



## MATHS

### BOOKS - S CHAND MATHS (ENGLISH)

### TRIGONOMETRICAL FUNCTIONS

#### Examples

1. Prove that  $\cos^4 A - \sin^4 A = \cos^2 A - \sin^2 A$ .



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2. Prove that  $(1 + \tan A)^2 + (1 - \tan A)^2 = 2 \sec^2 A$ .



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3. Prove that  $\cot^4 \theta + \cot^2 \theta = \operatorname{cosec}^4 \theta - \operatorname{cosec}^2 \theta$



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4. Show that  $\frac{\sec A + \tan A}{\operatorname{cosec} A + \cot A} = \frac{\operatorname{cosec} A - \cot A}{\sec A - \tan A}$ .



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5. Prove that  $\frac{1 + \sin \theta}{1 - \sin \theta} = (\sec \theta + \tan \theta)^2$



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6. If  $\cos \theta = \frac{-5}{12}$ , in which quadrant does  $\theta$  lie ?

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7. If  $\tan \theta = \frac{4}{3}$ , in which quadrant does  $\theta$  lie ?

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8. The following equations are impossible :

$$\sin \theta = -3, \quad \cos \theta = \frac{5}{4}, \quad \operatorname{cosec} \theta = \frac{3}{4}, \quad \sec \theta = \frac{-4}{5}$$

. Why ?

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9. The cosecant of a certain angle is  $\frac{13}{12}$ . Evaluate other ratios of this angle.

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10. If  $\cos \alpha = \frac{5}{13}$  and  $\alpha$  lies in the fourth quadrant, find the value of  $\frac{2 - 3 \cot \alpha}{4 - 9\sqrt{\sec^2 \alpha - 1}}$ .

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11. Verify :

$$\sin^2 \theta + \cos^2 \theta = 1 \quad \text{if } \theta = 30^\circ,$$

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12. Verify :

$$\sec^2 \theta = 1 + \tan^2 \theta \quad \text{if } \theta = \frac{\pi}{4},$$

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13. Verify :

$$\operatorname{cosec} \alpha = 1 + \cot^2 \alpha \quad \text{if } \alpha = \frac{\pi}{3}.$$

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$$14. \sin 115^\circ = \sin(90^\circ + 25^\circ) = \cos 25^\circ = 0.9063.$$

$$\cos 134^\circ = \cos(90^\circ + 44^\circ) = -\sin 44^\circ = -0.6947.$$

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$$15. \sin 120^\circ = \sin(180^\circ - 60^\circ) = \sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\cos 150^\circ = \cos(180^\circ - 30^\circ) = -\cos 30^\circ = \frac{-\sqrt{3}}{2}$$

$$\tan 172^\circ = \tan(180^\circ - 8^\circ) = -\tan 8^\circ = -0.1405$$



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$$16. \sin 225^\circ = \sin(180^\circ + 45^\circ) = -\sin 45^\circ = -\frac{1}{\sqrt{2}}$$

$$\cos 246^\circ = \cos(180^\circ + 66^\circ) = -\cos 66^\circ = -0.4067$$

$$\tan 211^\circ = \tan(180^\circ + 31^\circ) = \tan 31^\circ = 0.6009.$$



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17. Find the values of each of the following :

$$\tan 225^\circ, \sin 315^\circ, \tan(-1742^\circ), \cos(-1760^\circ).$$



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18. Prove that  $\tan 225^\circ \cot 405^\circ + \tan 765^\circ \cot 675^\circ = 0$



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19. If  $\tan A = -\sqrt{3}$ , find all the possible values of  $A$  between  $0^\circ$  and  $360^\circ$ .



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20. If  $\theta = -1000^\circ$ , determine the sign of  $\theta - \cos \theta$ .



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**21.** Find the values of  $x$  and  $y$ , lying between 0 and 360 which satisfy the equations,

$$\sin 2x^\circ = 0.6428$$

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**22.** Find the values of  $x$  and  $y$ , lying between 0 and 360 which satisfy the equations,

$$\cos\left(\frac{1}{2}y^\circ + 71^\circ\right) = -0.3420.$$

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**23.** In what quadrant does an angle lie if

(a) its sine is positive and its cosine is negative ?



