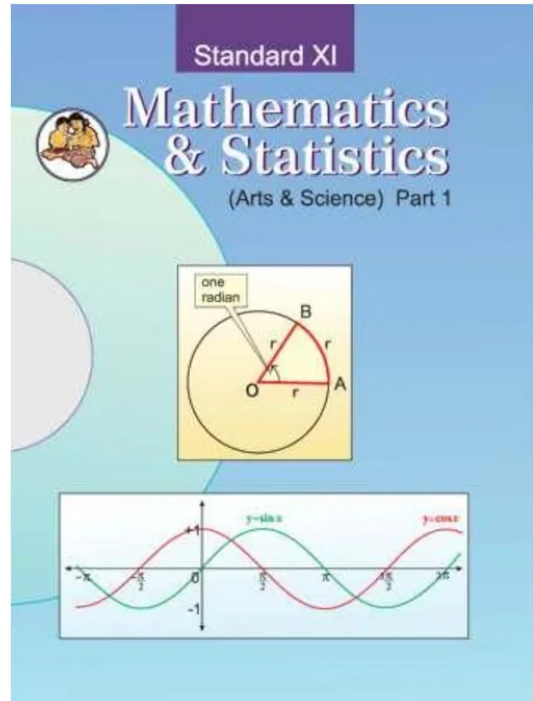


Maharashtra Board Solutions Class 11-Arts & Science Maths (Part 1): Chapter 2- Trigonometry – I

Class 11 - Chapter 2 Trigonometry - I



For any clarifications or questions you can write to info@indcareer.com

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Maharashtra Board Solutions Class 11-Arts & Science Maths (Part 1): Chapter 2- Trigonometry – I

Class 11: Maths Chapter 2 solutions. Complete Class 11 Maths Chapter 2 Notes.

Maharashtra Board Solutions Class 11-Arts & Science Maths (Part 1): Chapter 2- Trigonometry – I

Maharashtra Board 11th Maths Chapter 2, Class 11 Maths Chapter 2 solutions

Ex 2.1

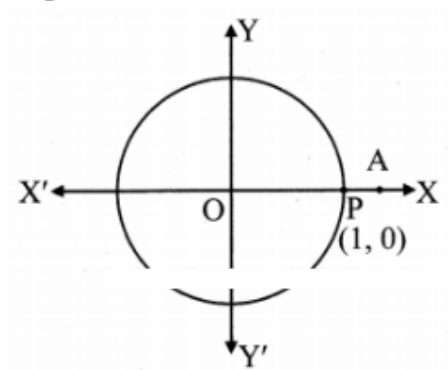
<https://www.indcareer.com/schools/maharashtra-board-solutions-class-11-arts-science-maths-part-1-chapter-2-trigonometry-i/>

Question 1.

Find the trigonometric functions of $0^\circ, 30^\circ, 45^\circ, 60^\circ, 150^\circ, 180^\circ, 210^\circ, 300^\circ, 330^\circ, -30^\circ, -45^\circ, -60^\circ, -90^\circ, -120^\circ, -225^\circ, -240^\circ, -270^\circ, -315^\circ$

Solution:

Angle of measure 0° :



Let $m\angle XOA = 0^\circ = 0^\circ$

Its terminal arm (ray OA) intersects the standard unit circle in $P(1, 0)$.

Hence, $x = 1$ and $y = 0$

$$\sin 0^\circ = y = 0,$$

$$\cos 0^\circ = x = 1,$$

$$\tan 0^\circ = \frac{y}{x} = \frac{0}{1} = 0$$

$$\cot 0^\circ = \frac{x}{y} = \frac{1}{0} \text{ which is not defined}$$

$$\sec 0^\circ = \frac{1}{x} = \frac{1}{1} = 1$$

$$\csc 0^\circ = \frac{1}{y} = \frac{1}{0} \text{ which is not defined,}$$

Angle of measure 30° :

Let $m\angle XOA = 30^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$OP = 1$

$$OM = \frac{\sqrt{3}}{2} OP$$

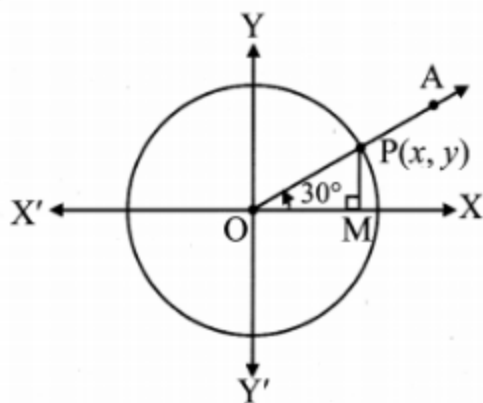
$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$

$$PM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1)$$

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



Since point P lies in 1st quadrant, $x > 0, y > 0$

$\therefore x = OM = \frac{\sqrt{3}}{2}$ and $y = PM = \frac{1}{2}$

$$\therefore P \equiv \left(\frac{\sqrt{3}}{2}, \frac{1}{2} \right)$$

$$\sin 30^\circ = y = \frac{1}{2}$$

$$\cos 30^\circ = x = \frac{\sqrt{3}}{2}$$

$$\tan 30^\circ = \frac{y}{x} = \frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}} = \frac{1}{\sqrt{3}}$$

$$\operatorname{cosec} 30^\circ = \frac{1}{y} = \frac{1}{\left(\frac{1}{2}\right)} = 2$$

$$\sec 30^\circ = \frac{1}{x} = \frac{1}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}}$$

$$\cot 30^\circ = \frac{x}{y} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$$

Angle of measure 45° :

Let $m\angle XOA = 45^\circ$

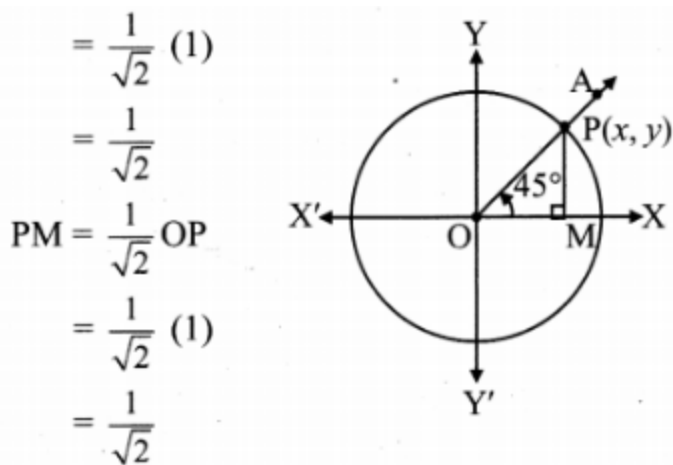
Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $45^\circ - 45^\circ - 90^\circ$ triangle.

$OP = 1$,

$$OM = \frac{1}{\sqrt{2}} OP$$



Since point P lies in the 1st quadrant, $x > 0, y > 0$

$$\therefore x = OM = \frac{1}{\sqrt{2}} \text{ and}$$

$$y = PM = \frac{1}{\sqrt{2}}$$

$$\therefore P = \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right)$$

$$\sin 45^\circ = y = \frac{1}{\sqrt{2}}$$

$$\cos 45^\circ = x = \frac{1}{\sqrt{2}}$$

$$\tan 45^\circ = \frac{y}{x} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}} = 1$$

$$\operatorname{cosec} 45^{\circ} = \frac{1}{y} = \frac{1}{\left(\frac{1}{\sqrt{2}}\right)} = \sqrt{2}$$

$$\sec 45^{\circ} = \frac{1}{x} = \frac{1}{\left(\frac{1}{\sqrt{2}}\right)} = \sqrt{2}$$

$$\cot 45^{\circ} = \frac{x}{y} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}} = 1$$

Angle of measure 60° :

Let $m\angle XOA = 60^{\circ}$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^{\circ} - 60^{\circ} - 90^{\circ}$ triangle.

OP = 1,

OP = 1,

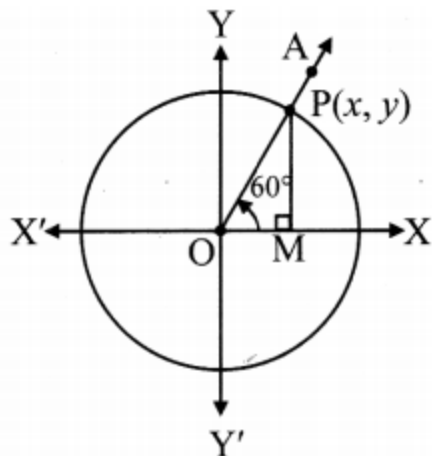
$$OM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1)$$

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

$$PM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1) = \frac{\sqrt{3}}{2}$$



Since point P lies in the 1st quadrant,
 $x > 0, y > 0$

$$\therefore x = OM = \frac{1}{2} \text{ and } y = PM = \frac{\sqrt{3}}{2}$$

$$\therefore P \equiv \left(\frac{1}{2}, \frac{\sqrt{3}}{2} \right)$$

$$\sin 60^\circ = y = \frac{\sqrt{3}}{2}$$

$$\cos 60^\circ = x = \frac{1}{2}$$

$$\tan 60^\circ = \frac{y}{x} = \frac{\left(\frac{\sqrt{3}}{2} \right)}{\left(\frac{1}{2} \right)} = \sqrt{3}$$

$$\operatorname{cosec} 60^{\circ} = \frac{1}{y} = \frac{1}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}}$$

$$\sec 60^{\circ} = \frac{1}{x} = \frac{1}{\left(\frac{1}{2}\right)} = 2$$

$$\cot 60^{\circ} = \frac{x}{y} = \frac{\left(\frac{1}{2}\right)}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{1}{\sqrt{3}}$$

Angle of measure 150° :

Let $m\angle XOA = 150^{\circ}$

Its terminal arm (ray OA) intersects the standard unit circle at P(x, y).

