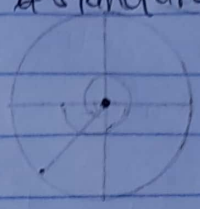
Section 2.1
(1, 7, 13, 19, 23, 27, 29, 33, 35, 37, 39, 41, 45)

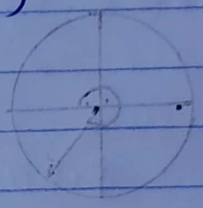
In which quadrant (axis) with which the standard position would lie.

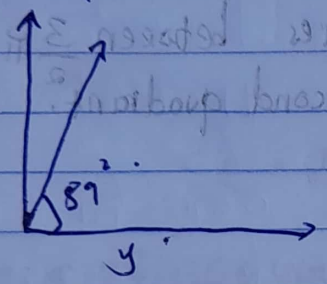


① 89°

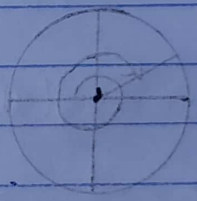
Answer: 1st Quadrant.

Soln: Both the initial and terminal point lie in the 1st quadrant ie, $(0^\circ < \theta < 90^\circ)$





⑦ 270°



Answer: Lies on the y-axis.

Soln: The initial side lies on the ~~positive~~ negative x-axis and the terminal side lies on the negative y-axis.

13 12.34°

Answer: Quadrant I

Solution: It lies between $0^\circ \leq \theta < 90^\circ$

19. -905°

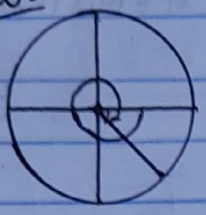
Answer: Quadrant III

Soln. $-905 = 2(-360) - 185$, and $2(-360)$ corresponds to two full clockwise revolutions about the circle.

21-32 Sketch the angles with the given measures:

23. -405°

Answer:

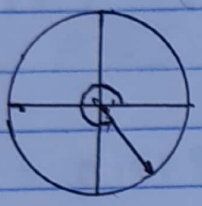


Soln:

$-405^\circ = -360^\circ - 45^\circ$

27. 330°

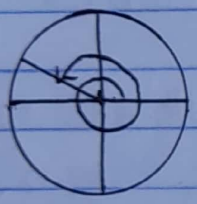
Answer:



Soln.

330° lies between $\frac{3}{2}\pi, < \theta < 2\pi$, in the second quadrant.

29.



Soln.

$510 - 360 = 150^\circ$. The coterminal angle of $510^\circ = 150^\circ$, which lies in the 2nd quadrant.

(33-38) Match the angle with its coterminal angle.

33. -535°

~~Answer:~~

$-535 + 360 = -175 + 360 = 185^\circ$

Answer: c

37. -645°

$-645 + 2(360) = 75^\circ$

Answer: f

(39-50): Determine the angle or smallest Possible +ve measure that is coterminal to:

39. 412°

$\Rightarrow 412 - 360 = 52^\circ$

Answer = 52°

41. -92°

$-92 + 360 = 268$

Ans = 268°

45. 510°

$\Rightarrow 510 - 360 = 150^\circ$

Ans = 150°

~~Section 2.2~~ Section 2.2.

Questions: (3, 7, 11, 15, 19, 21, 23, 25, 29, 31, 33, 39)

(1-16): Determine the six trigonometric fxns for θ.

3. $(3, 6)$ $x = 3$, $y = 6$.

$3^2 + 6^2 = 9 + 36 = 45$. $r = \sqrt{45} = 3\sqrt{5}$

Answer:

$\sin\theta = \frac{6}{3\sqrt{5}} = \frac{2}{\sqrt{5}}\left(\frac{\sqrt{5}}{\sqrt{5}}\right) = \frac{2\sqrt{5}}{5}$

$\cos\theta = \frac{x}{r} = \frac{3}{3\sqrt{5}} = \frac{1}{\sqrt{5}} = \frac{\sqrt{5}}{5}$

$\tan\theta = \frac{y}{x} = \frac{6}{3} = 2$.

$\csc\theta = \frac{r}{y} = \frac{\sqrt{5}}{2}$.

$\sec\theta = \frac{r}{x} = \sqrt{5}$

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

7. $(-2, 4)$ $x = -2, y = 4$ $r = \sqrt{16+4} = \sqrt{20} = 2\sqrt{5}$

$r = 2\sqrt{5}$.

