MATHS

BOOKS - FULL MARKS MATHS (TAMIL ENGLISH)

TRIGONOMETRY

Example

1. Prove that $\frac{\tan\theta + \sec\theta - 1}{\tan\theta - \sec\theta + 1} = \frac{1 + \sin\theta}{\cos\theta}$

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2. Prove that

$(\sec A - \text{cosec A})(1 + \tan A + \cot A) = \tan A \sec A - \cot A \quad \text{cosec} \quad A$

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3. Eliminate $\theta$from q $\cos\ \theta = b$ and $c\sin\theta = d,$ where a,b,c,d are constants

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4. Convert (i) 18° to radians (ii) -108° to radians.

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5. Convert (i) $\frac{\pi}{5}$ radians to degrees (ii)$\frac{\pi}{6}$ radians to degrees.

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6. Find the length of an arc of a circle of radius 5cm subtending a central angle measuring 15°.

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7. If the arcs of same lengths in two circles subtend central angle 30° and 80° and find the ratio of their radii.

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8. The terminal side of an angle θ in standard position passes through the point (3,-4). Find the six trigonometric function values at angle θ.

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9. If $\sin\theta = \frac{3}{5}$ and the angle θ in the second quadrant, then find $\cot\theta$.

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10. Find the value of (i) $\sin(-45^\circ)$ (ii) $\cos(-45^\circ)$ (iii) $\cot(-45^\circ)$

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11. Find the value of (i) $\sin 150^\circ$ (ii) $\cos 135^\circ$ (iii) $\tan^{120^\circ}$.

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12. Find the value of (i) $\sin 765^\circ$ (ii) $\operatorname{cosec}(-1410^\circ)$ (iii) $\cot\left(\frac{-15\pi}{4}\right)$

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13. Prove that $\tan 315^\circ \cot(-405^\circ) + \cot 495^\circ \tan(-585^\circ) = 2$

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14. Determine whether the following functions are even, odd or neither.

$(i)\sin^2 x - 2\cos^2 x - \cos x$ (ii) $\sin(\cos(x))$ (iii) $\cos(\sin(x))$ (iv) $\sin x + \cos x$

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15. Find the values of (i) $\cos 15^\circ$ and (ii) $\tan 165^\circ$

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16. If $\sin x = \frac{4}{5}$ (in I quadrant) and $\cos y = \frac{-12}{13}$ (in II quadrant), then find $(i)\sin(x-y)$, $(ii)\cos(x-y)$.

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17. Prove that $\cos\left(\frac{3\pi}{4}+x\right) - \cos\left(\frac{3\pi}{4}-x\right) = -\sqrt{2}\sin x$

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18. Point A(9,12) rotates around the origin O in a plane through 60° in the anticlockwise direction to a new position B. Find the coordinates of the point B.

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19. A ripple tank demostrates the effect of two water being added together. The two waves are described by $h = 8\cos t$ and $h = 6\sin t$, where $t \in [0, 2\pi)$ is in second and h is the height in millimeters above still water. Find the maximum height of the resultant wave and the value of t at which it occurs.

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20. Find the value of $\cos 45^\circ + \sin 45^\circ$

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21. A foot ball player can kick a football from ground level with an initial velocity of 80 ft/ second. Find the maximum horizontal distance the football travels and at what angle (Take g=32).

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22. Find the value of $\sin\left(22\frac{1^\circ}{2}\right)$

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23. Find the value of $\sin 2\theta$, when $\sin\ \theta = \frac{12}{13}, \theta$ lies in the first quadrant

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24. Prove that $\sin 4A = 4\sin A\cos^3 A - 4\cos A\sin^3 A$

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25. Prove that $\sin x = 2^{10}\sin\left(\frac{x}{2^{10}}\right)\cos\left(\frac{x}{2}\right)\cos\left(\frac{x}{2^2}\right).....\cos\left(\frac{x}{2^{10}}\right).$

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26. Prove that $\frac{\sin\theta + \sin 2\theta}{1 + \cos\theta + \cos 2\theta} = \tan\theta$

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27. prove that $1 - \frac{1}{2}(\sin 2x) = \frac{\sin^3 x + \cos^3 x}{\sin x + \cos x}$

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28. Find x such that $-\pi \leq x \leq \pi$ and $\cos 2x = \sin x$

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29. Find the value of $\cos 135^\circ$

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30. If $\tan\left(\frac{\phi}{2}\right) = \sqrt{\frac{1+a}{1-a}}\tan\frac{\theta}{2}$, then prove that $\cos\ \phi = \frac{\cos\theta - a}{1 - a\cos\theta}$

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31. Find the value of $\sqrt{3}\ \text{cosec}\ 20^\circ - \sec 20^\circ$

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32. Prove that $\cos A\cos 2A\cos 2^2 A\cos 2^3 A.... \cos 2^{n-1}A = \frac{\sin 2^n A}{2^n \sin A}$

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33. Express each of the following product as a sum or difference.

(i) $\sin 40^\circ \cos 30^\circ$

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34. Express the following sum or difference as a product

(i) $\sin 50^\circ + \sin 20^\circ$

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35. Find the value of $\sin 34^\circ + \cos 64^\circ - \cos 4^\circ$.