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^{\circ} - 60^{\circ} - 90^{\circ}$ triangle.

OP = 1,

$$OM = \frac{\sqrt{3}}{2} OP$$

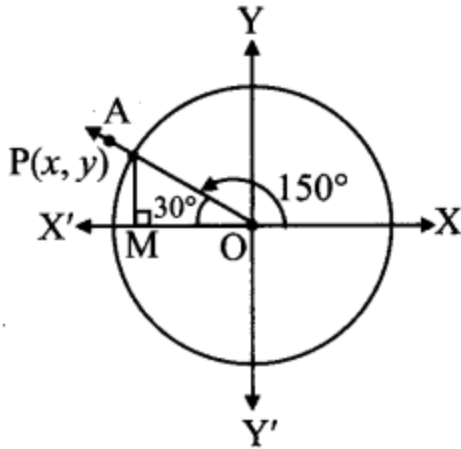
$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$

$$PM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1)$$

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



Since point P lies in the 2nd quadrant, $x < 0$, $y > 0$

$$\therefore x = -OM = \frac{-\sqrt{3}}{2} \text{ and } y = PM = \frac{1}{2}$$

$$\therefore P \equiv \left(\frac{-\sqrt{3}}{2}, \frac{1}{2} \right)$$

$$\sin 150^\circ = y = \frac{1}{2}$$

$$\cos 150^\circ = x = -\frac{\sqrt{3}}{2}$$

$$\tan 150^\circ = \frac{y}{x} = \frac{\frac{1}{2}}{-\left(\frac{\sqrt{3}}{2}\right)} = -\frac{1}{\sqrt{3}}$$

$$\operatorname{cosec} 150^\circ = \frac{1}{y} = \frac{1}{\left(\frac{1}{2}\right)} = 2$$

$$\sec 150^\circ = \frac{1}{x} = \frac{1}{-\left(\frac{\sqrt{3}}{2}\right)} = -\frac{2}{\sqrt{3}}$$

$$\cot 150^\circ = \frac{x}{y} = \frac{-\left(\frac{\sqrt{3}}{2}\right)}{\frac{1}{2}} = -\sqrt{3}$$

Angle of measure 180° :

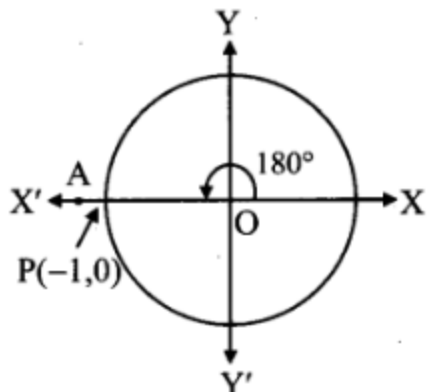
Let $m\angle XOA = 180^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(-1, 0)$.

$\therefore x = -1$ and $y = 0$

$\sin 180^\circ = y = 0$

$\cos 180^\circ = x = -1$



$$\tan 180^\circ = \frac{y}{x}$$

$$= \frac{0}{-1} = 0$$

$$\operatorname{Cosec} 180^\circ = \frac{1}{y}$$

$$= \frac{1}{0}$$

which is not defined.

$$\sec 180^\circ = \frac{1}{x} = \frac{1}{-1} = -1$$

$$\cot 180^\circ = \frac{x}{y} = \frac{-1}{0}, \text{ which is not defined.}$$

Angle of measure 210° :

Let $m\angle XOA = 210^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

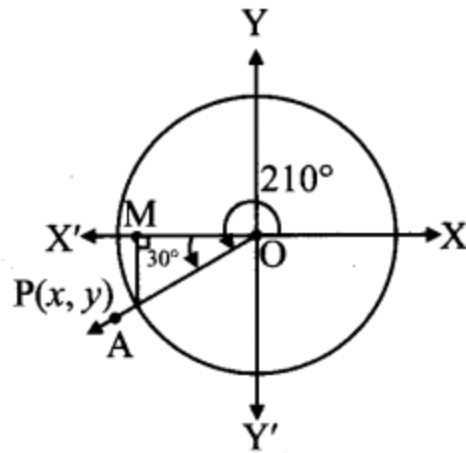
Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$OP = 1$,

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$$\begin{aligned} OM &= \frac{\sqrt{3}}{2} OP \\ &= \frac{\sqrt{3}}{2} (1) \\ &= \frac{\sqrt{3}}{2} \\ PM &= \frac{1}{2} OP \\ &= \frac{1}{2} (1) \\ &= \frac{1}{2} \end{aligned}$$



Since point P lies in the 3rd quadrant, $x < 0, y < 0$

$$\therefore x = -OM = \frac{-\sqrt{3}}{2} \text{ and } y = -PM = \frac{-1}{2}$$

$$\therefore P \equiv \left(\frac{-\sqrt{3}}{2}, \frac{-1}{2} \right)$$

$$\sin 210^\circ = y = \frac{-1}{2}$$

$$\cos 210^\circ = x = \frac{-\sqrt{3}}{2}$$

$$\tan 210^\circ = \frac{y}{x} = \frac{\left(\frac{-1}{2} \right)}{\left(\frac{-\sqrt{3}}{2} \right)} = \frac{1}{\sqrt{3}}$$

$$\operatorname{cosec} 210^\circ = \frac{1}{y} = \frac{1}{\left(\frac{-1}{2} \right)} = -2$$

$$\sec 210^\circ = \frac{1}{x} = \frac{1}{\left(\frac{-\sqrt{3}}{2} \right)} = -\frac{2}{\sqrt{3}}$$

$$\cot 210^\circ = \frac{x}{y} = \frac{\left(\frac{-\sqrt{3}}{2} \right)}{\left(\frac{-1}{2} \right)} = \sqrt{3}$$

Angle of measure 300° :

Let $m\angle XOA = 300^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$$OP = 1,$$

$$OM = \frac{1}{2} OP$$

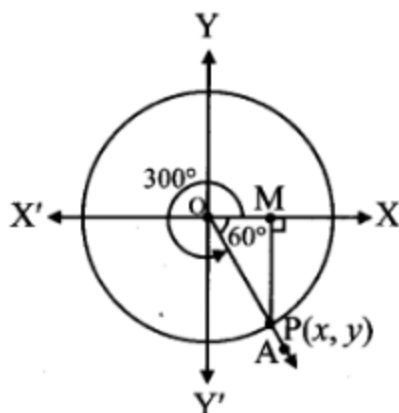
$$= \frac{1}{2} (1)$$

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

$$PM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$



Since point P lies in the 1st quadrant, $x > 0, y > 0$

$$x = OM = \frac{1}{2} \text{ and } y = -PM = \frac{-\sqrt{3}}{2}$$

$$\sin 300^\circ = y = \frac{-\sqrt{3}}{2}$$

$$\cos 300^\circ = x = \frac{1}{2}$$

$$\tan 300^\circ = \frac{y}{x} = \frac{\frac{-\sqrt{3}}{2}}{\frac{1}{2}} = -\sqrt{3}$$

$$\operatorname{cosec} 300^\circ = \frac{1}{y} = \frac{1}{\left(\frac{-\sqrt{3}}{2}\right)} = -\frac{2}{\sqrt{3}}$$

$$\sec 300^\circ = \frac{1}{x} = \frac{1}{\left(\frac{1}{2}\right)} = 2$$

$$\cot 300^\circ = \frac{x}{y} = \frac{\frac{1}{2}}{\frac{-\sqrt{3}}{2}} = -\frac{1}{\sqrt{3}}$$

Angle of measure 330° :

Let $m\angle XOA = 330^\circ$

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Its terminal arm (ray OA) intersects the standard unit circle at P(x, y).

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$OP = 1$,

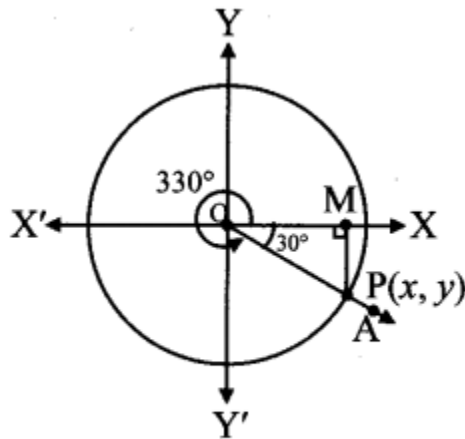
$$OM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$

$$PM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1) = \frac{1}{2}$$



Since point P lies in the 4th quadrant, $x > 0$, $y < 0$

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$$\therefore x = OM = \frac{\sqrt{3}}{2} \text{ and } y = -PM = -\frac{1}{2}$$

$$\therefore P \equiv \left(\frac{\sqrt{3}}{2}, -\frac{1}{2} \right)$$

$$\sin 330^\circ = y = -\frac{1}{2}$$

$$\cos 330^\circ = x = \frac{\sqrt{3}}{2}$$

$$\tan 330^\circ = \frac{y}{x} = \frac{-\frac{1}{2}}{\frac{\sqrt{3}}{2}} = -\frac{1}{\sqrt{3}}$$

$$\operatorname{cosec} 330^\circ = \frac{1}{y} = \frac{1}{\left(-\frac{1}{2}\right)} = -2$$

$$\sec 330^\circ = \frac{1}{x} = \frac{1}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}}$$

$$\cot 330^\circ = \frac{x}{y} = \frac{\frac{\sqrt{3}}{2}}{-\frac{1}{2}} = -\sqrt{3}$$

Angle of measure 30°

Let $m\angle XOA = -30^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at P(x,y).

