

Since θ_1 , θ_2 and θ_3 are all within the given domain,
 $\theta = -482^\circ, -122^\circ, 238^\circ$ are the values that satisfy the conditions.

Practise, Apply, Solve 5.3 page 433

1. (a) iii, $270^\circ \leq \theta \leq 360^\circ$

(b) i, $90^\circ \leq \theta \leq 180^\circ$

(c) iv, $-180^\circ \leq \theta \leq -90^\circ$

(d) ii, $-90^\circ \leq \theta \leq 0^\circ$

2. (a) ii, $-180^\circ \leq \theta \leq 0^\circ$

(b) iii, $-270^\circ \leq \theta \leq -90^\circ$

(c) iv, $90^\circ \leq \theta \leq 360^\circ$

(d) i, $0^\circ \leq \theta \leq 270^\circ$

3. (a) i, $-180^\circ \leq \theta \leq -90^\circ$

(b) ii, $-270^\circ \leq \theta \leq -180^\circ$

(c) iii, $0^\circ \leq \theta \leq 90^\circ$

(d) iv, $90^\circ \leq \theta \leq 270^\circ$

4. (a) quadrant I, positive

(b) quadrant II, positive

(c) quadrant II, negative

(d) quadrant II, negative

(e) quadrant III, negative

(f) quadrant IV, negative

(g) quadrant II, negative

(h) quadrant IV, negative

5. (a)

$$r = \sqrt{(-3)^2 + (-4)^2} = 5$$

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

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

$$\tan \theta = \frac{y}{x} = \frac{-4}{-3} = \frac{4}{3}$$

(b)

$$r = \sqrt{(3)^2 + (4)^2} = 5$$

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

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

$$\tan \theta = \frac{y}{x} = \frac{4}{3}$$

(c)

$$r = \sqrt{(5)^2 + (12)^2} = 13$$

$$\sin \theta = \frac{y}{r} = \frac{12}{13}$$

$$\cos \theta = \frac{x}{r} = \frac{5}{13}$$

$$\tan \theta = \frac{y}{x} = \frac{12}{5}$$

(d)

$$r = \sqrt{(-12)^2 + (5)^2} = 13$$

$$\sin \theta = \frac{y}{r} = \frac{5}{13}$$

$$\cos \theta = \frac{x}{r} = \frac{-12}{13} = -\frac{12}{13}$$

$$\tan \theta = \frac{y}{x} = \frac{5}{-12} = -\frac{5}{12}$$

(e)

$$r = \sqrt{(7)^2 + (-24)^2} = 25$$

$$\sin \theta = \frac{y}{r} = \frac{-24}{25} = -\frac{24}{25}$$

$$\cos \theta = \frac{x}{r} = \frac{7}{25}$$

$$\tan \theta = \frac{y}{x} = \frac{-24}{7} = -\frac{24}{7}$$

(f)

$$r = \sqrt{(-7)^2 + (24)^2} = 25$$

$$\sin \theta = \frac{y}{r} = \frac{24}{25}$$

$$\cos \theta = \frac{x}{r} = \frac{-7}{25} = -\frac{7}{25}$$

$$\tan \theta = \frac{y}{x} = \frac{24}{-7} = -\frac{24}{7}$$

(g)

$$r = \sqrt{(0)^2 + (-1)^2} = 1$$

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

$$\cos \theta = \frac{x}{r} = \frac{0}{1} = 0$$

$$\tan \theta = \frac{y}{x} = \frac{-1}{0} = \text{undefined}$$

(h)

$$r = \sqrt{(-1)^2 + (0)^2} = 1$$

$$\sin \theta = \frac{y}{r} = \frac{0}{1} = 0$$

$$\cos \theta = \frac{x}{r} = \frac{-1}{1} = -1$$

$$\tan \theta = \frac{y}{x} = \frac{0}{-1} = 0$$

6. (a)

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

$$\theta = \tan^{-1} \left(\frac{11}{5} \right) \doteq 66^\circ$$

This is in quadrant I

(b)

$$\tan \theta = \frac{y}{x} = \frac{-2}{9}$$

$$\theta = \tan^{-1} \left(\frac{-2}{9} \right) \doteq -12.5^\circ$$

The principal value is $360^\circ - 12.5^\circ = 348^\circ$

(c)

$$\tan \theta = \frac{y}{x} = \frac{-7}{-4} = \frac{7}{4}$$

$$\theta = \tan^{-1} \left(\frac{7}{4} \right) \doteq 60^\circ$$

This is a related acute angle. Therefore, the principal angle is $180^\circ + 60^\circ = 240^\circ$