$\sin\theta = \frac{4}{2\sqrt{5}} = \frac{2(\sqrt{5})}{\sqrt{5}(\sqrt{5})} = \frac{2\sqrt{5}}{5}$ | $\csc\theta = \frac{r}{y} = \frac{\sqrt{5}}{2}$

$\cos\theta = \frac{-2}{2\sqrt{5}} = -\frac{1(\sqrt{5})}{\sqrt{5}(\sqrt{5})} = -\frac{\sqrt{5}}{5}$ | $\sec\theta = \frac{x}{x} = \frac{-\sqrt{5}}{1} = -\sqrt{5}$

$\tan\theta = \frac{4}{-2} = -2$. | $\cot\theta = -\frac{1}{2}$.

Answer:

$\sin\theta = \frac{2\sqrt{5}}{5}$ $\csc\theta = \frac{\sqrt{5}}{2}$.

$\cos\theta = -\frac{\sqrt{5}}{5}$ $\sec\theta = -\sqrt{5}$

$\tan\theta = -2$. $\cot\theta = -\frac{1}{2}$.

11. $(-\sqrt{2}, \sqrt{3})$ $x = -\sqrt{2}$ $y = \sqrt{3}$ $x^2 + y^2 = r^2$

$2 + 3 = r^2$ $r = \sqrt{5}$.

$\sin\theta = \frac{y}{r} = \frac{\sqrt{3}}{\sqrt{5}}\frac{(\sqrt{5})}{(\sqrt{5})} = \frac{\sqrt{15}}{5}$. | $\csc\theta = \frac{r}{y} = \frac{\sqrt{5}}{\sqrt{3}}\cdot\frac{(\sqrt{3})}{(\sqrt{3})} = \frac{\sqrt{15}}{3}$

$\cos\theta = \frac{x}{r} = \frac{-\sqrt{2}}{\sqrt{5}}\frac{(\sqrt{5})}{(\sqrt{5})} = -\frac{\sqrt{10}}{5}$ | $\sec\theta = \frac{r}{x} = \frac{\sqrt{5}}{\sqrt{2}}\frac{(\sqrt{2})}{(\sqrt{2})} = -\frac{\sqrt{10}}{2}$.

$\tan\theta = \frac{y}{x} = \frac{\sqrt{3}}{\sqrt{2}}\frac{(\sqrt{2})}{(\sqrt{2})} = -\frac{\sqrt{6}}{2}$ | $\cot\theta = \frac{x}{y} = -\frac{\sqrt{2}}{\sqrt{3}}\frac{(\sqrt{3})}{(\sqrt{3})} = -\frac{\sqrt{6}}{3}$

Answer:

$\sin\theta = \frac{\sqrt{15}}{5}$ $\tan\theta = -\frac{\sqrt{6}}{2}$ $\sec\theta = -\frac{\sqrt{10}}{2}$

$\cos\theta = -\frac{\sqrt{10}}{5}$ $\csc\theta = \frac{\sqrt{15}}{3}$ $\cot\theta = -\frac{\sqrt{6}}{3}$.

15. $(-10/3, 4/3)$ $x = -10/3$, $y = 4/3$ $r = \sqrt{\frac{100}{9} + \frac{16}{9}} = \sqrt{\frac{116}{9}} = \frac{2}{3}\sqrt{29}$.

$r = \frac{2}{3}\sqrt{29}$.

$\sin\theta = \frac{y}{r} = \frac{4}{3} \cdot \frac{3}{2\sqrt{29}} = \frac{2}{\sqrt{29}} = \frac{2\sqrt{29}}{29}$.

$\csc\theta = \frac{1}{\sin\theta} = \frac{\sqrt{29}}{2}$.

$\cos\theta = \frac{x}{r} = -\frac{10}{3} \cdot \frac{3}{2\sqrt{29}} = \frac{-5}{\sqrt{29}} = -\frac{5\sqrt{29}}{29}$

$\sec\theta = \frac{1}{\cos\theta} = -\frac{\sqrt{29}}{5}$.

$\tan\theta = \frac{y}{x} = \frac{4}{3} \cdot -\frac{3}{10} = -\frac{2}{5}$

$\cot\theta = -\frac{5}{2}$.

∴ Answer

$\sin\theta = \frac{2\sqrt{29}}{29}$ $\tan\theta = -\frac{2}{5}$ $\sec\theta = -\frac{\sqrt{29}}{5}$.

$\cos\theta = \frac{-5\sqrt{29}}{29}$ $\csc\theta = \frac{\sqrt{29}}{2}$. $\cot\theta = -\frac{5}{2}$.

~~14. $y = \frac{1}{2}x$ $x = 1$ $y = \frac{1}{2}$ $r = \sqrt{1 + \frac{1}{4}} = \sqrt{\frac{5}{4}} = \frac{\sqrt{5}}{2}$~~

19. $y = \frac{1}{2}x$. $x = 2$, $y = 1$. $r = \sqrt{2^2 + 1^2} = \sqrt{4+1} = \sqrt{5}$.