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

<https://www.indcareer.com/schools/maharashtra-board-solutions-class-11-arts-science-maths-part-1-chapter-2-trigonometry-i/>

op = 1,

$$OP = 1,$$

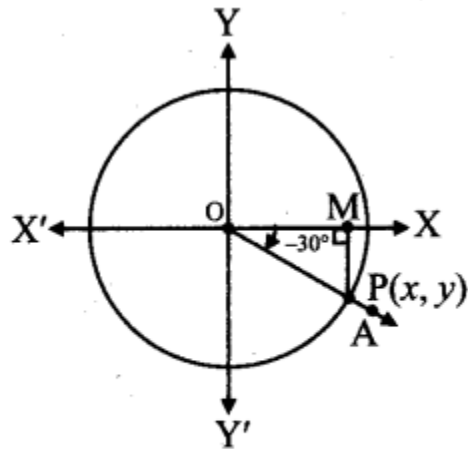
$$OM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$

$$PM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1) = \frac{1}{2}$$



Since point P lies in the 4th quadrant $x > 0$, $y < 0$

<https://www.indcareer.com/schools/maharashtra-board-solutions-class-11-arts-science-maths-part-1-chapter-2-trigonometry-i/>

$$\therefore x = OM = \frac{\sqrt{3}}{2} \text{ and } y = -PM = \frac{-1}{2}$$

$$\therefore P \equiv \left(\frac{\sqrt{3}}{2}, \frac{-1}{2} \right)$$

$$\sin(-30^\circ) = y = -\frac{1}{2}$$

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

$$\tan(-30^\circ) = \frac{y}{x} = \frac{\left(-\frac{1}{2}\right)}{\left(\frac{\sqrt{3}}{2}\right)} = -\frac{1}{\sqrt{3}}$$

$$\operatorname{cosec}(-30^\circ) = \frac{1}{y} = \frac{1}{\left(-\frac{1}{2}\right)} = -2$$

$$\sec(-30^\circ) = \frac{1}{x} = \frac{1}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}}$$

$$\cot(-30^\circ) = \frac{x}{y} = \frac{\left(\frac{\sqrt{3}}{2}\right)}{\left(-\frac{1}{2}\right)} = -\sqrt{3}$$

Angle of measure 45° :

Let $m\angle XOA = 45^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at P(x, y).

Draw seg PM perpendicular to the X-axis.

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$\therefore \triangle OMP$ is a $45^\circ - 45^\circ - 90^\circ$ triangle.

$OP = 1,$

$$OM = \frac{1}{\sqrt{2}} OP$$

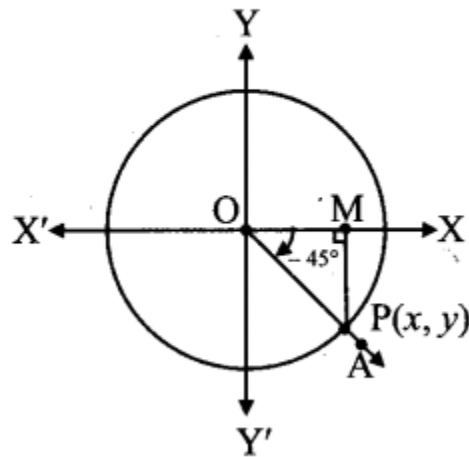
$$= \frac{1}{\sqrt{2}} (1)$$

$$= \frac{1}{\sqrt{2}}$$

$$PM = \frac{1}{\sqrt{2}} OP$$

$$= \frac{1}{\sqrt{2}} (1)$$

$$= \frac{1}{\sqrt{2}}$$



Since point P lies in the 4th quadrant $x > 0, y < 0$

$$\therefore x = OM = \frac{1}{\sqrt{2}} \text{ and } y = -PM = \frac{-1}{\sqrt{2}}$$

$$\therefore P \equiv \left(\frac{1}{\sqrt{2}}, \frac{-1}{\sqrt{2}} \right)$$

$$\sin(-45^\circ) = y = -\frac{1}{\sqrt{2}}$$

$$\cos(-45^\circ) = x = \frac{1}{\sqrt{2}}$$

$$\tan(-45^\circ) = \frac{y}{x} = \frac{\left(-\frac{1}{\sqrt{2}} \right)}{\left(\frac{1}{\sqrt{2}} \right)} = -1$$

$$\operatorname{cosec}(-45^\circ) = \frac{1}{y} = \frac{1}{\left(-\frac{1}{\sqrt{2}} \right)} = -\sqrt{2}$$

$$\sec(-45^\circ) = \frac{1}{x} = \frac{1}{\left(\frac{1}{\sqrt{2}} \right)} = \sqrt{2}$$

$$\cot(-45^\circ) = \frac{x}{y} = \frac{\left(\frac{1}{\sqrt{2}} \right)}{\left(-\frac{1}{\sqrt{2}} \right)} = -1$$

[Note : Answer given in the textbook of $\sin(45^\circ) = \frac{1}{2}$. However, as per our calculation it is $\frac{1}{\sqrt{2}}$]

Angle of measure (-60°) :

Let $m\angle XOA = -60^\circ$

Its terminal arm (ray OA) intersects the standard

unit circle at P(x, y).

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Draw seg PM perpendicular to the X-axis.

$\triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$OP = 1$,

$$OM = \frac{1}{2} OP$$

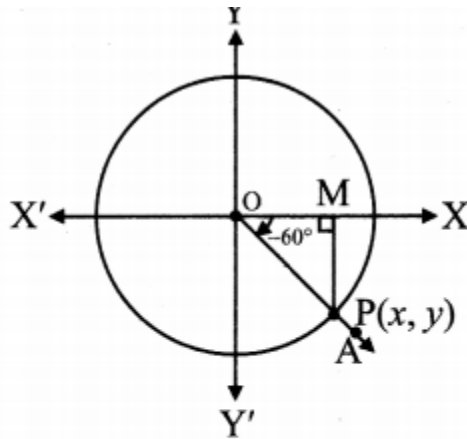
$$= \frac{1}{2} (1)$$

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

$$PM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1)$$

$$= \frac{\sqrt{3}}{2}$$



Since point P lies in the 4th quadrant,

$x > 0$, $y < 0$

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$$x = OM = \frac{1}{2} \text{ and } y = -PM = -\frac{\sqrt{3}}{2}$$

$$\therefore P \equiv \left(\frac{1}{2}, -\frac{\sqrt{3}}{2} \right)$$

$$\sin(-60^\circ) = y = -\frac{\sqrt{3}}{2}$$

$$\cos(-60^\circ) = x = \frac{1}{2}$$

$$\begin{aligned} \tan(-60^\circ) &= \frac{y}{x} = \frac{-\frac{\sqrt{3}}{2}}{\frac{1}{2}} \\ &= -\sqrt{3} \end{aligned}$$

$$\begin{aligned} \operatorname{cosec}(-60^\circ) &= \frac{1}{y} = \frac{1}{\left(-\frac{\sqrt{3}}{2}\right)} \\ &= -\frac{2}{\sqrt{3}} \end{aligned}$$

$$\sec(-60^\circ) = \frac{1}{x} = \frac{1}{\left(\frac{1}{2}\right)} = 2$$

$$\begin{aligned} \cot(-60^\circ) &= \frac{x}{y} = \frac{\frac{1}{2}}{-\frac{\sqrt{3}}{2}} \\ &= -\frac{1}{\sqrt{3}} \end{aligned}$$

Angle of measure (-90°) :

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Let $m\angle XOA = -90^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(0, -1)$

$$\therefore x = 0 \text{ and } y = -1$$

$$\sin(-90^\circ) = y = -1$$

$$\cos(-90^\circ) = x = 0$$

$$\begin{aligned}\tan(-90^\circ) &= \frac{y}{x} \\ &= \frac{-1}{0},\end{aligned}$$

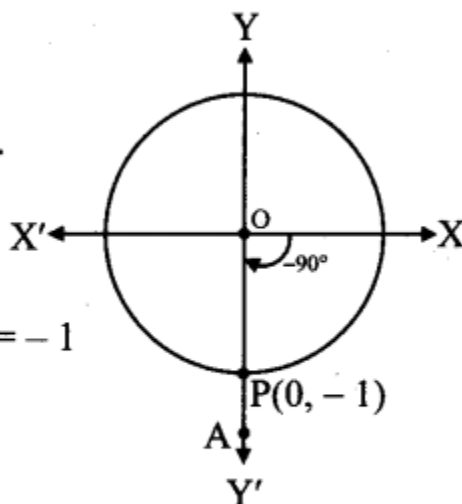
which is not defined.

$$\begin{aligned}\operatorname{cosec}(-90^\circ) &= \frac{1}{y} \\ &= \frac{1}{-1} = -1\end{aligned}$$

$$\sec(-90^\circ) = \frac{1}{x} = \frac{1}{0},$$

which is not defined.