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36. Find the value of $\sin 120^\circ$

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37. Simplify $\frac{\sin 75^\circ - \sin 15^\circ}{\cos 75^\circ + \cos 15^\circ}$

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38. Find the value of $\cos 30^\circ + \sin 30^\circ$

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39. $\cos A + \cos B + \cos C = 1 + 4\sin\left(\frac{A}{2}\right)\sin\left(\frac{B}{2}\right)\sin\left(\frac{C}{2}\right)$

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40. Prove that $\sin\frac{A}{2} + \sin\frac{B}{2} + \sin\frac{C}{2} = 1 + 4\sin\left(\frac{\pi - A}{4}\right)\sin\frac{\pi - B}{4}\sin\left(\frac{\pi - C}{4}\right),$

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41. If $A + B + C = \pi$ prove that $\cos^2 A + \cos^2 B + \cos^2 C = 1 - 2\cos A \cos B \cos C.$

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42. Find the general solution of $\sin\theta = \frac{1}{2}$

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43. Find the general solution of $\sin\theta = -\frac{\sqrt{3}}{2}$

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44. Find the general solution of $\tan\theta = \sqrt{3}$

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45. Solve $3\cos^2\theta = \sin^2\theta$

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46. Express the following sum or difference as a product

(iii) $\cos \frac{3x}{2} - \cos \frac{9x}{2}$

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47. Solve $2 \sin^2 x = 2$

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48. Solve the equation $\sin 9\theta = \sin \theta$

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49. Solve: tan 2x = - cot $\left(x + \frac{\pi}{3}\right)$.

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50. Solve $\sin x - 3\sin 2x + \sin 3x = \cos x - 3\cos 2x + \cos 3x$

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51. Solve $\sin x + \cos x = 1 + \sin x \cos x$

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52. Write the general form of $\cos\theta$

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53. Write the general form of $\sin\theta$

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54. Solve $\sqrt{3}\tan^2\theta + \left(\sqrt{3} - 1\right)\tan\theta - 1 = 0$

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55. The Government plans to have circular zoological park of diameter 8 km. A separate area in the form of a segment formed by a chord of length 4 km is to allotted exclusively for a veterinary hospital in the park find the area of the segment to be allotted for the veterinary hospital.

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56. In a $\triangle ABC$, prove that $b^2 \sin 2C + c^2 \sin 2B = 2bc \sin A$.

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

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58. If the three angles in a triangle are in the ratio 1:2:3, then prove that the corresponding sides are in the ratio $1:\sqrt{3}:2$.

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59. Show that $(b+c)\cos A+(c+a)\cos B+(a+b)\cos C=a+b+c$

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

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61. Derive cosine formula using the law of sines in a $\triangle ABC$.

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62. Using Heron's formula, show that equilateral triangle has the maximum area for any fixed perimeter. $\left[H \int: In\mathrm{xyz\,le\,k},\ \text{maximum occurs when } \mathrm{x{=}y{=}z}\right]$.

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63. In a $\triangle ABC, a=3, b=5$ and $c=7$. Find the vales of cos A, cos B and cos C.

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64. In a $\triangle ABC, A=30^\circ, B=60^\circ$. Find the other angle C

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65. In a $\triangle ABC,$ if $a=2\sqrt{2}, b=2\sqrt{3}$ and $C=75^\circ$, find the other side and the angles.

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66. Find the area of the triangle whose sides are 13cm, 14cm &15cm.

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67. In any triangle ABC, prove that a cos A+b cos B +c cos C $= \frac{8 \triangle^2}{abc}$.

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68. Suppose that there are two cell phone towers within range of a cell phone. The two towers are located at 6km apart along a straight highway. Running east to west and the cell phone is north of the highway. The signal is 5km from the first tower and $\sqrt{31}$ km from the second tower. Determine the position of the cell phone north and east of the first tower and how far it is from the highway.

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69. Suppose that a boat travels 10 km from the port towards east and then turns 60° to its left. If the boat travels further 8 km, how far from the port is the boat?

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70. Suppose two radar stations located 100km apart, each detect a fighter aircraft between them. The angle of elevation measured by the first station is 30°, whereas the angle of elevation measured by the second station is 45°. Find the altitude of the aircraft at that instant.

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Additional Questions Solved

1. Prove that $(\sec\theta + \cos\theta)(\sec\theta - \cos\theta) = \tan^2\theta + \sin^2\theta$

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2. If $\tan\theta + \sec\theta = x$ show that $2\tan\theta = x - \frac{1}{x}, 2\sec\theta = x + \frac{1}{x}$.

Hence show that $\sin\theta = \frac{x^2 - 1}{x^2 + 1}$

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3. If $\tan\theta + \sin\theta = p, \tan\theta - \sin\theta = q$ and $p > q$ then show that $p^2 - q^2 =$

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4. If $\cos\theta + \sin\theta = \sqrt{2}\cos\theta,$ show that $\cos\theta - \sin\theta = \sqrt{2}\sin\theta.$

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5. Prove that $(1 + \tan A + \sec A)(1 + \cot A - \text{ cosec A}) = 2$

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6. An athlete runs 4 times around a circular running track to describe 1760 m. What the (radius of the tract) degrees subtended at the centre of the circle, after he has run a distance of 308 m?

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7. Find the angle through which a pendulum swings if its length is 75cm and the tip describes an arc of length (i) 10 cm (ii) 15 cm (iii) 19 cm

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8. The angle of a quadrilateral are in A.P. and the greatest angle is 120°. Expres the other angle in radians.

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9. A railroad curve is to be laid on a circle. What radius should be used if the track to change direction by 25° in a distance of 40 meters?

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10. A horse is tied to a post by a rope. If the horse moves along a circular path always keeping the rope tight and describe 88 metres when it has tracted out 72° at the centre,find the length of the rope.

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11. A circular wire of radius 3 cm is out bent so as to lie along the circumference of a sector whose radius is 48cm. Find in degress the angle which is substended at the centre of the sector.

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12. Let α, β such that $\pi < \alpha - \beta < 3\pi$. If $\sin \alpha + \sin \beta = -21/65 \cos \alpha + c$, then find the value of $\cos \frac{\alpha - \beta}{2}$.