$\sin\theta = \frac{y}{r} = \frac{1}{\sqrt{5}} = \frac{\sqrt{5}}{5}$.

$\csc\theta = \frac{1}{\sin\theta} = \sqrt{5}$.

$\cos\theta = \frac{x}{r} = \frac{2}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$

$\sec\theta = \frac{1}{\cos\theta} = \frac{\sqrt{5}}{2}$.

$\tan = \frac{y}{x} = \frac{1}{2}$.

$\cot\theta = \frac{1}{\tan} = 2$.

Answer:

$\sin\theta = \frac{\sqrt{5}}{5}$. $\csc\theta = \sqrt{5}$

$\cos\theta = \frac{2\sqrt{5}}{5}$ $\sec\theta = \frac{\sqrt{5}}{2}$.

$\tan\theta = \frac{1}{2}$. $\cot\theta = 2$

21. $y = -\frac{1}{3}x \quad x \geq 0 \cdot \quad x = 3, \; y = -1 \quad r = \sqrt{9+1} = \sqrt{10}$

$r = \sqrt{10}$.

$\sin\theta = \frac{y}{r} = \frac{-1}{\sqrt{10}} = -\frac{\sqrt{10}}{10}$. $\quad \csc\theta = \frac{1}{\sin\theta} = -\sqrt{10}$.

$\cos\theta = \frac{x}{r} = \frac{3}{\sqrt{10}} = \frac{3\sqrt{10}}{10}$. $\quad \sec\theta = \frac{1}{\cos\theta} = \frac{\sqrt{10}}{3}$.

$\tan\theta = \frac{y}{x} = -\frac{1}{3}$. $\quad \cot\theta = -3$.

Answer.

$\sin\theta = -\frac{\sqrt{10}}{10}$ $\quad \tan\theta = -\frac{1}{3}$ $\quad \sec\theta = \frac{\sqrt{10}}{3}$

$\cos\theta = \frac{3\sqrt{10}}{10}$ $\quad \csc\theta = -\sqrt{10}$ $\quad \csc\theta = -\sqrt{10}$.

23. $2x + 3y = 0 \quad \therefore x \leq 0 \cdot \Rightarrow 3y = -2x$ and $y = -\frac{2}{3}x$.

Set $x = -3$ and $y = 2$. $\quad \therefore r = \sqrt{9+4} = \sqrt{13}$

$\sin\theta = \frac{y}{r} = \frac{2}{\sqrt{13}} = \frac{2\sqrt{13}}{13}$. $\quad \csc\theta = \frac{1}{\sin} = \frac{\sqrt{13}}{2}$

$\cos\theta = \frac{x}{r} = \frac{-3}{\sqrt{13}} = -\frac{3\sqrt{13}}{13}$. $\quad \sec\theta = \frac{1}{\cos\theta} = -\frac{\sqrt{3}}{3}$

$\tan\theta = \frac{y}{x} = -\frac{2}{3}$. $\quad \cot\theta = -\frac{3}{2}$

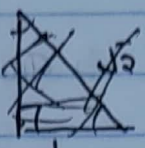
Answer:

$\sin\theta = \frac{2\sqrt{13}}{13}$ $\quad \tan\theta = -\frac{2}{3}$ $\quad \sec\theta = -\frac{\sqrt{3}}{3}$

$\cos\theta = \frac{-3\sqrt{13}}{13}$ $\quad \csc\theta = \frac{\sqrt{13}}{2}$. $\quad \cot\theta = -\frac{3}{2}$.

25. $\theta = 450°$

$450 - 360 = 90°$ $\therefore \theta = 90°$



$\sin\theta = 1$

$\cos\theta = 0$

$\tan\theta \Rightarrow$ undefined.

~~cot~~ $\csc\theta = 1$

$\sec\theta =$ undefined

$\cot\theta = 0$.

29. $\theta = -270°$

$-270 + 360 = 90°$ $\therefore \theta = 90°$

$x = 0, y = 1$ $r = 1$

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

$\cos\theta = \frac{0}{1} = 0$ $\sec\theta = \frac{1}{0} =$ undefined

$\tan\theta = \frac{1}{0} =$ undefined $\cot\theta = \frac{0}{1} = 0$

31. $\theta = -90°$

$-90 + 360 = 270$ $\theta = 270°$

$x = 0, y = -1$ $r = 1$

$\sin\theta = \frac{-1}{1} = -1$ ~~sec~~ $\csc\theta = \frac{1}{-1} = -1$

$\cos\theta = \frac{0}{1} =$ ~~0~~ 0

$\sec\theta = \frac{1}{0} =$ undefined

$\tan\theta = \frac{-1}{0} =$ undefined $\cot\theta = \frac{0}{-1} = 0$

33. $\theta = -450°$

$-450 + 2(360) = 270°$ $\therefore \theta = 270°$ $x = 0, y = -1, r = 1$

$\sin\theta = \frac{-1}{1} = -1$ $\tan\theta = \frac{-1}{0} =$ undefined $\sec\theta = \frac{1}{0} =$ undefined