(b) Its tangent positive and its sine is negative ?

(c) its cosine is positive and its tangent is negative ?

(d) its sine is negative and its cosine is positive ?



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**24.** Which is greater and why ?

$\sin 55^\circ$  or  $\cos 55^\circ$



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**25.** Which is greater and why ?

$\sin 30^\circ$  or  $\cos 30^\circ$



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26. Which is greater and why ?

$\sin 40^\circ$  or  $\cos 50^\circ$



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27. Is it possible to construct an angle whose sine =  $\frac{4}{3}$  ?



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28. Is it possible to construct an angle whose cosine = 5.7 ?



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29. Is it possible to construct an angle whose secant  
 $= \frac{3}{7}$  ?

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30. Is it possible to construct an angle whose cosecant  
 $= \frac{1}{2}$  ?

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31. Prove that

$$\tan \theta \tan(90^\circ - \theta) = 1$$

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**32.** Prove that

$$\sin \theta \cos(90^\circ - \theta) = \sin^2 \theta$$



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**33.** Prove that

$$\frac{\sin 18^\circ}{\cos 72^\circ} = 1$$



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**34.** Prove that

$$\frac{\sec 35^\circ}{\operatorname{cosec} 55^\circ} = 1$$



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**35.** Prove that

$$\frac{\tan 75^\circ}{\cot 15^\circ} = 1$$



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**36.** Prove that

$$\sin^2 47^\circ + \sin^2 43^\circ = 1$$



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**37.** Prove that

$$\sec^2 33^\circ - \cot^2 57^\circ = 1.$$



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**38.** If  $AB, AC$  are equal sides of an isosceles triangle, prove that  $\tan \frac{A}{2} = \cot B$ .

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## Exercise 4 A

**1.** Prove that

$$1 - \cos^2 \theta = \sin^2 \theta$$

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**2.** Prove that

$$\sqrt{1 - \sin^2 \theta} = \cos \theta.$$



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3. Prove that

$$\sec \alpha \sqrt{1 - \sin^2 \alpha} = 1$$



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4. Prove that

$$\frac{\sec^2 \theta - 1}{\tan^2 \theta} = 1$$



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5. Prove that

$$\sec^2 \theta - 1 - \tan^2 \theta = 0$$



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6. Prove that

$$\frac{\sin^2 \theta + \cos^2 \theta}{\sec^2 \theta - \tan^2 \theta} = 1$$



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7. Prove that

$$1 - \cos^2 \theta - \sin^2 \theta = 0$$



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8. Prove that

$$\sin^4 \theta + \sin^2 \theta \cos^2 \theta = \sin^2 \theta$$





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9. Prove that

$$\sin^4 \theta + 2 \sin^2 \theta \cos^2 \theta + \cos^4 \theta = 1$$



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10. Prove that

$$\cos^2 \theta (\operatorname{cosec}^2 \theta - \cot^2 \theta) = \cos^2 \theta.$$



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11. Prove that

$$\frac{\sin \theta \operatorname{cosec} \theta \tan \theta \cot \theta}{\sin^2 \theta + \cos^2 \theta} = 1$$



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12. Prove that

$$\frac{\sin^2 30^\circ + \cos^2 30^\circ}{\sec^2 57^\circ - \tan^2 57^\circ} = 1$$



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13. Prove that

$$\cos A \tan A = \sin A$$



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14. Prove that

$$\sin^4 A \operatorname{cosec}^2 A + \cos^4 A \sec^2 A = 1$$



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15. Prove that

$$\sin^2 A \cot^2 A + \cos^2 A \tan^2 A = 1.$$



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## Exercise 4 B

1. Prove that

$$\sec \theta \cot \theta = \operatorname{cosec} \theta$$



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2. Prove that

$$\tan \theta + \cot \theta = \sec \theta \operatorname{cosec} \theta.$$



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3. Prove that

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



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4. Prove that

$$\frac{1 + \cos \theta - \sin^2 \theta}{\sin \theta(1 + \cos \theta)} = \cot \theta$$