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13. Prove that $\sin 600^\circ \cdot \tan(-690^\circ) + \sec 840^\circ \cdot \cot(-945^\circ) = \frac{3}{2}$

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14. Prove that

$$\sin(270^\circ - \theta)\sin(90^\circ - \theta) - \cos(270^\circ - \theta)\cos(90^\circ + \theta) + 1 = 0$$

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15. Prove that $\cos 24^\circ + \cos 55^\circ + \cos 125^\circ + \cos 204^\circ + \cos 300^\circ = \frac{1}{2}$

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16. Prove that $\cos^2\frac{\pi}{8}+\cos^2\frac{3\pi}{8}+\cos^2\frac{5\pi}{8}+\cos^2\frac{7\pi}{8}=2$

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17. Prove that

$$\left[1+\cot\alpha-\sec\left(\alpha+\frac{\pi}{2}\right)\right]\left[1+\cot\alpha+\sec\left(\alpha+\frac{\pi}{2}\right)\right]=2\cot\alpha.$$

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18. Write the general form for $\tan\theta$

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19. Simplify $\frac{\cos(90^\circ+\theta)\sec(-\theta)\tan(180^\circ-\theta)}{\sec(360^\circ-\theta)\sin(180^\circ+\theta)\cot(90^\circ+\theta)}$

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20. Find x from the equation cosec $(90^\circ + A) + x \cos A \cot(90^\circ + A) = \sin(90^\circ + A)$

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21. Prove that $\sin(A + B)\sin(A - B) = \cos^2 B - \cos^2 A$

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22. Prove that

(i) $\sin A + \sin(120^\circ + A) + \sin(240^\circ + A) = 0$

(ii) $\cos A + \cos(120^\circ + A) + \cos(120^\circ - A) = 0$

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23. If $\tan A = \frac{5}{6}, \tan B = \frac{1}{11}$, show that A+B=45°.

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24. If $A + B = 45^\circ$, show that $(1 + \tan A)(1 + \tan B) = 2$ and hence deduce the value of $\tan 22\frac{1^\circ}{2}$.

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25. If $\tan\alpha = \frac{1}{3}$, $\tan\beta = \frac{1}{7}$,show that $2\alpha + \beta = \frac{\pi}{4}$

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26. If $2\cos\theta = x + \frac{1}{x}$ then prove that $\cos 2\theta = \frac{1}{2}\left(x^2 + \frac{1}{x^2}\right)$

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27. Prove that $\cos 20^\circ \cos 40^\circ \cos 80^\circ = \frac{1}{8}$

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28. Show that $4\sin A\sin(60^\circ + A).\sin(60^\circ - A) = \sin 3A$

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29. Prove that $\cos 20^\circ \cos 40^\circ \cos 80^\circ = \frac{1}{8}$

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30. Prove that $\sin 20^\circ \sin 40^\circ \sin 60^\circ \sin 80^\circ = \frac{3}{16}.$

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31. Prove that $\sin 50^\circ - \sin 70^\circ + \cos 80^\circ = 0.$

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32. Prove that $(\cos\alpha + \cos\beta)^2 + (\sin\alpha - \sin\beta)^2 = 4\cos^2\left(\frac{\alpha+\beta}{2}\right)$

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33. Prove that $2\cos\frac{\pi}{13}\cos\frac{9\pi}{13}+\cos\frac{3\pi}{13}+\cos\frac{5\pi}{13}=0$

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34. Prove that $\frac{2\cos 2\theta+1}{2\cos 2\theta-1}=\tan(60^\circ+\theta)(\tan 60^\circ-\theta)$

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35. Prove that $\cos 20^\circ\cos 40^\circ\cos 80^\circ=\frac{1}{8}$.

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36. Prove that $\tan 70^\circ-\tan 20^\circ-2\tan 40^\circ=4\tan 10^\circ$

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37. Prove that $\cos\theta + \cos\left(\frac{2\pi}{3} - \theta\right) + \cos\left(\frac{2\pi}{3} + \theta\right) = 0$

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38. Prove that $\frac{\sin 11A \sin A + \sin 7A \sin 3A}{\cos 11A \sin A + \cos 7A \sin 3A} = \tan 8A$

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39. If A + B + C = 180°, prove that

sin 2A + sin 2B + sin 2C = 4 sin A sin B sin C

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40. If

$A + B + C = \pi, \quad$ prove that $\sin^2\frac{A}{2} + \sin^2\frac{B}{2} + \sin^2\frac{C}{2} = 1 - 2\sin\frac{A}{2}\sin$

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41. Solve $2\cos^2\theta + 3\sin\theta = 0$

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42. Solve: $2\tan\theta - \cot\theta = -1$

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43. Solve $\tan^2\theta + \left(1-\sqrt{3}\right)\tan\theta - \sqrt{3} = 0$

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44. Solve $\sqrt{3}\sin x + \cos x = 2$

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45. Solve $\sin^2\theta - 2\cos\theta + \frac{1}{4} = 0$

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46. In any triangle prove that $a^2 = (b+c)^2 \sin^2\left(\frac{A}{2}\right) + (b-c)^2 \cos^2\left(\frac{A}{2}\right)$

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47. Show that `cosA/a +cosB/b +cosC/c =(a^2 +b^2 +c^2)/2abc

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

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49. Show that $\cos\left[\frac{B-C}{2}\right] = \frac{b+c}{a}\sin\left(\frac{A}{2}\right)$

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50. Show that $\frac{\sum a^2 \sin(B-C)}{\sin A} = 0$

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51. Given a=8, b=9, c=10, find all the angles.

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52. Given a=31, b=42, c=57, find all the angles.