$$\cot(-90^\circ) = \frac{x}{y} = \frac{0}{-1} = 0$$



Angle of measure (-120°) :

Let $m\angle XOA = -120^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$$OP = 1,$$

<https://www.indcareer.com/schools/maharashtra-board-solutions-class-11-arts-science-maths-part-1-chapter-2-trigonometry-i/>

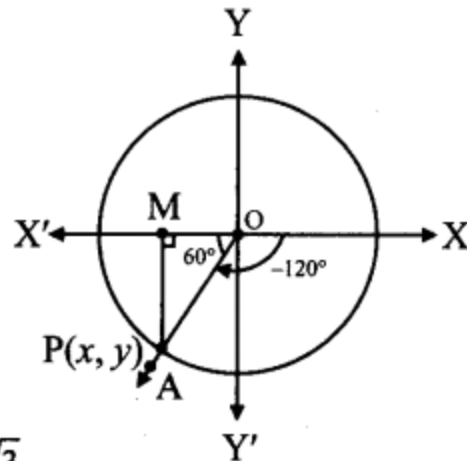
$$OM = \frac{1}{2} OP$$

$$= \frac{1}{2} (1)$$

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

$$PM = \frac{\sqrt{3}}{2} OP$$

$$= \frac{\sqrt{3}}{2} (1) = \frac{\sqrt{3}}{2}$$



Since point P lies in the 3rd quadrant, $x < 0$, $y < 0$

$$\therefore x = -OM = \frac{-1}{2} \text{ and } y = -PM = \frac{-\sqrt{3}}{2}$$

$$\therefore P \equiv \left(\frac{-1}{2}, \frac{-\sqrt{3}}{2} \right)$$

$$\sin(-120^\circ) = y = \frac{-\sqrt{3}}{2}$$

$$\cos(-120^\circ) = x = \frac{-1}{2}$$

$$\tan(-120^\circ) = \frac{y}{x} = \frac{\left(\frac{-\sqrt{3}}{2} \right)}{\left(\frac{-1}{2} \right)} = \sqrt{3}$$

$$\operatorname{cosec}(-120^\circ) = \frac{1}{y} = \frac{1}{\left(\frac{-\sqrt{3}}{2} \right)} = -\frac{2}{\sqrt{3}}$$

$$\sec(-120^\circ) = \frac{1}{x} = \frac{1}{\left(\frac{-1}{2} \right)} = -2$$

$$\cot(-120^\circ) = \frac{x}{y} = \frac{\left(\frac{-1}{2} \right)}{\left(\frac{-\sqrt{3}}{2} \right)} = \frac{1}{\sqrt{3}}$$

Angle of measure (-225°) :

Let $m\angle XOA = -225^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at $P(x, y)$.

Draw seg PM perpendicular to the X-axis.

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$\triangle OMP$ is a $45^\circ - 45^\circ - 90^\circ$ triangle.

$OP = 1,$

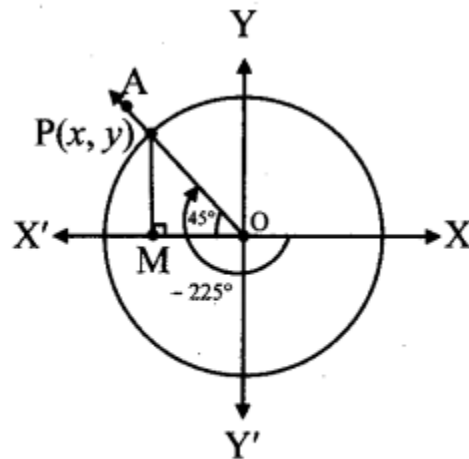
$$OM = \frac{1}{\sqrt{2}} OP$$

$$= \frac{1}{\sqrt{2}} (1)$$

$$= \frac{1}{\sqrt{2}}$$

$$PM = \frac{1}{\sqrt{2}} OP$$

$$= \frac{1}{\sqrt{2}} (1) = \frac{1}{\sqrt{2}}$$



Since point P lies in the 2nd quadrant, $x < 0, y > 0$

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$$\therefore x = -OM = \frac{-1}{\sqrt{2}} \text{ and } y = PM = \frac{1}{\sqrt{2}}$$

$$\therefore P \equiv \left(\frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right)$$

$$\sin(-225^\circ) = y = \frac{1}{\sqrt{2}}$$

$$\cos(-225^\circ) = x = -\frac{1}{\sqrt{2}}$$

$$\tan(-225^\circ) = \frac{y}{x} = \frac{\frac{1}{\sqrt{2}}}{-\frac{1}{\sqrt{2}}} = -1$$

$$\operatorname{cosec}(-225^\circ) = \frac{1}{y} = \frac{1}{\left(\frac{1}{\sqrt{2}}\right)} = \sqrt{2}$$

$$\sec(-225^\circ) = \frac{1}{x} = \frac{1}{\left(-\frac{1}{\sqrt{2}}\right)} = -\sqrt{2}$$

$$\cot(-225^\circ) = \frac{x}{y} = \frac{-\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}} = -1$$

Angle of measure 2400):

Let $m\angle XOA = 240^\circ$

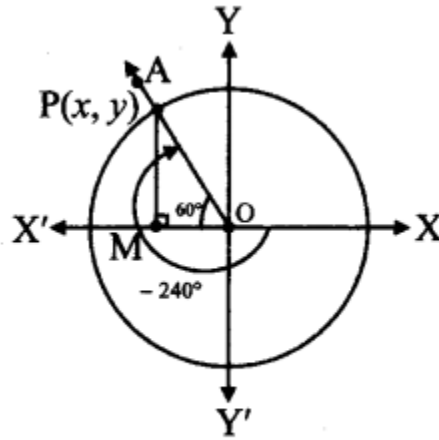
Its terminal arm (ray OA) intersects the standard unit circle at P(x, y).

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Draw seg PM perpendicular to the X-axis.

$\therefore \triangle OMP$ is a $30^\circ - 60^\circ - 90^\circ$ triangle.

$$\begin{aligned}OP &= 1, \\PM &= \frac{\sqrt{3}}{2} OP \\&= \frac{\sqrt{3}}{2} (1) \\&= \frac{\sqrt{3}}{2} \\OM &= \frac{1}{2} OP \\&= \frac{1}{2} (1) = \frac{1}{2}\end{aligned}$$



Since point P lies in the 2nd quadrant, $x < 0$, $y > 0$

$$\therefore x = -OM = -\frac{1}{2} \text{ and } y = PM = \frac{\sqrt{3}}{2}$$

$$\therefore P \equiv \left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$$

$$\sin(-240^\circ) = y = \frac{\sqrt{3}}{2}$$

$$\cos(-240^\circ) = x = -\frac{1}{2}$$

$$\tan(-240^\circ) = \frac{y}{x} = \frac{\frac{\sqrt{3}}{2}}{-\frac{1}{2}} = -\sqrt{3}$$

$$\operatorname{cosec}(-240^\circ) = \frac{1}{y} = \frac{1}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}}$$

$$\sec(-240^\circ) = \frac{1}{x} = \frac{1}{\left(-\frac{1}{2}\right)} = -2$$

$$\cot(-240^\circ) = \frac{x}{y} = \frac{-\frac{1}{2}}{\frac{\sqrt{3}}{2}} = -\frac{1}{\sqrt{3}}$$

Angle of measure (-270°) :

Let $m\angle XOA = -270^\circ$

Its terminal arm (ray OA)

intersects the standard unit,

circle at $P(0, 1)$.

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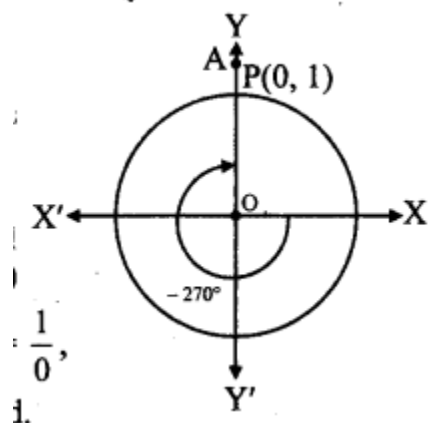
$$\therefore x = 0 \text{ and } y = 1$$

$$\sin(-270^\circ) = y = 1$$

$$\cos(-270^\circ) = x = 0$$

$$\tan(-270^\circ) = \frac{y}{x} = 10$$

which is not defined.



$$\operatorname{cosec}(-270^\circ) = \frac{1}{y} = \frac{1}{1} = 1$$

$$\sec(-270^\circ) = \frac{1}{x} = \frac{1}{0},$$

which is not defined.

$$\cot(-270^\circ) = \frac{x}{y} = \frac{0}{1} = 0$$

Angle of measure (315°):

Let $m\angle XOA = 315^\circ$

Its terminal arm (ray OA) intersects the standard unit circle at P(x,y).

Draw seg PM perpendicular to the X-axis.