$\cos\theta = \frac{0}{1} = 0$ $\csc\theta = \frac{1}{-1} = -1$ $\cot\theta = \frac{0}{-1} = 0$

39. $\theta = -810°$

29. $\Rightarrow -810 + 3(360) = 270 \quad \therefore \theta = 270$

$x = 0, y = -1, r = 1$

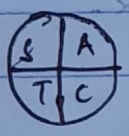
$\sin\theta = -\frac{1}{1} = -1$ $\qquad \csc\theta = \frac{1}{-1} = -1$

$\cos\theta = \frac{0}{1} = 0$ $\qquad \sec\theta = \frac{1}{0} = \text{undefined}$

$\tan\theta = \frac{-1}{0} = \text{undefined}$ $\qquad \cot\theta = \frac{0}{-1} = 0$

Section 2.3

(3) $\tan\theta$ is -ve and $\sin$ +ve.



= second quadrant.

5. $\sec\theta$ and $\csc\theta$ are both positive.

ie $\frac{1}{\cos\theta}$ and $\frac{1}{\sin\theta}$ are positive

$\Rightarrow \cos\theta$ and $\sin\theta$ are positive.

=  = First Quadrant.

7. $\cos\theta = \frac{-3}{5}$ find $\sin\theta$.

$\Rightarrow x = -3, r = 5. \quad \therefore y = \sqrt{25 - 9} = \sqrt{16} = 4.$

but in Q III, y is -ve $= -4$.

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

(11) If $\sin\theta = -\frac{3}{4}$ in Q IV find $\sec\theta$.

$x \Rightarrow +ve$ & y -ve. and $y = -3$, $r = 4$.

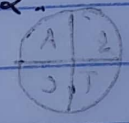
$$x = \sqrt{16-9} = \sqrt{7}$$

$\therefore \cos\theta = \frac{\sqrt{7}}{4}$ and $\sec\theta = \frac{4}{\sqrt{7}} = \frac{4\sqrt{7}}{7}$

(15) $\csc\theta = -\sqrt{5}$. in Q III ($x \Rightarrow$ -ve & y (-ve))

$\therefore \sin\theta = \frac{-1}{\sqrt{5}}$ $y = -1$ $x = \sqrt{5-1} = \sqrt{4} = -2$.

$\tan\theta = \frac{-1}{-2} = \frac{1}{2}$ $\therefore \cot\theta = 2$.



19 If $\sin\theta = \frac{\sqrt{11}}{6}$ in Q II find $\tan\theta$.

x (-ve), y (+ve)

$\sin\theta = \frac{y}{r}$ $y = \sqrt{11}$ $r = 6$

$$x = \sqrt{36-11} = \sqrt{25} = -5.$$

$\tan\theta = \frac{y}{x} = \frac{\sqrt{11}}{-5} = -\frac{\sqrt{11}}{5}$

25. $\cos(540^\circ) - \sec(-540)$

$540 - 360 = 180$. $-540 + 360 + 360 = 180$.

$= \cos(180) - \sec(180)$

$= -1 - \left(\frac{1}{-1}\right) = -1 + 1 = 0$

39. Reference angle.

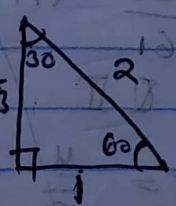
$\cos 240$

$240 - 180$

$\cos 240^\circ = -\cos(180 - 240)$

$\cos 240 = -\cos 60$.

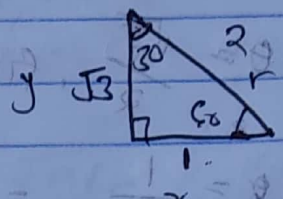
$\cos 60 = 1/2$. $= -1/2$.



43 $\cot(-150^\circ)$

$\cot(-150) = \dfrac{\cos(-150)}{\sin(-150)}$ $-150+360 = 210^\circ$ (3rd quadrant) x (-ve) y (-ve)

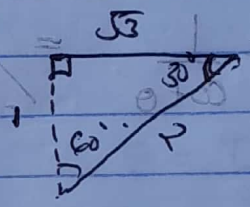
$= \dfrac{\cos(210)}{\sin(210)}$



$= \dfrac{-\frac{\sqrt{3}}{2}}{-\frac{1}{2}}$

$= \dfrac{\sqrt{3}}{2} \cdot -2 = \sqrt{3}$

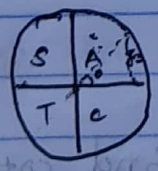
47 $\tan(210)$ 3rd quadrant. x (-ve), y (-ve)