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5. Prove that

$$\frac{3 - 4\sin^2 \theta}{\cos^2 \theta} = 3 - \tan^2 \theta$$



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6. Prove that

$$(\tan A + \cot A)\sin A \times \cos A = 1$$



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7. Prove that

$$\cos A = \frac{\cot A}{\operatorname{cosec} A} = \frac{\cot A}{\sqrt{(1 + \cot^2 A)}} \quad (A \in \text{III quad.})$$



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8. Prove that

$$\sin^4 \theta - \cos^4 \theta = \sin^2 \theta - \cos^2 \theta.$$



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9. Prove that

$$\sec^2 A + \operatorname{cosec}^2 A = \sec^2 A \operatorname{cosec}^2 A.$$



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10. Prove that

$$\sin^3 \theta + \cos^3 \theta = (\sin \theta + \cos \theta)(1 - \sin \theta \cos \theta).$$



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**11. Prove that**

$$\sin^2 \phi (1 + \cot^2 \phi) = 1$$

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**12. Prove that**

$$\cos^2 A + \sec^2 A = (\tan A + \cot A)^2$$

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**13. Prove that**

$$\sec^4 A - \sec^2 A = \tan^2 A + \tan^4 A.$$

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**14.** Prove that

$$(\operatorname{cosec} \theta - \sin \theta)(\sec \theta - \cos \theta)(\tan \theta + \cot \theta) = 1$$



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**15.** Prove that

$$\frac{\cot A + \tan B}{\cot B + \tan A} = \cot A \tan B$$



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**16.** Prove that

$$\frac{\sin \alpha}{1 + \cos \alpha} + \frac{1 + \cos \alpha}{\sin \alpha} = 2 \operatorname{cosec} \alpha.$$



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17. Prove that

$$1 + \frac{1}{\cos A} = \frac{\tan^2 A}{\sec A - 1}$$

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18. Prove that

$$\frac{1 + \cos A}{1 - \cos A} = (\operatorname{cosec} A + \cot A)^2$$

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19. If  $\tan \theta + \sin \theta = \alpha$  and  $\tan \theta - \sin \theta = \beta$ , show that

$$\alpha^2 - \beta^2 = 4\sqrt{\alpha\beta}. \quad (\theta \in \text{II or III quad.})$$

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## Exercise 4 C

1. If  $\cot \theta = \frac{4}{3}$ , find the values of other t-ratios of  $\theta$ .

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2. If  $\cos A = 0.6$ , find the value of  $5 \sin A - 3 \tan A$ .

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3. If  $\sin A = \frac{3}{5}$ , prove that  $\tan A + \frac{1}{\cos A} = 2$  or  $-2$

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4. If  $\tan \theta = \frac{1}{\sqrt{7}}$ , find the value of  $\frac{\operatorname{cosec}^2 \theta - \sec^2 \theta}{\operatorname{cosec}^2 \theta + \sec^2 \theta}$ .

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5. If  $\sin \theta = \frac{21}{29}$ , prove that  $\sec \theta + \tan \theta = 2\frac{1}{2}$  if  $\theta$  lies between 0 and  $\frac{\pi}{2}$ . What will be the value of the expression when  $\theta$  lies (i) between  $\frac{\pi}{2}$  and  $\pi$  and (ii) between  $\pi$  and  $\frac{3\pi}{2}$ ?

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6. If  $\theta$  lies in the second quadrant and  $\tan \theta = \frac{-5}{12}$ , find the value of  $\frac{2 \cos \theta}{1 - \sin \theta}$ .

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7. If  $\sin \theta \sec \theta = -1$  and  $\theta$  lies in the second quadrant, find  $\sin \theta$  and  $\sec \theta$ .

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8. If  $A$  is in the fourth quadrant and  $\cos A = \frac{5}{13}$ , find the value of  $\frac{13 \sin A + 5 \sec A}{5 \tan A + 6 \operatorname{cosec} A}$ .