$\triangle OMP$ is a $45^\circ - 45^\circ - 90^\circ$ triangle.

$$OP = 1,$$

$$OM = \frac{1}{\sqrt{2}} \quad OP = \frac{1}{\sqrt{2}} (1) = \frac{1}{\sqrt{2}}$$

$$PM = \frac{1}{\sqrt{2}} \quad OP = \frac{1}{\sqrt{2}} (1) = \frac{1}{\sqrt{2}}$$

Since point P lies in the 1st quadrant,
 $x > 0, y > 0$

$$\therefore x = OM = \frac{1}{\sqrt{2}} \text{ and } y = PM = \frac{1}{\sqrt{2}}$$

$$\therefore P \equiv \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right)$$

$$\sin(-315^\circ) = y = \frac{1}{\sqrt{2}}$$

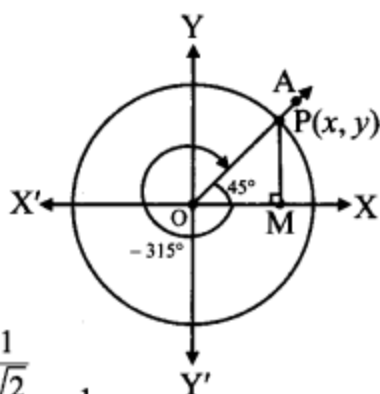
$$\cos(-315^\circ) = x = \frac{1}{\sqrt{2}}$$

$$\tan(-315^\circ) = \frac{y}{x} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}} = 1$$

$$\operatorname{cosec}(-315^\circ) = \frac{1}{y} = \frac{1}{\left(\frac{1}{\sqrt{2}}\right)} = \sqrt{2}$$

$$\sec(-315^\circ) = \frac{1}{x} = \frac{1}{\left(\frac{1}{\sqrt{2}}\right)} = \sqrt{2}$$

$$\cot(-315^\circ) = \frac{x}{y} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}} = 1$$



Question 2.

State the signs of:

i. $\tan 380^\circ$

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ii. $\cot 230^\circ$

iii 468°

Solution:

1. $380^\circ = 360^\circ + 20^\circ$

$\therefore 380^\circ$ and 20° are co-terminal angles.

Since $0^\circ < 20^\circ < 90^\circ$,

20° lies in the I quadrant.

$\therefore 380^\circ$ lies in the 1st quadrant,

$\therefore \tan 380^\circ$ is positive.

ii. Since, $180^\circ < 230^\circ < 270^\circ$

$\therefore 230^\circ$ lies in the 3rd quadrant.

$\therefore \cot 230^\circ$ is positive.

iii. $468^\circ = 360^\circ + 108^\circ$

$\therefore 468^\circ$ and 108° are co-terminal angles.

Since $90^\circ < 108^\circ < 180^\circ$,

108° lies in the 2nd quadrant.

$\therefore 468^\circ$ lies in the 2nd quadrant.

$\therefore \sec 468^\circ$ is negative.

Question 3.

State the signs of $\cos 4^\circ$ and $\cos 4^\circ$. Which of these two functions is greater?

Solution:

Since $0^\circ < 4^\circ < 90^\circ$, 4° lies in the first quadrant. $\therefore \cos 4^\circ > 0 \dots (i)$

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Since $1^\circ = 57'$ nearly,

$$180^\circ < 4^\circ < 270^\circ$$

$\therefore 4^\circ$ lies in the third quadrant.

$$\therefore \cos 4^\circ < 0 \dots\dots\dots(ii)$$

From (i) and (ii),

$\cos 4^\circ$ is greater.

Question 4.

State the quadrant in which θ lies if

i. $\sin \theta < 0$ and $\tan \theta > 0$

ii. $\cos \theta < 0$ and $\tan \theta > 0$

Solution:

i. $\sin \theta < 0$ $\sin \theta$ is negative in 3rd and 4th quadrants, $\tan \theta > 0$

$\tan \theta$ is positive in 1st and 3rd quadrants.

$\therefore \theta$ lies in the 3rd quadrant.

ii. $\cos \theta < 0$ $\cos \theta$ is negative in 2nd and 3rd quadrants, $\tan \theta > 0$

$\tan \theta$ is positive in 1st and 3rd quadrants.

$\therefore \theta$ lies in the 3rd quadrant.

Question 5.

Evaluate each of the following:

i. $\sin 30^\circ + \cos 45^\circ + \tan 180^\circ$

ii. $\operatorname{cosec} 45^\circ + \cot 45^\circ + \tan 0^\circ$

iii. $\sin 30^\circ \times \cos 45^\circ \times \tan 360^\circ$

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Solution:

<https://www.indcareer.com/schools/maharashtra-board-solutions-class-11-arts-science-maths-part-1-chapter-2-trigonometry-i/>

i. We know that,

$$\sin 30^\circ = 1/2, \cos 45^\circ = \frac{1}{\sqrt{2}}, \tan 180^\circ = 0$$

$$\sin 30^\circ + \cos 45^\circ + \tan 180^\circ$$

$$= \frac{1}{2} + \frac{1}{\sqrt{2}} + 0 = \frac{\sqrt{2}+1}{2}$$

ii. We know that,

$$\operatorname{cosec} 45^\circ = \sqrt{2}, \cot 45^\circ = 1, \tan 0^\circ = 0$$

$$\operatorname{cosec} 45^\circ + \cot 45^\circ + \tan 0^\circ$$

$$= \sqrt{2} + 1 + 0 = \sqrt{2} + 1$$

iii. We know that,

$$\sin 30^\circ = \frac{1}{2}, \cos 45^\circ = \frac{1}{\sqrt{2}}, \tan 360^\circ = 0$$

$$\sin 30^\circ \times \cos 45^\circ \times \tan 360^\circ$$

$$= \left(\frac{1}{2}\right) \left(\frac{1}{\sqrt{2}}\right) = 0$$

Question 6.

Find all trigonometric functions of angle in standard position whose terminal arm passes through point (3, -4).

Solution:

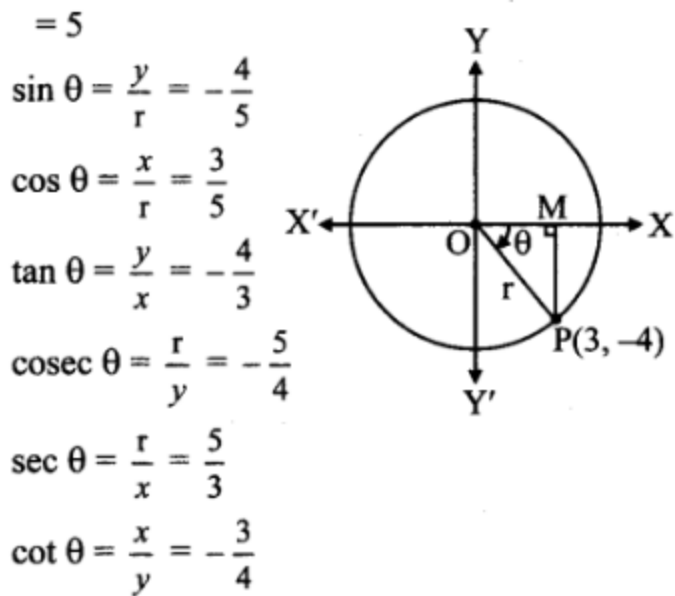
Let θ be the measure of the angle in standard position whose terminal arm passes through P(3, -4).

$$\therefore x = 3 \text{ and } y = -4$$

$$r = OP$$

$$= \sqrt{3^2 + (-4)^2}$$

$$= \sqrt{9+16}$$



Question 7.

If $\cos \theta = \frac{12}{13}$, $0 < \theta < \frac{\pi}{2}$ find the value of $\frac{\sin^2 \theta - \cos^2 \theta}{2 \sin \theta \cos \theta}$, $\frac{1}{\tan^2 \theta}$

Solution:

$$\cos \theta = \frac{12}{13}$$

We know that,

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

$$= 1 - \left(\frac{12}{13}\right)^2$$

$$= 1 - \frac{144}{169}$$

$$= \frac{25}{169}$$

$$\therefore \sin \theta = \pm \frac{5}{13}$$

Since $0 < \theta < \frac{\pi}{2}$, θ lies in the 1st quadrant, $\therefore \sin \theta > 0$

$$\therefore \sin \theta = \frac{5}{13}$$

$$\therefore \frac{\sin^2 \theta - \cos^2 \theta}{2 \sin \theta \cos \theta} = \frac{\left(\frac{5}{13}\right)^2 - \left(\frac{12}{13}\right)^2}{2 \left(\frac{5}{13}\right) \left(\frac{12}{13}\right)}$$

$$= \frac{\frac{25}{169} - \frac{144}{169}}{\frac{120}{169}}$$

$$= \frac{\frac{119}{169}}{\frac{120}{169}}$$

$$= -\frac{119}{120}$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\frac{5}{13}}{\frac{12}{13}} = \frac{5}{12}$$

$$\begin{aligned}\therefore \frac{1}{\tan^2 \theta} &= \frac{1}{\left(\frac{5}{12}\right)^2} \\ &= \frac{1}{\frac{25}{144}} = \frac{144}{25}\end{aligned}$$

Question 8.

Using tables evaluate the following:

i. $4 \cot 45^\circ - \sec^2 60^\circ + \sin 30^\circ$

ii. $\cos^2 0 + \cos^2 \frac{\pi}{6} + \cos^2 \frac{\pi}{3} + \cos^2 \frac{\pi}{2}$

Solution:

i. We know that,

$$\cot 45^\circ = 1, \sec 60^\circ = 2, \sin 30^\circ = \frac{1}{2}$$

$$4 \cot 45^\circ - \sec^2 60^\circ + \sin 30^\circ$$

$$= 4(1) - (2)^2 + \frac{1}{2}$$

$$= 4 - 4 + \frac{1}{2} = \frac{1}{2}$$

ii. We know that,

$$\cos 0 = 1, \cos \frac{\pi}{6} = \frac{\sqrt{3}}{2}, \cos \frac{\pi}{3} = \frac{1}{2},$$

$$\cos \frac{\pi}{2} = 0$$

$$\begin{aligned}\cos^2 0 + \cos^2 \frac{\pi}{6} + \cos^2 \frac{\pi}{3} + \cos^2 \frac{\pi}{2} \\&= 1 + \left(\frac{\sqrt{3}}{2}\right)^2 + \left(\frac{1}{2}\right)^2 + 0 \\&= 1 + \frac{3}{4} + \frac{1}{4} = 2\end{aligned}$$

Question 9.