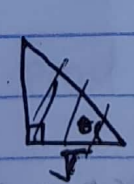


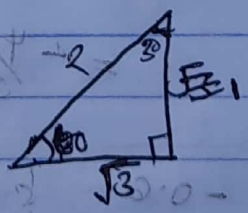
$\tan(210) = \dfrac{opp}{adj} = \dfrac{1}{\sqrt{3}} = \dfrac{\sqrt{3}}{3}$

53. All +ve values of θ where $0^\circ \leq \theta \leq 360^\circ$

$\cos\theta = \dfrac{\sqrt{3}}{2}$







In quadrant 1, $\theta = 30^\circ$

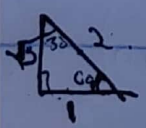
~~Quadrant II $180 - 60 = 120$~~ In quadrant IV

~~Quadrant III~~

$= 360 - 30 = 330^\circ$

$\theta = 30, 330^\circ$

55 $\sin\theta = -\frac{1}{2} = \frac{y}{r}$ y(-ve) $\therefore$ (⇒ Q III and Q IV



$\theta = 30 + 180 = 210$ and $360 - 30 = 330^\circ$

Section 2.4

5. If $\tan\theta = -5$, find $\cot\theta$.

$$\cot\theta = \frac{1}{\tan\theta} = \frac{1}{-5} = -\frac{1}{5}.$$

7. If $\csc\theta = \frac{\sqrt{5}}{2}$, find $\sin\theta$.

$$\sin\theta = \frac{1}{\frac{\sqrt{5}}{2}} = \frac{2}{\sqrt{5}} \cdot \frac{(\sqrt{5})}{(\sqrt{5})} = \frac{2\sqrt{5}}{5}.$$

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

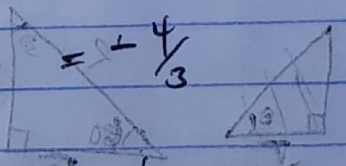
9. $\cot\theta = -\frac{\sqrt{7}}{5}$ find $\tan\theta$.

$$\tan\theta = \frac{1}{\cot\theta} = \frac{1}{-\frac{\sqrt{7}}{5}} = -\frac{5}{\sqrt{7}} \cdot \frac{(\sqrt{7})}{(\sqrt{7})} = -\frac{5\sqrt{7}}{7}$$

13. $\sin\theta = \frac{4}{5}$, $\cos\theta = -\frac{3}{5}$, find $\tan\theta$.

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

$$= -\frac{4}{3}$$



15. If $\sin\theta = -0.6$ & $\cos\theta = -0.8$ find $\cot\theta$.

$$\cot\theta = \frac{\cos\theta}{\sin\theta} = \frac{-0.8}{-0.6} = \frac{8}{6} = \frac{4}{3}$$

17. $\sin\theta = -\frac{\sqrt{11}}{6}$ and $\cos\theta = -\frac{5}{6}$ find $\tan\theta$.

$$\tan\theta = \frac{\sin\theta}{\cos\theta} = -\frac{\sqrt{11}}{6} \cdot \frac{-6}{5} = \frac{\sqrt{11}}{5}$$

21. If $\csc\theta = -2$ find $\csc^3\theta$.

$\csc^3\theta = (\csc\theta)^3 = (-2)^3 = -8$.

25. $\cos\theta = \frac{2}{5}$ in Q IV find $\sin\theta$.

In Q IV, x (+ve), y (−ve).

$\cos\theta = \frac{x}{r}$

$\therefore y = \sqrt{25-4} = \sqrt{21}$.

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

$\sin\theta = -\sqrt{1-\cos^2\theta} = -\sqrt{\left(\frac{25}{25} - \frac{4}{25}\right)} = -\sqrt{\frac{21}{25}}$

$= -\frac{\sqrt{21}}{5}$

27. $\tan\theta = 4$ in Q III, find $\sec\theta$.

$1 + \tan^2\theta = \sec^2\theta \Rightarrow \sec\theta = \pm\sqrt{1+\tan^2\theta}$.

In Q III $\sec\theta < 0$ $\therefore$ we use $\sec\theta = -\sqrt{1+\tan^2\theta}$

$\sec\theta = -\sqrt{1+16} = -\sqrt{17}$

29. $\cot\theta = 2$ in Q III, find $\csc\theta$.

$1 + \cot^2\theta = \csc^2\theta \Rightarrow \csc\theta = \pm\sqrt{1+\cot^2\theta}$

In Q III, $\sin\theta < 0$.

$\therefore$ we use $\csc\theta = -\sqrt{1+\cot^2\theta}$

$= -\sqrt{1+4} = -\sqrt{5}$.