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9. Verify that

$$\sin 60^\circ = \frac{2 \tan 30^\circ}{1 + \tan^2 30^\circ}$$



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10. Verify that

$$\cos 60^\circ = \frac{1 - \tan^2 30^\circ}{1 + \tan^2 30^\circ}$$

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11. Prove that

$$\sec 30^\circ \tan 60^\circ + \sin 45^\circ \operatorname{cosec} 45^\circ + \cos 30^\circ \cot 60^\circ = \frac{7}{2}$$

.

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12. Prove that

$$\frac{4}{3}\cot^2 30^\circ + 3\sin^2 60^\circ - 2\operatorname{cosec}^2 60^\circ - \frac{3}{4}\tan^2 30^\circ = 3\frac{1}{3}$$



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## Exercise 4 D

1. Express the following as functions of angles less than

$45^\circ$  :

$\sin 194^\circ$



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2. Express the following as functions of angles less than  $45^\circ$  :

$$\sin 348^\circ$$



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3. Express the following as functions of angles less than  $45^\circ$  :

$$\cos 189^\circ$$



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4. Express the following as functions of angles less than  $45^\circ$  :

$$\sin(-1785^\circ)$$

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5. Express the following as functions of angles less than  $45^\circ$  :

$$\tan(3598^\circ)$$

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6. Express the following as function of angle less than  $45^\circ$  :

$$\cot(-1952^\circ)$$

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7. Express the following as functions of angles less than  $45^\circ$  :

$$\operatorname{cosec}(-7498^\circ).$$



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8. Without using tables, give the value of each of the following :

$$\sin 120^\circ$$



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9. Without using tables, give the value of each of the following :

$$\cos 330^\circ$$



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10. Without using tables, give the value of each of the following :

$$\sec 210^\circ$$



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11. Without using tables, give the value of each of the following :

$$\cos 315^\circ$$



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**12.** Without using tables, give the value of each of the following :

$$\operatorname{cosec} 675^\circ$$

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**13.** Without using tables, give the value of each of the following :

$$\cos 855^\circ$$

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**14.** Without using tables, give the value of the following :

$$\sin 4530^\circ$$



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15. Without using tables, give the value of the following :

$$\sec \frac{15\pi}{4}$$



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16. With the help of tables, find the values, correct to places of decimals, of each of the following :

$$\cos 116^\circ$$



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17. With the help of tables, find the values, correct to places of decimals, of each of the following :

$$\sin 267^\circ$$

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18. With the help of tables, find the values, correct to places of decimals, of each of the following :

$$\sin(-263^\circ)$$

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19. With the help of tables, find the values, correct to places of decimals, of each of the following :

$$\cos 280^{\circ} 10'$$



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20. With the help of tables, find the values, correct to places of decimals, of each of the following :

$$\tan(2015^{\circ} 24').$$



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21. Find the value of

$$\sin 750^{\circ} \cos 300^{\circ} + \cos 1470^{\circ} \sin( - 1020^{\circ} )$$



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22. Evaluate  $\frac{\cos 3\theta - 2 \cos 4\theta}{\sin 3\theta + 2 \sin 4\theta}$ , when  $\theta = 150^\circ$ .

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23. Simplify:  $\frac{\cos(-\theta)}{\sin(90^\circ + \theta)}$

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24.  $\frac{\tan(-\theta)}{\sin(540^\circ + \theta)}$

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25.  $\frac{\sin(90^\circ - \theta)\sec(180^\circ - \theta)\sin(-\theta)}{\sin(180^\circ + \theta)\cot(360^\circ - \theta)\operatorname{cosec}(90^\circ + \theta)}$ .

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26. 
$$\frac{\sin 150^\circ - 5\cos 300^\circ + 7\tan 225^\circ}{\tan 135^\circ + 3\sin 210^\circ}$$

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27. If  $\sin(7\phi + 9^\circ) = \cos 2\phi$ , find a value of  $\phi$ .