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53. In a triangle AC, $A = 35^\circ 17', C - 45^\circ 13', b = 42.1$ Solve the triangle

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54. Solve the triangle ABC if a=5, b=4 and $C = 68^\circ$

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55. Prove that $\tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) = \tan^{=-1}\left(\frac{2}{9}\right)$

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56. The number of solution of the eqution $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$ is

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57. Prove that $\tan^{-1}\left(\frac{m}{n}\right) - \tan^{-1}\left(\frac{m-n}{m+n}\right) = \frac{\pi}{4}.$

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58. Solve : $\tan^{-1}\left(\frac{2x}{1-x^2}\right) + \cot^{-1}\left(\frac{1-x^2}{2x}\right) = \frac{\pi}{3}, x > 0$

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59. Solve, $\tan^{-1}(x+1)+\tan^{-1}(x-1)=\tan^{-1}\frac{4}{7}$

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Exercise 3 1

1. Identify the quadrant in which an angle of each given measure lies:

825°

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2. For each given angle, find a coterminal angle with measure of θ such that $0^\circ \leq \theta < 360^\circ$

(i) 395° (ii) 525° (iii) 1150° (iv) -270° (v) -450°

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3. If a cos θ - b sinθ = c, show that a sin θ + b cos $\theta = \pm \sqrt{a^2 + b^2 - c^2}$

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4. If sin θ + cos θ = m, show that

$\cos^6 \theta + \sin^6 \theta = \frac{4 - 3(m^2 - 1)^2}{4}$ where $m^2 \leq 2$.

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5. If $\frac{\cos^4 \alpha}{\cos^2 \beta} + \frac{\sin^4 \alpha}{\sin^2 \beta}$ = 1, prove that

$\sin^4 \alpha + \sin^4 \beta = 2 \sin^2 \alpha \sin^2 \beta$

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6. If y = $\frac{2 \sin \alpha}{1 + \cos \alpha + \sin \alpha}$ then, prove that $\frac{1 - \cos \alpha + \sin \alpha}{1 + \sin \alpha} = y$.

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7. If

$$x = \sum_{n=0}^{\infty} \cos^{2n}\theta,\ y = \sum_{n=\theta}^{\infty} \sin^{2n}\theta \text{ and } z = \sum_{n=0}^{\infty} \theta \sin^{2n}\theta, 0 < \theta < \frac{\pi}{2}.$$

Then show that $xyz = x + y + z$.

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8. If $\tan^2\theta = 1 - k^2$, show that sec θ + $\tan^3\theta$ cosec $\theta = \left(2 - k^2\right)^{3/2}$.

Also, find the values of k for which this result holds.

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9. If sec $\theta + \tan\theta =$ p, obtain the values of sec θ, tan θ and sin θ in terms of p.

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10. If cot $\theta(1 + \sin\theta) = 4m$ and cot θ $(1 - \sin\theta) = 4n$, prove that $\left(m^2 - n^2\right)^2 = mn$.

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11. If $\operatorname{cosec}\theta - \sin\theta = a^3$ and $\sec\theta - \cos\theta = b^3$, then prove that $a^2b^2\left(a^2 + b^2\right) = 1$.

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12. Eliminate θ from the equations a sec θ - c tan θ = b and b sec θ + d tan θ = c.`

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Exercise 3 2

1. Express each the angles in radian measure.

-205°

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2. Find the degree measure corresponding to the radian measures.

$\frac{\pi}{3}$

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3. What must be the radius of a circular running path, around which an athlete must run 5 times in order to describe 1 km?

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4. In a circle of diameter 40 cm, a chord is of length 20 cm. find the length of the minor are of the chord.

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5. Find the degree measure of the angle subtended at the centre of circle of radius 100 cm by an are of length 22 cm.

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6. What is the length of the are intercepted by a central angle of measure 41° in a circle of radius 10 ft?

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7. If in two circles, arcs of same length subtend angles 60° and 75° at the centre, find the ratio of their radii?

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8. The perimeter of certain sector of a circle is equal to the length of the a semi-circle having the same radius. Express the angle of the sector in degress, minutes and seconds.

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9. An airplane propeller rotates 1000 times per minute. Find the number of degrees that a point on the edge of the propeller will rotate in 1 second.

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10. A train is moving on a circular track of 1500 m radius at the rate of 66 km/hr. what angle will it turn in 20 seconds?

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11. A circular metallic plate of radius 8 cm and thickness 6 mm is melted and molded into a pie (a sector of the circle with thickness) of radius 16 cm and thickness 4 mm. Find the angle of the sector. $= \frac{3}{4}\pi$ radians.

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Exercise 3 3

1. Find the values of

$\sin(480^\circ)$

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2. $\left(\frac{5}{7}\frac{2\sqrt{6}}{7}\right)$ is a point on the terminal side of an angle θ in standard position. Determine the trigonometric function values of angle θ.

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3. Find the values of other five trigonometric functions.

$\cos\theta = -\frac{1}{2}$, θ lies in the III quadrant.

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4. Prove that $-\frac{\cot(180^\circ+\theta)\sin(90^\circ-\theta)\cos(-\theta)}{\sin(270^\circ+\theta)\tan(-\theta)\cos ec(360^\circ+\theta)} = \cos^2\theta\cot\theta.$

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5. Find all the angles between 0° and 360° which satisfy the equation $\sin^2\theta = \frac{3}{4}$

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6. Show that $\sin^2\frac{\pi}{18} + \sin^2\frac{\pi}{9} + \sin^2\frac{7\pi}{18} + \sin^2\frac{4\pi}{9} = 2.$

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Exercise 3 4

1. If sin x = $\frac{15}{17}$ and cos y = $\frac{12}{13}, 0 < x < \frac{\pi}{2}, 0 < y < \frac{\pi}{2},$

find the values of

sin (x + y)

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2. If sin A = $\frac{3}{5}$ and cos B = $\frac{9}{41}, 0 < A < \frac{\pi}{2}, 0 < B < \frac{\pi}{2}$

Find the value of

sin (A + B)

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3. Find cos (x - y), given that cos x = $-\frac{4}{5}$ with $\pi < x < \frac{3\pi}{2}$ and sin y = $-\frac{24}{25}$ with $\pi < y < \frac{3\pi}{2}$.