39. Find $\sin\theta$ and $\cos\theta$ if $\tan\theta = -\frac{1}{5}$ in Q IV

$\tan\theta = \frac{y}{x}$ In Q IV, x (+ve), y (−ve)

$\therefore y = -1, \; x = 5. \quad r = \sqrt{25+1} = \sqrt{26}.$

$\sin\theta = \frac{y}{r} = \frac{-1}{\sqrt{26}} = -\frac{\sqrt{26}}{26}.$

$\cos\theta = \frac{x}{r} = \frac{5}{\sqrt{26}} = \frac{5\sqrt{26}}{26}.$

47 $\tan^2\theta - \sec^2\theta.$

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

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

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

49. $\csc\theta - \sin\theta.$ $\csc\theta = 1/\sin\theta.$

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

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

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

$= \frac{\cos^2\theta}{\sin\theta}$ or $\cot\theta \cdot \cos\theta$

Section 3.1

Questions: (3, 6, 9, 12, 15, 16, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60, 63, 66, 69, 72, 75, 78, 81)

3. $\theta = \frac{s}{r}$ $r = 22$. $s = 4$ in.

$$\theta = \frac{s}{r} = \frac{4}{22} = 0.1818 \text{ radians.}$$

6. $r = 1$ m, $s = 2$ cm.

$r = 100$ cm

$$\theta = \frac{s}{r} = \frac{2}{100} = 0.02 \text{ radians.}$$

9. $r = 2.5$ cm, $s = 5$ mm.

$r = 25$ mm.

$$= \frac{0.2}{25} =$$

12. $r = 2.5$ cm, $s = 5$ mm.

$r = 25$ mm

$$\theta = \frac{s}{r}$$

$$= \frac{5}{25} = 0.2$$

$= 0.2$ radians.

Degrees to radians.

12. 60°

$$= 60 \cdot \frac{\pi}{180} = \frac{\pi}{3}$$

15. 315°

$$= 315 \cdot \frac{\pi}{180} = \frac{7}{4}\pi$$

18. 100°

$$= 100 \cdot \frac{\pi}{180} = \frac{5}{9}\pi$$

21. 780°

$= 780 \cdot \frac{\pi}{180} = \frac{13}{3}\pi$

24 -320°

$= -320 \cdot \frac{\pi}{180}$

$= -\frac{16}{9}\pi$

Radians to degrees.

27 $\frac{3}{4}\pi$.

$= \frac{3}{4}\pi \cdot \frac{180}{\pi}$

$= \frac{3\pi}{4} \cdot \frac{180}{\pi} = 135^\circ$

30. $\frac{11}{9}\pi$

$= \frac{11\pi}{9_1} \cdot \frac{\overset{2}{180}}{\pi} = 220^\circ$

33. 9π

$= 9\pi \cdot \frac{180}{\pi} = 1620^\circ$

36. $\frac{13}{36}\pi$

$= \frac{13\pi}{36_1} \cdot \frac{\overset{5}{180}}{\pi} = 65^\circ$

Radians to degrees

39. 4.

$= 4 \cdot \frac{180}{\pi} = \left(\frac{720}{\pi}\right)^\circ = 229.18^\circ$

42. # 3.27

$= 3.27 \cdot \frac{180}{\pi} = \left(\frac{588.6}{\pi}\right)^{\circ} = 187.36^{\circ}$

Degrees to radians

45. 47°

$= 47 \cdot \frac{\pi}{180} = \frac{47\pi}{180} = \frac{147.65}{180}$

$= 0.820$

48. $172^{\circ} = 172 \cdot \frac{\pi}{180} = \frac{172\pi}{180}$

$= 3.00$

Reference angle in terms of Both radians and degrees.

51

Reference angle.

$= \pi - \frac{3}{4}\pi = \frac{\pi}{4}$.

In degrees $= \frac{\pi}{4} \cdot \frac{180}{\pi} = 45^{\circ}$.

54 $\frac{2}{3}\pi$

Reference angle $= \pi - \frac{2}{3}\pi = \frac{\pi}{3}$.

In degrees: $= \frac{\pi}{3} \cdot \frac{180}{\pi} = 60^{\circ}$

54. $\frac{5}{4}\pi$ (Q III)

Reference angle $= \frac{5}{4}\pi - \pi = \frac{\pi}{4}$.

In degrees $= \frac{\pi}{4} \cdot \frac{180}{\pi} = 45^{\circ}$.

57 $\frac{4}{3}\pi$ (Q III)

Reference angle $= \frac{4}{3}\pi - \pi = \frac{\pi}{3}$.