(d)

$$\tan \theta = \frac{y}{x} = \frac{9}{-5}$$

$$\theta = \tan^{-1} \left(\frac{9}{-5} \right) \doteq -61^\circ$$

The related acute angle is 61° . Therefore, the principal angle is $180^\circ - 61^\circ = 119^\circ$

7. (a)

$$r = \sqrt{(4)^2 + (6)^2} = \sqrt{52} \doteq 7.2$$

$$\tan \theta = \frac{y}{x} = \frac{6}{4}$$

$$\theta = \tan^{-1} \left(\frac{6}{4} \right) = 56^\circ$$

This is in quadrant I. Then, $(4, 6) = (7.2 \cos 56^\circ, 7.2 \sin 56^\circ)$.

(b)

$$r = \sqrt{(-3)^2 + (7)^2} = \sqrt{58} \doteq 7.6$$

$$\tan \theta = \frac{y}{x} = \frac{7}{-3}$$

$$\theta = \tan^{-1} \left(\frac{7}{-3} \right) = -67^\circ$$

This is not in quadrant II. The required angle is

$$\theta = 180^\circ - 67^\circ = 113^\circ$$

Then, $(-3, 7) = (7.6 \cos 113^\circ, 7.6 \sin 113^\circ)$.

(c)

$$r = \sqrt{(10)^2 + (-23)^2} = \sqrt{629} \doteq 25.1$$

$$\tan \theta = \frac{y}{x} = \frac{-23}{10}$$

$$\theta = \tan^{-1} \left(\frac{-23}{10} \right) = -67^\circ$$

This is not the principal angle. Then, $\theta = 360^\circ - 67^\circ = 293^\circ$.

Then, $(-10, 23) = (25.1 \cos 293^\circ, 25.1 \sin 293^\circ)$.

8. For the point $(-3, -4)$:

$$r = \sqrt{(-3)^2 + (-4)^2} = 5$$

$$\sin \alpha = \frac{y}{r} = \frac{-4}{5} = -\frac{4}{5}$$

$$\cos \alpha = \frac{x}{r} = \frac{-3}{5} = -\frac{3}{5}$$

$$\text{L.S} = (\sin \alpha)^2 + (\cos \alpha)^2 \quad \text{R.S} = 1$$

$$= \left(-\frac{4}{5} \right)^2 + \left(-\frac{3}{5} \right)^2$$

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

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

$$= 1$$

$$\therefore \text{L.S} = \text{R.S} \text{ and } (\sin \alpha)^2 + (\cos \alpha)^2 = 1$$

9.

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

$$\therefore \frac{y}{x} = \frac{1}{2} \text{ and } r = \sqrt{(1)^2 + (2)^2} = \sqrt{5}$$

$$\therefore \sin \theta = \frac{y}{r} = \frac{1}{\sqrt{5}} \doteq 0.447$$

Alternate Solution :

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

$$\theta = \tan^{-1} \left(\frac{1}{2} \right)$$

$$\theta \doteq 26.565^\circ$$

This is a quadrant I angle. So, $\sin (26.565^\circ) \doteq 0.447$

10.

$$\sin \alpha = \frac{6}{\sqrt{61}}$$

$$\alpha = \sin^{-1} \left(\frac{6}{\sqrt{61}} \right) \doteq 50.1944^\circ$$

Then in quadrant II, $\alpha = 180^\circ - 50.1944^\circ = 129.8056^\circ$

$$\therefore \cos 129.8056^\circ = -0.640$$

Alternate Solution :

$$\sin \alpha = \frac{y}{r} = \frac{6}{\sqrt{61}}$$

$$\text{Since } x^2 + y^2 = r^2, \text{ then } x^2 + 6^2 = (\sqrt{61})^2$$

$$x^2 = 61 - 36$$

$$x^2 = 25$$

$$x = \pm 5$$

α is a quadrant II angle

$$\therefore x = -5$$

$$\cos \alpha = \frac{x}{r} = \frac{-5}{\sqrt{61}} \doteq -0.640$$

11.