Find the other trigonometric functions if

- i. $\cot \theta = -\frac{3}{5}$, and $180 < \theta < 270$
- ii. $\sec A = -\frac{25}{7}$ and A lies in the second quadrant.
- iii $\cot x = \frac{3}{4}$, x lies in the third quadrant.
- iv. $\tan x = \frac{-5}{12}$ x lies in the fourth quadrant.

Solution:

i. $\cot \theta = -\frac{3}{5}$

we know that,

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

$$= 1 - \left(-\frac{3}{5}\right)^2$$

$$= 1 - \frac{9}{25} = \frac{16}{25}$$

$$\therefore \sin \theta = \pm \frac{4}{5}$$

Since $180^\circ < \theta < 270^\circ$,

θ lies in the 3rd quadrant.

$$\therefore \sin \theta < 0$$

$$\therefore \sin \theta < 0$$

$$\therefore \sin \theta = -\frac{4}{5}$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{-\frac{4}{5}}{-\frac{3}{5}} = \frac{4}{3}$$

$$\operatorname{cosec} \theta = \frac{1}{\sin \theta} = \frac{1}{\left(-\frac{4}{5}\right)} = -\frac{5}{4}$$

$$\sec \theta = \frac{1}{\cos \theta} = \frac{1}{\left(-\frac{3}{5}\right)} = -\frac{5}{3}$$

$$\cot \theta = \frac{1}{\tan \theta} = \frac{1}{\left(\frac{4}{3}\right)} = \frac{3}{4}$$

Since A lies in the 2nd quadrant,

$$\tan A < 0$$

$$\therefore \tan A = -\frac{24}{7}$$

$$\therefore \cot A = \frac{1}{\tan A} = \frac{1}{\left(-\frac{24}{7}\right)} = -\frac{7}{24}$$

$$\cos A = \frac{1}{\sec A} = \frac{1}{\left(-\frac{25}{7}\right)} = -\frac{7}{25}$$

$$\tan A = \frac{\sin A}{\cos A}$$

$$\therefore \sin A = \tan A \cos A = -\frac{24}{7} \times -\frac{7}{25} = \frac{24}{25}$$

$$\therefore \operatorname{cosec} A = \frac{1}{\sin A} = \frac{1}{\frac{24}{25}} = \frac{25}{24}$$

iii. Given, $\cot x = \frac{3}{4}$

We know that,

$$\operatorname{cosec}^2 x = 1 + \cot^2 x$$

$$= 1 + \left(\frac{3}{4}\right)^2 = 1 + \frac{9}{16} = \frac{25}{16}$$

$$\therefore \operatorname{cosec} x = \pm \frac{5}{4}$$

Since x lies in the 3rd quadrant, $\operatorname{cosec} x < 0$

$$\therefore \operatorname{cosec} x = -\frac{5}{4}$$

$$\therefore \sin x = \frac{1}{\operatorname{cosec} x} = \frac{1}{\left(-\frac{5}{4}\right)} = -\frac{4}{5}$$

$$\tan x = \frac{1}{\cot x} = \frac{1}{\frac{3}{4}} = \frac{4}{3}$$

$$\cot x = \frac{\cos x}{\sin x}$$

$$\therefore \cos x = \cot x \sin x = \frac{3}{4} \left(-\frac{4}{5}\right) = -\frac{3}{5}$$

$$\therefore \sec x = \frac{1}{\cos x} = \frac{1}{\left(-\frac{3}{5}\right)} = -\frac{5}{3}$$

iv. Given, $\tan x = -\frac{5}{12}$

$$\sec^2 x = 1 + \tan^2 x$$

$$= 1 + \left(-\frac{5}{12}\right)^2$$

$$= 1 + \frac{25}{144} = \frac{169}{144}$$

$$\therefore \sec x = \pm \frac{13}{12}$$

Since x lies in the 4th quadrant,

$$\sec x > 0$$

$$\therefore \sec x = \frac{13}{12}$$

$$\therefore \cos x = \frac{1}{\sec x} = \frac{1}{\frac{13}{12}} = \frac{12}{13}$$

$$\tan x = \frac{\sin x}{\cos x}$$

$$\therefore \sin x = \tan x \cos x = -\frac{5}{12} \times \frac{12}{13} = -\frac{5}{13}$$

$$\operatorname{cosec} x = \frac{1}{\sin x} = \frac{1}{\left(-\frac{5}{13}\right)} = -\frac{13}{5}$$

$$\cot x = \frac{1}{\tan x} = \frac{1}{\left(-\frac{5}{12}\right)} = -\frac{12}{5}$$

Ex 2.2

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Question 1.

If $2\sin A = 1 = \sqrt{2} \cos B$ and $\frac{\pi}{2} < A < \pi$, $\frac{3\pi}{2}$

Solution:

Given, $2\sin A = 1$

$$\therefore \sin A = 1/2$$

we know that,

$$\cos^2 A = 1 - \sin^2 A = 1 - \left(\frac{1}{2}\right)^2 = 1 - \frac{1}{4} = \frac{3}{4}$$

$$\therefore \cos A = \pm \frac{\sqrt{3}}{2}$$

Since $\frac{\pi}{2} < A < \pi$

A lies in the 2nd quadrant.

$$\therefore \cos A = -\frac{\sqrt{3}}{2}$$

Since $\frac{\pi}{2} < A < \pi$,

A lies in the 2nd quadrant.

$$\therefore \cos A = -\frac{\sqrt{3}}{2}$$

$$\tan A = \frac{\sin A}{\cos A} = \frac{\frac{1}{2}}{-\frac{\sqrt{3}}{2}} = -\frac{1}{\sqrt{3}}$$

Also, $\sqrt{2} \cos B = 1$

$$\therefore \cos B = \frac{1}{\sqrt{2}}$$

We know that,

$$\sin^2 B = 1 - \cos^2 B = 1 - \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$$

$$\therefore \sin B = \pm \frac{1}{\sqrt{2}}$$

Since $\frac{3\pi}{2} < B < 2\pi$

B lies in the 4th quadrant,

$$\therefore \sin B = -\frac{1}{\sqrt{2}}$$

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

$$\begin{aligned}\therefore \frac{\tan A + \tan B}{\cos A - \cos B} &= \frac{-\frac{1}{\sqrt{3}} - 1}{\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}} = \frac{\frac{-1 - \sqrt{3}}{\sqrt{3}}}{\frac{-\sqrt{3} - \sqrt{2}}{2}} \\ &= \frac{-(1 + \sqrt{3})}{\sqrt{3}} \times \frac{2}{-(\sqrt{3} + \sqrt{2})} \\ &= \frac{2(1 + \sqrt{3})}{\sqrt{3}(\sqrt{3} + \sqrt{2})}\end{aligned}$$

Question 2.

If A and B are angles in the second quadrant, then prove that $4\cos A + 3\cos B = -5$

Solution:

$$\text{Given, } \frac{\sin A}{3} = \frac{\sin B}{4} = \frac{1}{5}$$

$$\therefore \sin A = \frac{3}{5} \text{ and } \sin B = \frac{4}{5}$$

We know that,

$$\cos^2 A = 1 - \sin^2 A = 1 - \left(\frac{3}{5}\right)^2 = 1 - \frac{9}{25} = \frac{16}{25}$$

$$\therefore \cos A = \pm \frac{4}{5}$$

Since A lies in the second quadrant,

$$\cos A < 0$$

$$\therefore \cos A = -\frac{4}{5}$$

$$\sin B = \frac{4}{5}$$

We know that,

$$\cos^2 B = 1 - \sin^2 B = 1 - \left(\frac{4}{5}\right)^2 = 1 - \frac{16}{25} = \frac{9}{25}$$

$$\therefore \cos B = \pm \frac{3}{5}$$

Since B lies in the second quadrant, $\cos B < 0$

$$\therefore \cos B = -\frac{3}{5}$$

$$\begin{aligned} \therefore 4\cos A + 3\cos B &= 4\left(-\frac{4}{5}\right) + 3\left(-\frac{3}{5}\right) \\ &= -\frac{16}{5} - \frac{9}{5} = -\frac{25}{5} = -5 \end{aligned}$$

Question 3.

If $\tan \theta = \frac{1}{2}$, evaluate $\frac{2\sin \theta + 3\cos \theta}{4\cos \theta + 3\sin \theta}$

Solution:

$$\text{Given, } \tan \theta = \frac{1}{2}$$

$$\frac{2\sin \theta + 3\cos \theta}{4\cos \theta + 3\sin \theta} = \frac{\frac{2\sin \theta}{\cos \theta} + 3}{4 + \frac{3\sin \theta}{\cos \theta}}$$

...[Dividing numerator and denominator by $\cos \theta$]

$$= \frac{2\tan \theta + 3}{4 + 3\tan \theta}$$

$$= \frac{2\left(\frac{1}{2}\right) + 3}{4 + 3\left(\frac{1}{2}\right)} = \frac{4}{\left(\frac{11}{2}\right)} = \frac{8}{11}$$

Question 4.