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28. Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\sin \theta = \frac{1}{2}$$

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**29.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\tan \theta = -1$$

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**30.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\sec \theta = -2$$

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**31.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\sin \theta = \sin 21^\circ$$

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**32.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\tan \theta = -2.0145$$



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**33.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\sin \theta = \cos 317^\circ$$



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**34.** Find the values of  $\theta$  lying between  $0^\circ$  and  $360^\circ$  when

$$\cos \theta = \sin 285^\circ.$$



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35. If  $0^\circ < \theta < 90^\circ$  and  $\cos \theta = \frac{4}{5}$  find the values of  $\cos(90^\circ + \theta)$

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36. If  $0^\circ < \theta < 90^\circ$  and  $\cos \theta = \frac{4}{5}$  find the values of  $\operatorname{cosec}(180^\circ + \theta)$

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37. If  $0^\circ < \theta < 90^\circ$  and  $\cos \theta = \frac{4}{5}$  find the values of  $\tan(360^\circ - \theta)$

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38. If  $0^\circ < \theta < 90^\circ$  and  $\cos \theta = \frac{4}{5}$  find the values of  $\sin(270^\circ - \theta)$

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39. Find six angles for which  $\sin \theta = -\frac{\sqrt{3}}{2}$ .

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40. Find all the angles between  $0^\circ$  and  $720^\circ$  whose tangent is  $-\frac{1}{\sqrt{3}}$ .

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**41.** Find the values of  $\theta$  between  $0^\circ$  and  $360^\circ$  which satisfy the equations

$$\sin^2 \theta = \frac{3}{4}$$

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**42.** Find the values of  $\theta$  between  $0^\circ$  and  $360^\circ$  which satisfy the equations

$$\cos 2\theta = \frac{1}{2}.$$

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**43.** If  $\tan \theta = 0.4$ , when  $\theta$  lies between  $0^\circ$  and  $360^\circ$ , write down the possible values of  $\theta$  and  $\sin \theta$ .





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44. If  $\cos x^\circ = \sin 200^\circ$ , find the possible values of  $x$  between  $-180^\circ$  and  $360^\circ$ .



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45. If  $A, B, C$  are angles of a triangle, prove that  $\cos C = -\cos(A + B)$ .



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46. If  $A, B, C$  are angles of a triangle, prove that

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

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47. If  $A, B, C$  are angles of a triangle, prove that

$$\frac{\tan(B + C) + \tan(C + A) + \tan(A + B)}{\tan(\pi - A) + \tan(2\pi - B) + \tan(3\pi - C)} = 1.$$

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48. If  $A, B, C, D$  are the angles of a quadrilateral, prove that

$$\cos \frac{1}{2}(A + B) + \cos \frac{1}{2}(C + D) = 0.$$

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Chapter Test

1. If  $\cot A = \frac{3}{4}$ , find the value of  $3 \cos A + 5 \sin A$ , where  $A$  lies in the first quadrant.

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2. If  $\cos 120^\circ = \frac{-1}{2}$  find the values of  $\sin 120^\circ$  and  $\tan 120^\circ$ .

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3. Prove that  $\sec(-1680^\circ) \cdot \sin 330^\circ = 1$

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4. If  $A, B, C, D$  are the angles of a cyclic quadrilateral, show that  $\cos A + \cos B + \cos C + \cos D = 0$

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5. If  $\tan 25^\circ = a$ , prove that 
$$\frac{\tan 155^\circ - \tan 115^\circ}{1 + \tan 155^\circ \tan 115^\circ} = \frac{1 - a^2}{2a}.$$

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6. If  $A, B, C$  be the angles of a triangle, prove that 
$$\frac{\sin(B + C) + \sin(C + A) + \sin(A + B)}{\sin(\pi + A) + \sin(3\pi + B) + \sin(5\pi + C)} = -1$$

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7. Prove that  $\frac{\cos \theta}{1 - \sin \theta} + \frac{1 - \sin \theta}{\cos \theta} = 2 \sec \theta$ .



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8. If  $\sec \theta = \sqrt{2}$  and  $\frac{3\pi}{2} < \theta < 2\pi$ , find the value of  $\frac{1 + \tan \theta + \operatorname{cosec} \theta}{1 + \cot \theta - \operatorname{cosec} \theta}$ .



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