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4. Find sin (x - y) given that sin x = $\frac{8}{17}$ with $0 < x < \frac{\pi}{2}$ and cos y = - $\frac{24}{25}$ with $\pi < y < \frac{3\pi}{2}$.

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5. Find the value of

cos 105°

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6. Prove that

$\sin(\pi + \theta) = -\sin\theta$

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7. Find a quadratic equation whose roots are sin 15° and cos 15°

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8. Expand cos (A + B + C). Hence prove that cos A cos B cos C = sin A sin B cos C + sin B sin C cos A + sin C sin A cos B, if A + B + C = $\frac{\pi}{2}$.

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9. Prove that

$\sin(45^\circ + \theta) - \sin(45^\circ - \theta) = \sqrt{2}\sin\theta$

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10. If a cos (x + y) = b cos (x - y), show that (a + b)tan x = (a - b) cot y.

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11. Prove that $\sin 105^\circ + \cos 105^\circ = \cos 45^\circ$

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12. Prove that $\sin 75^\circ - \sin 15^\circ = \cos 105^\circ + \cos 15^\circ$

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13. Show that $\tan 75^\circ + \cot 75^\circ = 4$

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14. Prove that cos (A + B) cos C - cos (B + C)

cos A = sin B sin (C - A)

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15. Prove that sin (n + 1)θ sin (n - 1) θ + cos (n + 1)θ cos (n - 1) θ = cos 2θ, n $\in \mathbb{Z}$.

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16. If x cos θ = y cos $\left(\theta + \frac{2\pi}{3}\right)$ = z cos $\left(\theta + \frac{4\pi}{3}\right)$, find the value of xy + yz + zx

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17. Prove that

$\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B.$

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18. Show that

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

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19. If $\cos(\alpha-\beta)+\cos(\beta-\gamma)+\cos(\gamma-\alpha)=\frac{-3}{2}$ then prove that $\cos\alpha+\cos\beta+\cos\gamma=\sin\alpha+\sin\beta+\sin\gamma=0$.

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20. Show that

$$\tan(45^\circ+A)=\frac{1+\tan A}{1-\tan A}$$

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21. Prove that cot (A + B) = $\frac{\cot A\cot B-1}{\cot A+\cot B}$

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22. If tan x = $\frac{n}{n+1}$ and tan y = $\frac{1}{2n+1}$, find tan (x + y).

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23. Prove that $\tan\left(\frac{\pi}{4}+\theta\right)\tan\left(\frac{3\pi}{4}+\theta\right) = -1$

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24. Find the values of $\tan(\alpha+\beta)$, given that $\cot\alpha = \frac{1}{2}$ $\alpha \in \left(\pi, \frac{3\pi}{2}\right)$ and $\sec\beta = -\frac{5}{3}, \beta \in \left(\frac{\pi}{2}, \pi\right)$.

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25. If $\theta+\phi=\alpha$ and $\tan\theta = k\tan\phi$, then prove that $\sin(\theta-\phi) = \frac{k-1}{k+1}\sin\alpha$.

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Exercise 3 5

1. Find the values of cos 2A, A lies in the first quadrant, when

$\cos A = \frac{15}{17}$

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2. If $\theta$is an acute angle, then find

$\sin\left(\frac{\pi}{4} - \frac{\theta}{2}\right)$ when $\sin\theta = \frac{1}{25}$

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3. If $\cos\theta = \frac{1}{2}\left(a + \frac{1}{a}\right)$, show that $\cos 30 = \frac{1}{2}\left(a^3 + \frac{1}{a^3}\right)$.

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4. Prove that $\cos 50 = 16\cos^5\theta - 20\cos^3\theta + 5\cos\theta$

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5. Prove that $\sin 4\alpha = 4\tan\alpha \dfrac{1-\tan^2\alpha}{\left(1+\tan^2\alpha\right)^2}$

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6. If $A + B = 45^\circ$, show that $(1+\tan A)(1+\tan B) = 2$.

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7. Prove that $(1+\tan 1^\circ)(1+\tan 2^\circ)(1+\tan 3^\circ)....$

$(1+\tan 44^\circ)$ is multiple of 4.

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8. Prove that $\tan\left(\dfrac{\pi}{4}+\theta\right) - \tan\left(\dfrac{\pi}{4}-\theta\right) = 2\tan 2\theta.$

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9. Show that $\cot\left(7\frac{1}{2}\right) = \sqrt{2}+\sqrt{3}+\sqrt{4}+\sqrt{6}$.

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10. Prove that

$(1+\sec 2\theta)(1+\sec 4\theta)\ldots\ldots.(1+\sec 2^n\theta) = \tan 2^n\theta \cot\theta$

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11. Prove that $32(\sqrt{3})\sin\frac{\pi}{48}\cos\frac{\pi}{48}\cos\frac{\pi}{24}\cos\frac{\pi}{12}\cos\frac{\pi}{6} = 3$

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Exercise 3 6

1. Express each of the following as a sum or difference.

$\sin 5\theta \sin 4\theta$

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2. Express each of the folloiwng as a product

(i) $\sin 75^\circ - \sin 35^\circ$ (ii) $\cos 65^\circ + \cos 15^\circ$ (iii) $\sin 50^\circ + \sin 40^\circ$ (iv) $\cos 35^\circ - \cos 75^\circ$.