$$\cos \alpha = -\frac{8}{17}$$

$$\alpha = \cos^{-1}\left(-\frac{8}{17}\right) \doteq 118.07^\circ$$

This is a quadrant II angle. The cosine of an angle is negative in quadrants II and III. The related acute angle is

$$180^\circ - 118.07^\circ = 61.93^\circ.$$

$$\alpha = 180^\circ + 61.93^\circ = 241.93^\circ$$

Thus, α is 118.07° and 241.93°

12.

$$\text{For } 0^\circ \leq \alpha \leq 360^\circ$$

$$\sin \alpha = \frac{15}{17}$$

$$\alpha = \sin^{-1}\left(\frac{15}{17}\right) \doteq 61.93^\circ$$

The sine of α is also positive in quadrant II.

$$\text{Thus, } \alpha = 180^\circ - 61.93^\circ = 118.07^\circ$$

For $-360^\circ \leq \alpha \leq 0^\circ$, the rotation is clockwise so:

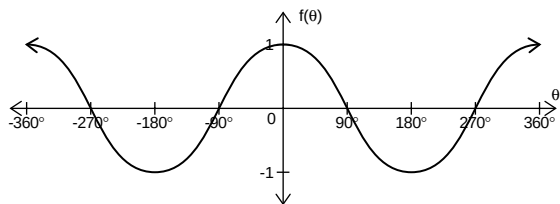
$$\alpha = -180^\circ - 61.93^\circ = -241.93^\circ$$

$$\text{and } \alpha = -360^\circ + 61.93^\circ = -298.07^\circ$$

Therefore, $\alpha = -298.07^\circ, -241.93^\circ, 61.93^\circ$, and 118.07° .

13. (a)

θ°	-360°	-270°	-180°	-90°	0°	90°	180°	270°	360°
$f(\theta)$	1	0	-1	0	1	0	-1	0	1



(b) Maximum values at $(-360^\circ, 1)$, $(0^\circ, 1)$, and $(360^\circ, 1)$.

Minimum values at $(-180^\circ, -1)$ and $(180^\circ, -1)$.

(c) Coordinates of the zeros are $(-270^\circ, 0)$, $(-90^\circ, 0)$, $(90^\circ, 0)$, and $(270^\circ, 0)$.

$$(d) f(-360^\circ) = f(360^\circ) = 1$$

$$f(-270^\circ) = f(270^\circ) = 0$$

$$f(-180^\circ) = f(180^\circ) = -1$$

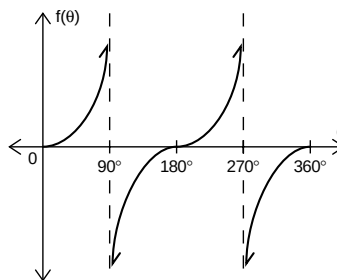
$$f(-90^\circ) = f(90^\circ) = 0$$

(e) $f(\theta) = f(-\theta)$ for all θ because $f(\theta) = \cos \theta$ is symmetric about the y-axis.

14. (a)

θ°	0°	30°	60°	90°	120°	150°
$f(\theta)$	0	0.6	1.7	—	-1.7	-0.6

180°	210°	240°	270°	300°	330°	360°
0	0.6	1.7	—	-1.7	-0.6	0



(b) Coordinates of the zeros are $(0^\circ, 0)$, $(180^\circ, 0)$, and $(360^\circ, 0)$.

(c) There is no value for $f(\theta) = \tan \theta$ for $0^\circ \leq \theta \leq 360^\circ$ when $\theta = 90^\circ$ and 270° . Extending the pattern of $f(\theta)$ for $\theta = n^\circ$, $n \in \mathbf{I}$, shows $f(\theta)$ undefined at $90^\circ, 270^\circ, 450^\circ, 630^\circ, \dots$

This forms an arithmetic sequence with common difference $d = 180^\circ$:

$$\begin{aligned} \text{Then } t_n &= a + (n-1)d \\ &= 90^\circ + (n-1)(180^\circ) \\ &= 90^\circ + n180^\circ - 180^\circ \\ &= -90^\circ + 180^\circ n \end{aligned}$$

The domain of $f(\theta) = \tan \theta$ is $\theta = n^\circ, n \in \mathbf{I}, \theta \neq -90^\circ + 180^\circ n$.