Eliminate θ from the following:

i. $x = 3\sec \theta, y = 4\tan \theta$

ii. $x = 6\operatorname{cosec} \theta, y = 8\cot \theta$

iii. $x = 4\cos \theta - 5\sin \theta, y = 4\sin \theta + 5\cos \theta$

iv. $x = 5 + 6\operatorname{cosec} \theta, y = 3 + 8\cot \theta$

v. $x = 3 - 4\tan \theta, 3y = 5 + 3\sec \theta$

Solution:

i. $x = 3\sec \theta, y = 4\tan \theta$

$$\therefore \sec \theta = \frac{x}{3} \text{ and } \tan \theta = \frac{y}{4}$$

We know that,

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

$$\therefore \left(\frac{x}{3}\right)^2 - \left(\frac{y}{4}\right)^2 = 1$$

$$\therefore \frac{x^2}{9} - \frac{y^2}{16} = 1$$

$$\therefore 16x^2 - 9y^2 = 144$$

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ii. $x = 6\operatorname{cosec} \theta$ and $y = 8\cot \theta$

$\therefore \operatorname{cosec} \theta = \frac{x}{6}$ and $\cot \theta = \frac{y}{8}$

We know that,

$$\operatorname{cosec}^2 \theta - \cot^2 \theta = 1$$

$$\therefore \left(\frac{x}{6}\right)^2 - \left(\frac{y}{8}\right)^2 = 1$$

$$\therefore \frac{x^2}{36} - \frac{y^2}{64} = 1$$

$$16x^2 - 9y^2 = 576$$

iii. $x = 4\cos \theta - 5\sin \theta \dots (i)$

$y = 4\sin \theta + 5\cos \theta \dots (ii)$

Squaring (i) and (ii) and adding, we get

$$x^2 + y^2 = (4\cos \theta - 5\sin \theta)^2 + (4\sin \theta + 5\cos \theta)^2$$

$$= 16\cos^2 \theta - 40\sin \theta \cos \theta + 25\sin^2 \theta + 16\sin^2 \theta + 40\sin \theta \cos \theta + 25\cos^2 \theta$$

$$= 16(\sin^2 \theta + \cos^2 \theta) + 25(\sin^2 \theta + \cos^2 \theta)$$

$$= 16(1) + 25(1)$$

$$= 41$$

iv. $x = 5 + 6\operatorname{cosec} \theta$ and $y = 3 + 8\cot \theta$

$\therefore x - 5 = 6\operatorname{cosec} \theta$ and $y - 3 = 8\cot \theta$

$\therefore \operatorname{cosec} \theta = \frac{x-5}{6}$ and $\cot \theta = \frac{y-3}{8}$

We know that,

$$\operatorname{cosec}^2 \theta - \cot^2 \theta = 1$$

$$\therefore \left(\frac{x-5}{6}\right)^2 - \left(\frac{y-3}{8}\right)^2 = 1$$

$$\text{v. } 2x = 3 - 4\tan \theta \text{ and } 3y = 5 + 3\sec \theta$$

$$\therefore 2x - 3 = -4\tan \theta \text{ and } 3y - 5 = 3\sec \theta$$

$$\therefore \tan \theta = \frac{3-2x}{4} \text{ and } \sec \theta = \frac{3y-5}{3}$$

$$\text{We know that, } \sec^2 \theta - \tan^2 \theta = 1$$

$$\therefore \left(\frac{3y-5}{3}\right)^2 - \left(\frac{3-2x}{4}\right)^2 = 1$$

$$\therefore \left(\frac{3y-5}{3}\right)^2 - \left(\frac{2x-3}{4}\right)^2 = 1$$

Question 5.

If $2\sin^2 \theta + 3\sin \theta = 0$, find the permissible values of $\cos \theta$.

Solution:

$$2\sin^2 \theta + 3\sin \theta = 0$$

$$\therefore \sin \theta (2\sin \theta + 3) = 0$$

$$\therefore \sin \theta = 0 \text{ or } \sin \theta = \frac{-3}{2}$$

$$\text{Since } -1 \leq \sin \theta \leq 1,$$

$$\sin \theta = 0$$

$$\sqrt{1 - \cos^2 \theta} = 0 \dots [\because \sin^2 \theta = 1 - \cos^2 \theta]$$

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

$$\therefore \cos^2 \theta = 1$$

$$\therefore \cos \theta = \pm 1 \dots [\because -1 \leq \cos \theta \leq 1]$$

Question 6.

If $2\cos^2 \theta - 11 \cos \theta + 5 = 0$, then find the possible values of $\cos \theta$.

Solution:

$$2\cos^2 \theta - 11 \cos \theta + 5 = 0$$

$$\therefore 2\cos^2 \theta - 10 \cos \theta - \cos \theta + 5 = 0$$

$$\therefore 2\cos \theta (\cos \theta - 5) - 1 (\cos \theta - 5) = 0$$

$$\therefore (\cos \theta - 5) (2\cos \theta - 1) = 0$$

$$\cos \theta - 5 = 0 \text{ or } 2\cos \theta - 1 = 0$$

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$$\therefore \cos \theta = 5 \text{ or } \cos \theta = 1/2$$

Since, $-1 \leq \cos \theta \leq 1$

$$\therefore \cos \theta = 1/2$$

Question 7.

Find the acute angle θ such $2\cos^2 \theta = 3\sin \theta$.

Solution:

$$2\cos^2 \theta = 3\sin \theta$$

$$\therefore 2(1 - \sin^2 \theta) = 3\sin \theta$$

$$\therefore 2 - 2\sin^2 \theta = 3\sin \theta$$

$$\therefore 2\sin^2 \theta + 3\sin \theta - 2 = 0$$

$$\therefore 2\sin^2 \theta + 4\sin \theta - \sin \theta - 2 = 0$$

$$\therefore 2\sin \theta(\sin \theta + 2) - 1(\sin \theta + 2) = 0$$

$$\therefore (\sin \theta + 2)(2\sin \theta - 1) = 0$$

$$\therefore \sin \theta + 2 = 0 \text{ or } 2\sin \theta - 1 = 0$$

$$\therefore \sin \theta = -2 \text{ or } \sin \theta = 1/2$$

Since, $-1 \leq \sin \theta \leq 1$

$$\therefore \sin \theta = 1/2$$

$$\therefore \theta = 30^\circ \dots [\because \sin 30 = 1/2]$$

Question 8.

Find the acute angle θ such that $5\tan^2 \theta + 3 = 9\sec \theta$.

Solution:

$$5\tan^2 \theta + 3 = 9\sec \theta$$

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$$\therefore 5(\sec^2 \theta - 1) + 3 = 9\sec \theta$$

$$\therefore 5\sec^2 \theta - 5 + 3 = 9\sec \theta$$

$$\therefore 5\sec^2 \theta - 9\sec \theta - 2 = 0$$

$$\therefore 5\sec^2 \theta - 10\sec \theta + \sec \theta - 2 = 0$$

$$\therefore 5\sec \theta(\sec \theta - 2) + 1(\sec \theta - 2) = 0$$

$$\therefore (\sec \theta - 2)(5\sec \theta + 1) = 0$$

$$\therefore \sec \theta - 2 = 0 \text{ or } 5\sec \theta + 1 = 0$$

$$\therefore \sec \theta = 2 \text{ or } \sec \theta = -1/5$$

Since $\sec \theta \geq 1$ or $\sec \theta \leq -1$,

$$\sec \theta = 2$$

$$\therefore \theta = 60^\circ \dots [\because \sec 60^\circ = 2]$$

Question 9.

Find $\sin \theta$ such that $3\cos \theta + 4\sin \theta = 4$.

Solution:

$$3\cos \theta + 4\sin \theta = 4$$

$$\therefore 3\cos \theta = 4(1 - \sin \theta)$$

Squaring both the sides, we get .

$$9\cos^2 \theta = 16(1 - \sin \theta)^2$$

$$\therefore 9(1 - \sin^2 \theta) = 16(1 + \sin^2 \theta - 2\sin \theta)$$

$$\therefore 9 - 9\sin^2 \theta = 16 + 16\sin^2 \theta - 32\sin \theta$$

$$\therefore 25\sin^2 \theta - 32\sin \theta + 7 = 0$$

$$\therefore 25\sin^2 \theta - 25\sin \theta - 7\sin \theta + 7 = 0$$

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$$25\sin \theta (\sin \theta - 1) - 7 (\sin \theta - 1) = 0$$

$$\therefore (\sin \theta - 1) (25\sin \theta - 7) = 0$$

$$\therefore \sin \theta - 1 = 0 \text{ or } 25 \sin \theta - 7 = 0$$

$$\therefore \sin \theta = 1 \text{ or } \sin \theta = \frac{7}{25}$$

Since, $-1 \leq \sin \theta \leq 1$

$$\therefore \sin \theta = 1 \text{ or } \frac{7}{25}$$

[Note: Answer given in the textbook is 1. However, as per our calculation it is 1 or $\frac{7}{25}$.]

Question 10.

If $\operatorname{cosec} \theta + \cot \theta = 5$, then evaluate $\sec \theta$.