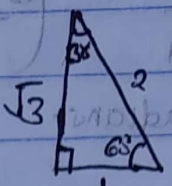
In degrees: $\frac{\pi}{3} \cdot \frac{180}{\pi} = 60^{\circ}$

~~60~~. Exact value of the following expressions:

Q5 $\cos(\pi/6)$ $\frac{\pi}{6} \cdot \frac{180}{\pi} = 30^\circ$

$= \cos(30^\circ)$

$\cos 30 = \frac{adj}{hyp} = \frac{\sqrt{3}/2}{}$



Q3. $\sin\left(-\frac{3}{4}\pi\right)$

$-\frac{3\pi}{4} \cdot \frac{180}{\pi} = -135^\circ$

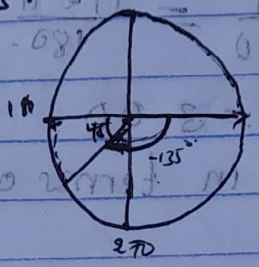
$= \sin(-135^\circ)$

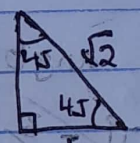
$= -\sin(135^\circ)$

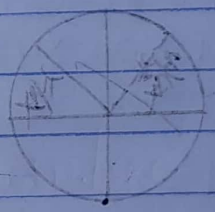
$= -\sin(45)$

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

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







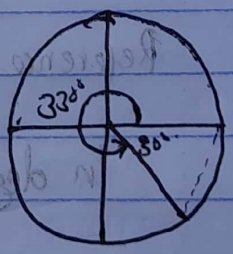
Q6. $\cos\left(\frac{11}{6}\pi\right)$

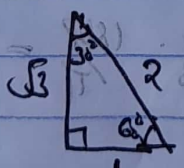
$\frac{11\pi}{6_1} \cdot \frac{30}{180_1} = 330^\circ$

$= \cos(330)^\circ$

$= \cos(30^\circ)$

$= \frac{adj}{hyp} = \frac{\sqrt{3}}{2.}$





Section 3.2

Questions: (1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45)

Arc length

1. $\theta = 3, \quad r = 4$ mm.

$$s = \theta \cdot r = 3 \times 4 = 12 \text{ mm}$$

5. $\theta = \frac{2}{7}\pi, \quad r = 3.5$ m.

$$s = \theta \cdot r = \frac{2}{7}\pi \cdot 3.5 \text{ m} = \pi \text{ m}.$$

9. $\theta = 8^\circ, \quad r = 1500$ km.

$$s = r \cdot \theta_d \left(\frac{\pi}{180}\right) = 1500 \times 8 \left(\frac{\pi}{180}\right) = \frac{200}{3}\pi$$

Given θ and s, find r

13. $s = \frac{5}{2}\pi$ ft, $\theta = \frac{\pi}{10}$.

$$s = \theta_r \cdot r \quad \therefore \quad r = \frac{s}{\theta_r} = \frac{5}{2} \Big/ \frac{\pi}{10}$$

$$= \frac{5}{2}\pi \times \frac{10}{\pi} = 25 \text{ ft}.$$

17. $s = \frac{12\pi}{5}$ yards, $\theta = \frac{4}{5}\pi$

$$r = \frac{s}{\theta_r} = \frac{12\pi}{5} \Big/ \frac{4}{5}\pi = \frac{12\pi}{5} \cdot \frac{5}{4\pi} = 3 \text{ yards}.$$

21. $s = \frac{8\pi}{3}$ mi., $\theta = 40^\circ$.

$$s = r \cdot \theta_d \left(\frac{\pi}{180}\right) \quad \therefore \quad r = \frac{s}{\theta_d \left(\frac{\pi}{180}\right)} = \frac{\frac{8}{3}\pi}{\frac{40\pi}{180}}$$

$$= \frac{8\pi}{3} \times \frac{180}{40\pi} = 12 \text{ mi}.$$

Approximate the arc length in 2 s.f.

25. $\theta = 3.3$, $r = 0.4\text{m}$.

$s = \theta_r \cdot r$

$= 3.3 \times 0.4 = 1.3\text{ m}$.

29. $\theta = 4.95$, $r = 30\text{ mi}$.

$s = \theta_r \cdot r$

$= 4.95 \times 30 = 148.5 \approx 150\text{ mi}$.

Find the linear speed.

33 $\omega = \frac{2}{3}\pi$ rad/sec. $r = 9$ in.

$v = r\omega = \frac{2\pi\text{ rad}}{3\text{ sec}} \cdot \frac{9}{1}\text{ in} = 6\pi\text{ in./sec}$.

37 $\omega = \frac{4\pi\text{ rad}}{15\text{ sec}}$, $r = 2.5$ in.

$= r\omega = \frac{4\pi\text{ rad}}{15\text{ sec}} \cdot \frac{2.5}{10}\text{ in} = \frac{2}{3}\pi\text{ in./sec}$.

