respectively. A false statement among the following is

A. there is a regular polygon with $\dfrac{r}{R} = \dfrac{1}{2}$

B. there is a regular polygon with $\dfrac{r}{R} = \dfrac{1}{\sqrt{2}}$

C. there is a regular plygon with $\frac{r}{R} = \frac{2}{3}$

D. there is a regular plygon with $\frac{r}{R} = \frac{\sqrt{3}}{2}$

Answer: A::B::D

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20. In triangle ABC, let $\angle c = \frac{\pi}{2}$. If r is the inradius and R is circumradius of the triangle, then $2(r + R)$ is equal to $a + b$ (b) $b + c$ $c + a$ (d) $a + b + c$

A. $c + a$

B. $a + b + c$

C. $a + b$

D. $b + c$

Answer: A

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21. If in a ΔABC, the altitudes from the vertices A, B, C on opposite sides are in H.P, then sin A, sin B, sin C are in

A. HP

B. AGP

C. AP

D. GP

Answer: C

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