Solution:

$$\operatorname{cosec} \theta + \cot \theta = 5$$

$$\therefore \frac{1}{\sin \theta} + \frac{\cos \theta}{\sin \theta} = 5$$

$$\therefore \frac{1 + \cos \theta}{\sin \theta} = 5$$

$$\therefore 1 + \cos \theta = 5 \sin \theta$$

Squaring both the sides, we get

$$1 + 2 \cos \theta + \cos^2 \theta = 25 \sin^2 \theta$$

$$\therefore \cos^2 \theta + 2 \cos \theta + 1 = 25 (1 - \cos^2 \theta)$$

$$\therefore \cos^2 \theta + 2 \cos \theta + 1 = 25 - 25 \cos^2 \theta$$

$$\therefore 26 \cos^2 \theta + 2 \cos \theta - 24 = 0$$

$$\therefore 26 \cos^2 \theta + 26 \cos \theta - 24 \cos \theta - 24 = 0$$

$$\therefore 26 \cos \theta (\cos \theta + 1) - 24 (\cos \theta + 1) = 0$$

$$\therefore (\cos \theta + 1) (26 \cos \theta - 24) = 0$$

$$\therefore \cos \theta + 1 = 0 \text{ or } 26 \cos \theta - 24 = 0$$

$$\therefore \cos \theta = -1 \text{ or } \cos \theta = \frac{24}{26} = \frac{12}{13}$$

When $\cos \theta = -1$, $\sin \theta = 0$

$\therefore \cot \theta$ and $\operatorname{cosec} \theta$ are not defined,

$$\therefore \cos \theta \neq -1$$

$$\therefore \cos \theta = \frac{12}{13}$$

$$\therefore \sec \theta = \frac{1}{\cos \theta} = \frac{13}{12}$$

[Note: Answer given in the textbook is -1 or $\frac{13}{12}$.

However, as per our calculation it is only $\frac{13}{12}$.]

Question 11.

If $\cot \theta = \frac{3}{4}$ and $n < \theta < \frac{3\pi}{2}$, then find the value of $4 \operatorname{cosec} \theta + 5 \cos \theta$.

Solution:

We know that,

$$\operatorname{cosec}^2 \theta = 1 + \cot^2 \theta = \left(\frac{3}{4}\right)^2 = 1 + \frac{9}{16}$$

$$\therefore \operatorname{cosec}^2 \theta = \frac{25}{16}$$

$$\therefore \operatorname{cosec} \theta = \pm \frac{5}{4}$$

$$\text{Since } n < \theta < \frac{3\pi}{2}$$

θ lies in the third quadrant.

$$\therefore \operatorname{cosec} \theta < 0$$

$$\therefore \operatorname{cosec} \theta = -\frac{5}{4}$$

$$\cot \theta = \frac{3}{4}$$

$$\tan \theta = \frac{1}{\cot \theta} = \frac{4}{3}$$

We know that,

$$\sec^2 \theta = 1 + \tan^2 \theta = 1 + \left(\frac{4}{3}\right)^2$$

$$= 1 + \frac{16}{9} = \frac{25}{9}$$

$$\therefore \sec \theta = \pm \frac{5}{3}$$

Since θ lies in the third quadrant,

$$\sec \theta < 0$$

$$\therefore \sec \theta = -\frac{5}{3}$$

$$\cos \theta = \frac{1}{\sec \theta} = -\frac{3}{5}$$

$$\therefore 4 \operatorname{cosec} \theta + 5 \cos \theta$$

$$= 4 \left(-\frac{5}{4}\right) + 5 \left(-\frac{3}{5}\right)$$

$$= -5 - 3 = -8$$

[Note: The question has been modified.]

Question 12.

Find the Cartesian co-ordinates of points whose polar co-ordinates are:

i. $(3, 90^\circ)$ ii. $(1, 180^\circ)$

Solution:

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i. $(r, \theta) = (3, 90^\circ)$

Using $x = r \cos \theta$ and $y = r \sin \theta$, where (x, y) are the required cartesian co-ordinates, we get

$$x = 3 \cos 90^\circ \text{ and } y = 3 \sin 90^\circ$$

$$\therefore x = 3(0) = 0 \text{ and } y = 3(1) = 3$$

$\therefore$ the required cartesian co-ordinates are $(0, 3)$.

ii. $(r, \theta) = (1, 180^\circ)$

Using $x = r \cos \theta$ and $y = r \sin \theta$, where (x, y) are the required cartesian co-ordinates, we get

$$x = 1(\cos 180^\circ) \text{ and } y = 1(\sin 180^\circ)$$

$$\therefore x = -1 \text{ and } y = 0$$

$\therefore$ the required cartesian co-ordinates are $(-1, 0)$.

Question 13.

Find the polar co-ordinates of points whose Cartesian co-ordinates are:

i. (5, 5) ii. (1, $\sqrt{3}$)

iii. (-1, -1) iv. ($-\sqrt{3}$, 1)

Solution:

i. (x, y) = (5, 5)

$$\therefore r = \sqrt{x^2 + y^2} = \sqrt{25 + 25}$$

$$= \sqrt{50} = 5\sqrt{2}$$

$$\tan \theta = \frac{y}{x} = \frac{5}{5} = 1$$

Since the given point lies in the 1st quadrant,

$$\theta = 45^\circ \dots [\because \tan 45^\circ = 1]$$

$\therefore$ the required polar co-ordinates are $(5\sqrt{2}, 45^\circ)$.

ii. (x, y) = (1, $\sqrt{3}$)

$$\therefore r = \sqrt{x^2 + y^2} = \sqrt{1 + 3} = \sqrt{4} = 2$$

$$\tan \theta = \frac{y}{x} = \frac{\sqrt{3}}{1} = \sqrt{3}$$

Since the given point lies in the 1st quadrant,

$$\theta = 60^\circ \dots [\because \tan 60^\circ = \sqrt{3}]$$

$\therefore$ the required polar co-ordinates are $(2, 60^\circ)$.

iii. (x, y) = (-1, -1)

$$\therefore r = \sqrt{x^2 + y^2} = \sqrt{1 + 1} = \sqrt{2}$$

$$\tan \theta = \frac{y}{x} = \frac{-1}{-1} = 1$$

$$\therefore \tan \theta = \tan \frac{\pi}{4}$$

Since the given point lies in the 3rd quadrant,

$$\tan \theta = \tan \left(\pi + \frac{\pi}{4} \right) \dots [\because \tan (n + x) = \tan x]$$

$$\therefore \tan \theta = \tan \left(\frac{5\pi}{4} \right)$$

$$\therefore \theta = \frac{5\pi}{4} = 225^\circ$$

$\therefore$ the required polar co-ordinates are $(\sqrt{2}, 225^\circ)$.

iv. $(x, y) = (-\sqrt{3}, 1)$

$$\therefore r = \sqrt{x^2 + y^2} = \sqrt{3 + 1} = \sqrt{4} = 2$$

$$\tan \theta = \frac{y}{x} = \frac{1}{-\sqrt{3}} = -\tan \frac{\pi}{6}$$

Since the given point lies in the 2nd quadrant,

$$\tan \theta = \tan \left(\pi - \frac{\pi}{6} \right) \dots [\because \tan (\pi - x) = -\tan x]$$

$$\therefore \tan \theta = \tan \left(\frac{5\pi}{6} \right)$$

$$\therefore \theta = \frac{5\pi}{6} = 150^\circ$$

$\therefore$ the required polar co-ordinates are $(2, 150^\circ)$

Question 14.

Find the values of:

i. $\sin \frac{19\pi}{3}$

ii. $\cos 1140^\circ$

iii. $\cot \frac{25\pi}{3}$

Solution:

i. We know that sine function is periodic with period 2π .

$$\sin \frac{19\pi}{3} = \sin \left(6\pi + \frac{\pi}{3} \right) = \sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$$

ii. We know that cosine function is periodic with period 2π .

$$\cos 1140^\circ = \cos (3 \times 360^\circ + 60^\circ)$$

$$= \cos 60^\circ = \frac{1}{2}$$

iii. We know that cotangent function is periodic with period π .

$$\cot \frac{25\pi}{3} = \cot \left(8\pi + \frac{\pi}{3} \right) = \cot \frac{\pi}{3} = \frac{1}{\sqrt{3}}$$

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Class 11 Arts & Science Maths

(Part 1)

- Chapter 1- Angle and its Measurement
- Chapter 2- Trigonometry – I
- Chapter 3- Trigonometry – II
- Chapter 4- Determinants and Matrices
- Chapter 5- Straight Line
- Chapter 6- Circle
- Chapter 7- Conic Sections
- Chapter 8- Measures of Dispersion
- Chapter 9- Probability

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The Maharashtra State Board of Secondary and Higher Secondary Education or MSBSHSE (Marathi: महाराष्ट्र राज्य माध्यमिक आणि उच्च माध्यमिक शिक्षण मंडळ), is an **autonomous and statutory body established in 1965**. The board was amended in the year 1977 under the provisions of the Maharashtra Act No. 41 of 1965.

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The Maharashtra government established the Maharashtra State Bureau of Textbook Production and Curriculum Research, also commonly referred to as Ebalbharati, in 1967 to take up the responsibility of providing quality textbooks to students from all classes studying under the Maharashtra State Board. MSBHSE prepares and updates the curriculum to provide holistic development for students. It is designed to tackle the difficulty in understanding the concepts with simple language with simple illustrations. Every year around 10 lakh students are enrolled in schools that are affiliated with the Maharashtra State Board.

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