41. $\omega = 10\pi$ rad/sec $r = 40\text{cm}$.

$r = 0.4\text{m}$.

$v = r\omega = 0.4\text{m} \times 10\pi = 4\pi\text{ m./sec}$.

Find Arc length.

45. $r = 5.2$ in $\omega = \frac{\pi}{15}$ rad/sec, $t = 10$ min.

$\omega = \frac{\theta}{t} \therefore \theta = \omega t$.

$\theta = \frac{\pi}{15} \times 10 = \frac{10\pi}{15}$

$s = \theta_r \cdot r$

$= \frac{2\pi}{3} \cdot \frac{52}{10}$.

$t = 10\text{mins}$ $1\text{ min} = 60\text{secs}$

10 min

$= 600\text{secs}$.

$\theta = \frac{\pi\text{ rad}}{15\text{ sec}} \cdot 600\text{secs} = 40\pi\text{ rad}$.

$\therefore s = \theta_r \cdot r = 40\pi \times (5.2)$

$= 208\pi$ in.

$= 653.$ in

Section 3.3

Questions: (1, 3, 5, 7, 9, 13, 17, 21, 25, 29, 33, 35)

Find linear speed.

1. $S = 2\text{ m}, \quad t = 5\text{ sec}$

$$v = \frac{S}{t} = \frac{2}{5} = \frac{2}{5}\text{ m/sec}$$

3. $S = \cancel{600}\,68000\text{ km} \quad t = 250\text{ h}$

$$v = \frac{S}{t} = \frac{\cancel{600\text{ km}}\ 68{,}000\text{ km}}{250\text{ hr}} = 272\text{ km/hr}$$

5. $S = 1.75\text{ nm} \quad t = 0.25\text{ ms}$

$$v = \frac{S}{t} = \frac{1.75\text{ nm}}{0.25\text{ ms}} = 7\text{ nm/ms}$$

7. $S = \frac{1}{16}\text{ in} \quad t = 4\text{ min}$

$$v = \frac{S}{t} = \frac{\frac{1}{16}\text{ in}}{4\text{ min}} = \frac{1}{16}\text{ in} \times \frac{1}{4}\text{ min} = \frac{1}{64}\text{ in/min}$$

9. $S = \frac{3}{10}\text{ m}, \quad t = 5.2\text{ sec}$

$$v = \frac{S}{t} = \frac{\frac{3}{10}\text{ m}}{5.2\text{ sec}} = \frac{3}{10}\text{ m} \times \frac{10}{52}\frac{\text{sec}}{} = \frac{3}{52}\text{ m/sec}$$

Find arc length.

13. $v = 4.5\text{ mi/hr}, \quad t = 20\text{ min}$

$$20\text{ mins} = \frac{20}{60}\ \cancel{\text{sec}}\text{ hrs} = \frac{1}{3}\text{ hrs}$$

$$S = vt = \frac{4.5\text{ mi}}{1\text{ hr}} \cdot \frac{1}{3}\text{ hrs} = 1.5\text{ mi}$$

17. $v = 750$ km/min, $t = 4$ days.

1 day = 24 hrs.
4 days =

$= 96$ hrs.

1 hr = 60 min
96 $= 5760$ mins.

$s = vt$.

$= \frac{750 \text{ km}}{1 \text{ min}} \cdot 5760 \text{ mins}$.

$= 4,320,000$ km.

~~21.~~ Find angular speed.

21. $\theta = 25\pi$, $t = 10$ sec.

$\omega = \frac{\theta}{t} = \frac{25\pi}{10} = 2.5\pi$ rad/sec.
or
$\frac{5}{2}\pi$ rad/sec.

25. $\theta = \frac{7}{2}\pi$ $t = 12$ hr.

$\omega = \frac{\theta}{t} = \frac{\frac{7\pi}{2}}{12} = \frac{7}{24}\pi$ rad/hr.

29. $\theta = 780^\circ$ $t = 3$ min.

$780 \cdot \frac{\pi}{180} = \frac{13}{3}\pi$ $\omega = \theta \cdot t = \frac{13}{3}\pi \cdot 3 \text{ min} = 13\pi$ rad/min.

Find linear speed.

33. $\omega = \frac{2\pi \text{ rad}}{3 \text{ sec}}$, $r = 9$ in.

$v = r\omega = \frac{2\pi \text{ rad}}{3 \text{ sec}} \cdot 9 \text{ in} = 6\pi$ in/sec.

35. $\omega = \frac{\pi \text{ rad}}{20 \text{ sec}}$ $r = 5$ mm.

$v = r\omega = 5 \text{ mm} \times \frac{\pi \text{ rad}}{20 \text{ sec}} = \frac{\pi}{4}$ mm/sec.