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3. Show that $\sin 12^\circ \sin 48^\circ \sin 54^\circ = \frac{1}{8}$

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4. Show that $\cos\frac{\pi}{15}\cos\frac{2\pi}{15}\cos\frac{3\pi}{15}\cos\frac{4\pi}{15}\cos\frac{5\pi}{15}\cos\frac{6\pi}{15}\cos\frac{7\pi}{15} = \frac{1}{128}$.

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5. Show that $\frac{\sin 8x \cos x - \sin 6x \cos 3x}{\cos 2x \cos x - \sin 3x \sin 4x} = \tan 2x$

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6. Show that $\frac{(\cos\theta - \cos 3\theta)(\sin 8\theta + \sin 2\theta)}{(\sin 5\theta - \sin\theta)(\cos 4\theta - \cos 6\theta)} = 1$

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7. Prove that sin x + sin 2x + sin 3x = sin 2x (1 + 2 cos x)

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8. Prove that $\frac{\sin 4x + \sin 2x}{\cos 4x + \cos 2x} = \tan 3x.$

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9. Prove that 1 + cos 2x + cos 4x + cos 6x = 4 cos x cos 2x cos 3x

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10. Prove that $\sin\frac{\theta}{2}\sin\frac{7\theta}{2}+\sin\frac{3\theta}{2}\sin\frac{11\theta}{2}=\sin 2\theta\sin 5\theta.$

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11. Prove that $\cos(30^\circ-A)\cos(30^\circ+A)+\cos(45^\circ-A)\cos(45^\circ+A)=\cos 2A+\frac{1}{4}.$

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12. Prove that $\frac{\sin x+\sin 3x+\sin 5x+\sin 7x}{\cos x+\cos 3x+\cos 5x+\cos 7x}=\tan 4x$

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13. Prove that $\frac{\sin(4A-2B)+\sin(4B-2A)}{\cos(4A-2B)+\cos(4B-2A)}=\tan(A+B)$

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14. Show that $\cot(A+15^\circ) - \tan(A-15^\circ) = \dfrac{4\cos 2A}{1+2\sin 2A}$.

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Exercise 3 7

1. If $A+B+C=180^\circ$, prove that

(i) $\sin 2A + \sin 2B + \sin 2C = 4\sin A \sin B \sin C$

(ii) $\cos A + \cos B - \cos C = -1 + 4\cos\dfrac{A}{2}\cos\dfrac{B}{2}\sin\dfrac{C}{2}$

(iii) $\sin^2 A + \sin^2 B + \sin^2 C = 2 + 2\cos A \cos B \cos C$

(iv) $\sin^2 A + \sin^2 B - \sin^2 C = 2\sin A \sin B \cos C$

(v) $\tan\dfrac{A}{2}\tan\dfrac{B}{2} + \tan\dfrac{B}{2}\tan\dfrac{C}{2} + \tan\dfrac{C}{2}\tan\dfrac{A}{2} = 1$

(vi) $\sin A + \sin B + \sin C = 4\cos\dfrac{A}{2}\cos\dfrac{B}{2}\cos\dfrac{C}{2}$

(viii)

$\sin(B+C-A) + \sin(C+A-B) + \sin(A+B-C) = 4\sin A \sin B \sin$

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2. If A + B + C = 2s, then prove that sin (s - A) sin (s - B) + sin s. sin (s - C) = sin A sin B .

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3. If x + y + z = xyz, then prove that $\frac{2x}{1-x^2}+\frac{2y}{1-y^2}+\frac{2z}{1-z^2}=\frac{2x}{1-x^2}\cdot\frac{2y}{1-y^2}\cdot\frac{2z}{1-z^2}$.

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4. If $A+B+C=\frac{\pi}{2}$ prove the following

(i) $\sin 2A+\sin 2B+\sin 2C=4\cos A\cos B\cos C$

(ii) $\cos 2A+\cos 2B+\cos 2C=1+4\sin A\sin B\sin C.$

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5. If $\triangle ABC$ is a right triangle and if $\angle A=\frac{\pi}{2}$, then prove that

(i) $\cos^2 B+\cos^2 C=1$

(ii) $\sin^2 B + \sin^2 C = 1$

$\cos B - \cos C = -1 + 2\sqrt{2}\cos\frac{B}{2}\sin\frac{C}{2}$

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Exercise 3 8

1. Find the pricipal solution and general solutions of the following

(i) $\sin\theta = -\frac{1}{\sqrt{2}}$ (ii) $\cot\theta = \sqrt{3}$ (iii) $\tan\theta = -\frac{1}{\sqrt{3}}$

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2. Solve the following equations for which solution lies in the interval $0^\circ \leq \theta < 360^\circ$.

(i) $\sin^4 x = \sin^2 x$ (ii) $2\cos x + 1 = -3\cos x$

(iii) $2\sin^2 x + 1 = 3\sin x$ (iv) $\cos 2x = 1 - 3x\sin x$.

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3. Solve the following equations:

(i) $\sin 5x - \sin x = \cos 3x$ (ii) $2\cos^2\theta + 3\sin\theta - 3 = \theta$

(iii) $\cos\theta + \cos 3\theta = 2\cos 2\theta$ (iv) $\sin\theta + \sin 3\theta + \sin 5\theta = 0$

(v) $\sin 2\theta - \cos 2\theta - \sin\theta + \cos\theta = 0$ (vi) $\sin\theta + \cos\theta = \sqrt{3}$

(vii) $\sin\theta + \sqrt{3}\cos\theta = 1$ (viii) $\cot\theta + \quad \text{cosec} \quad \theta = \sqrt{3}$

$(ix)\tan\theta + \tan\left(\theta + \frac{\pi}{3}\right) + \tan\left(\theta + \frac{2\pi}{3}\right) = \sqrt{3}$

(x) $\cos 2\theta = \frac{\sqrt{5}+1}{4}$ (xi) $2\cos^2 x - 7\cos x + 3 = 0$

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Exercise 3 9

1. In a $\triangle ABC$, if $\frac{\sin A}{\sin C} = \frac{\sin(A-B)}{\sin(B-C)}$, prove that a^2, b^2, c^2 are in Artithmetic Progression.

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2. The angles of a triangle ABC, are in Arithmetic progression and if b : c = $\sqrt{3}:\sqrt{2}$, find $\angle A$

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

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4. In a $\triangle ABC$, prove that $\frac{\sin B}{\sin C} = \frac{c - a\cos B}{b - a\cos C}$

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5. In a $\triangle ABC$, prove that a cos A+b cos B+c cos C=2a sin B sin C

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6. In a ΔABC, $\angle A = 60^\circ$, prove that b + c = 2a cos $\left(\frac{B-C}{2}\right)$.

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7. In a $\triangle ABC$, prove that following

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

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

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

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

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8. In ΔABC, prove that $\left(a^2-b^2+c^2\right)$ tan B = $\left(a^2+b^2-c^2\right)$ tan C.

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9. An Engineer has to develop a triangular shaped park with a perimeter 120 m in a village. The park to be developed must be of maximum area. Find out the dimensions of the park.

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10. A rope of length 12 m is given. Find the largest area of the triangle formed by this rope and find the dimensions of the triangle so formed.

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11. Derive Projection formula from (i) Law of sines, (ii) Law of cosines.

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Exercise 3 10

1. Determine whether the following measurements produce one triangle, two triangles or no triangle.

$\angle B = 88^\circ, a = 23, b = 2$. Solve if solution exists.

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

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3. In ΔABC, if a = $\sqrt{3} - 1, b = \sqrt{3} + 1$ and $\angle C = 60^\circ$, find the other side and the other two angles.

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

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5. In a ΔABC, if a = 12 cm, b = 8 cm $\angle C = 30^\circ$, then show that its area is 24 sq.cm.

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6. In a ΔABC, if a = 18 cm, b = 24 cm and c = 30 cm. then show that its area is 216 sq.cm

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7. Two soldiers A and B in two different underground bunkers on a straight road, spot an intruder at the top of a hill. The angle of elevation of the intruder from A and B to the ground level in the eastern direction are $30^\circ \text{ and } 45^\circ$ respectively. If A and B stand 5 km apart, find the distance of the intruder from B.

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8. A researcher wants to determine the width of a pond from east to west, which cannot by done by actual measurement . From a point p, he finds the distance to the eastern-most point of the pond to be 8 km, while the distance to the western most point from P to be 6 km. if the angle between the two lines of sight is 60°, find the width of the pond.

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9. Two Navy helicopters A and B are flying over the bay of Bengal at same altitude from the sea level to search a missing boat. Pilots of both the helicopters sight the boat the same time while they are part 10 km from each other. If the distance of the boat from A is 6 km and if the line segment AB subtends 60° at the boat, find the distance of the boat from B.

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10. A straight tunnel is to be made through a mountain. A surveyor observer the two extremities A and B of the tunnel to be built from a point P in front of the mountain. If AP = 3 km, BP = 5 km and $\angle APB = 120^\circ$, then find the length of the tunnel to be built .

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11. A farmer wants to purchase a triangular shaped land with sides 120 feet and 60 feet and the angle included between these two sides is 60°. If the land costs ₹ 500 per sq. ft. find the amount he needed to purchase the land. Also, find the perimeter of the land.

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12. A fighter jet has to hit a small target by flying a horizontal distance. When the target is sighted, the pilot measures the angle of depression to be 30°. If after 100 km, the target has an angle of depression of 45°, how far is the target from the fighter jet at that instant?

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13. A plane is 1km from one landmark and 2km from another. From the planes point of view the land between them subtends an angle 60°. How far apart are the landmarks?

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14. A man starts his morning walk at a point A reaches two points B and C and finally back to A such that $\angle A = 60^\circ \text{ and } \angle B = 45^\circ$, AC = 4 km in ΔABC. Find the total distance he covered during his morning walk.

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15. Two vehicles leave the same place P at the same time moving along two different roads. One vehicle moves at an average speed of 60km/hr and the other vehicle moves at an average speed of 80km/hr. After half an

hour the vehicle reach the destinations A and B. If AB subtends 60° at the initial point. P, then find AB.

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16. Suppose that a satellite in space, an earth station and the centre of earth all lie in the same plane. Let r be the radius of earth and R be the distance from the centre of earth to the satellite. Let d be the distance from the earth station from the satellite. Let 30° be the angle of elevation from the earth station to the satellite. if the line segment connecting earth station and satellite subtends angle α at the centre of earth, then prove that

$$d = R\sqrt{1 + \left(\frac{r}{R}\right)^2 - 2\frac{r}{R}\cos\alpha}.$$

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Exercise 3 11

1. Find the principal value of (i) $\sin^{-1}\frac{1}{\sqrt{2}}$ (ii) $\sin^{-1}-\frac{1}{\sqrt{2}}$ (iii) $\cos^{-1}\frac{\sqrt{3}}{2}$ (iv) $\sec^{-1}(-\sqrt{2})$ (v) $\tan^{-1}(\sqrt{3})$

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2. A man standing directly opposite to one side of a road of width x meter views a circular shaped traffic green signal of diameter a meter on the other side of the road. The bottom of the green signal is b meter height from the horizontal level of viewer's eye. If a denotes the angle subtended by the diameter of the green signal at the viewer's eye, then prove that $\alpha=\tan^{-1}\left(\frac{a+b}{x}\right)-\tan^{-1}\left(\frac{b}{x}\right)$.

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Exercise 3 12

1. $\frac{1}{\cos 80^\circ}-\frac{\sqrt{3}}{\sin 80^\circ}=$

A. $\sqrt{2}$

B. $\sqrt{3}$

C. 2

D. 4

Answer: D

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2. If $\cos 28^\circ + \sin 28^\circ = k^3$, then $\cos 17^\circ$ is equal to

A. $\frac{k^3}{\sqrt{2}}$

B. $-\frac{k^3}{\sqrt{2}}$

C. $\pm\frac{k^3}{\sqrt{2}}$

D. $-\frac{k^3}{\sqrt{3}}$

Answer: A

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3. The maximum value of $4\sin^2 x + 3\cos^2 x + \sin\frac{x}{2} + \cos\frac{x}{2}$ is

A. $4 + \sqrt{2}$

B. $3 + \sqrt{2}$

C. 9

D. 4

Answer: A

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4. $\left(1 + \cos\frac{\pi}{8}\right)\left(1 + \cos\frac{3\pi}{8}\right)\left(1 + \cos\frac{5\pi}{8}\right)\left(1 + \cos\frac{7\pi}{8}\right) =$

A. $\frac{1}{8}$

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

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

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

Answer: A

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5. If $\pi < 2\theta < \frac{3\pi}{2}$, then $\sqrt{2+\sqrt{2+2\cos 4\theta}}$ equals to

A. $-2\cos\theta$

B. $-2\sin\theta$

C. $2\cos\theta$

D. $2\sin\theta$

Answer: C

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6. If $\tan 40^\circ = \lambda$, then $\frac{\tan 140^\circ - \tan 130^\circ}{1+\tan 140^\circ \tan 130^\circ}$ =

A. $\frac{1-\lambda^2}{\lambda}$

B. $\frac{1+\lambda^2}{\lambda}$

C. $\frac{1-\lambda^2}{2\lambda}$

D. $\frac{1-\lambda^2}{2\lambda}$

Answer: D

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7. $\cos 1^\circ + \cos 2^\circ + \cos 3^\circ + \ldots + \cos 179^\circ =$

A. 0

B. 1

C. -1

D. 89

Answer: A

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8. Let $f_4(x) = \frac{1}{k}\left[\sin^k + \cos^k x\right]$ where x $\in \mathbb{R}$ and $k \geq 1$.

then $f_4(x) - f_6(x)$ =

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

B. $\frac{1}{12}$

C. $\frac{1}{6}$

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

Answer: B

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9. Which of the following is not true?

A. $\sin\theta = -\frac{3}{4}$

B. $\cos\theta = -1$

C. $\tan\theta = 25$

D. $\sec\theta = \frac{1}{4}$

Answer: D

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10. $\cos 2\theta \cos 2\phi + \sin^2(\theta - \phi) - \sin^2(\theta + \phi)$ is equal to

A. $\sin 2(\theta + \phi)$

B. $\cos 2(\theta + \phi)$

C. $\sin 2(\theta - \phi)$

D. $\cos 2(\theta - \phi)$

Answer: C

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11. $\frac{\sin(A - B)}{\cos A \cos B} + \frac{\sin(B - C)}{\cos B \cos C} + \frac{\sin(C - A)}{\cos C \cos A}$ is

A. sin A+ sin B+sin C

B. 1

C. 0

D. cos A+cos B+cos C

Answer: B

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12. If cos pθ + cos qθ = 0 and if p $\neq$ q, then θ is equal to (n is any integer)

A. $\frac{\pi(3n+1)}{p-q}$

B. $\frac{\pi(2n+1)}{p \pm q}$

C. $\frac{\pi(n \pm 1)}{p \pm q}$

D. $\frac{\pi(n+2)}{p+q}$

Answer: B

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13. If $\tan\alpha$ and $\tan\beta$ are the roots of $x^2 + ax + b = 0$, then $\frac{\sin(\alpha+\beta)}{\sin\alpha\sin\beta}$ is equal to

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

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

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

D. $-\frac{b}{a}$

Answer: C

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14. In a triangle ABC, $\sin^2 A + \sin^2 B + \sin^2 C = 2$, then the triangle is

A. equilateral triangle

B. isosceles triangle

C. right triangle

D. scalene triangle

Answer: C

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15. If $f(\theta) = |\sin\theta| + |\cos\theta|, \theta \in \mathbb{R},$ then $f(\theta)$ is in the interval

A. [0,2]

B. $\left[1, \sqrt{2}\right]$

C. [1,2]

D. [0,1]

Answer: B

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16. $\frac{\cos 6x + 6\cos 4x + 15\cos 2x + 10}{\cos 5x + 5\cos 3x + 10\cos x}$ is equal to

A. cos 2x

B. cos x

C. cos 3x

D. cos 2x

Answer: D

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17. The triangle of maximum area with constant perimeter 12m

A. is an equilateral triangle with side 4m

B. is an isosceles triangle with sides 2m, 5m, 5m

C. is a triangle with sides 3m, 4m, 5m

D. does not exists

Answer: A

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18. A wheel is spinning at 2 radians/second. How many seconds will it take to make 10 complete rotations?

A. 10π seconds

B. 20π seconds

C. 5π seconds

D. 15π seconds

Answer: A

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19. If $\sin\alpha + \cos\alpha$= b, then $\sin 2\alpha$ is equal to

A. $b^2 - 1, \quad \text{if} \quad b \leq \sqrt{2}$

B. $b^2 - 1, \quad \text{if} \quad b > \sqrt{2}$

C. $b^2 - 1, \quad \text{if} \quad b \geq 1$

D. $b^2 - 1, \quad \text{if} \quad b \geq \sqrt{2}$

Answer: B

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20. In a ΔABC, if

(i)$\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} > 0$ (ii)$\sin A \sin B \sin C > 0$

A. Both (i) and (ii) are true

B. Only (i) is true

C. Only (ii) is true

D. Neighter (i) nor (ii) is true

Answer: A

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