(d) The zeros occur at $0^\circ, 180^\circ, 360^\circ, \dots$ or $\theta = 180^\circ n, n \in \mathbf{I}$.

(e)

θ°	-360°	-330°	-300°	-270°	-240°	-210°
$f(\theta)$	0	0.6	1.7	—	-1.7	-0.6

-180°	-150°	-120°	-90°	-60°	-30°
0	0.6	1.7	—	-1.7	-0.6

$$f(360^\circ) = 0, f(-360^\circ) = 0$$

$$\therefore f(360^\circ) = -f(-360^\circ)$$

$$f(330^\circ) = -0.6, f(-330^\circ) = 0.6$$

$$\therefore f(330^\circ) = -f(-330^\circ)$$

$$f(300^\circ) = -1.7, f(-300^\circ) = 1.7$$

$$\therefore f(300^\circ) = -f(-300^\circ)$$

$$f(30^\circ) = 0.6, f(-30^\circ) = -0.6$$

$$\therefore f(30^\circ) = -f(-30^\circ)$$

$$\therefore f(\theta) = -f(-\theta) \text{ for all values in the table}$$

(f) $f(\theta) = -f(-\theta)$ for all values of θ if $f(\theta) = \tan \theta$ because $f(\theta) = \tan \theta$ is symmetric about the origin.

15. When $y = -0.7, y = \cos \theta$ becomes $-0.7 = \cos \theta$

Then:

$$\theta = \cos^{-1}(-0.7)$$

$$\doteq 134.4^\circ$$

$$\doteq 134^\circ$$

Examine the graph $y = \cos \theta$ for $0^\circ \leq \theta \leq 540^\circ$.

There are three values of θ that satisfy the equation within that domain:

$$\theta = 134^\circ$$

$$\theta = 180^\circ + (180^\circ - 134^\circ) = 226^\circ$$

$$\theta = 134^\circ + 360^\circ = 494^\circ$$

16. When $y = -0.3, y = \sin \theta$ becomes $-0.3 = \sin \theta$:

$$\theta = \sin^{-1}(-0.3) \doteq -17^\circ$$

Examine the graph $y = \sin \theta$ for $-90^\circ \leq \theta \leq 540^\circ$

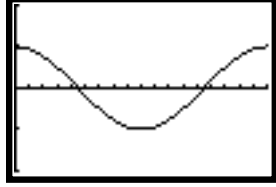
There are three values of θ that satisfy the equation within that domain:

$$\begin{aligned}\theta &= -17^\circ \\ \theta &= 180^\circ + 17^\circ = 197^\circ \\ \theta &= 360^\circ - 17^\circ = 343^\circ\end{aligned}$$

17. (a) $h(t) = \cos(20t)^\circ$

Then $h(3) = \cos[(20(3))]^\circ = \cos 60^\circ = 0.5$

(b) To solve $h(t) = \cos(20t)^\circ$ when $h(t) = 0.3$ draw the graph of $h(t) = \cos(20t)^\circ$ for $0 \leq t \leq 18$ and interpolate from the graph.



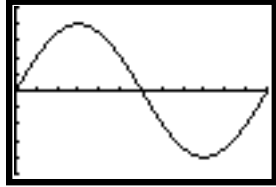
The graph takes on the value $h(t) = 0.3$ at two values of t . Therefore, $t \doteq 3.6$ and $t \doteq 14.4$.

18. (a) Substitute $t = 10$ into $h(t) = 4 \sin(30t)^\circ$

Then:

$$\begin{aligned}h(10) &= 4 \sin(30(10))^\circ \\ &= 4 \sin 300^\circ \\ &\doteq -3.5\end{aligned}$$

(b) Graph $h(t) = 4 \sin(30t)^\circ$ for $0 \leq t \leq 12$.



The graph takes on the value $h(t) = 3.2$ at two values of t . Therefore, $t \doteq 1.8$ and $t \doteq 4.2$.

19. (a) Substitute the given values for t into

$$h(t) = 5 \cos(18t)^\circ:$$

$$h(8) = 5 \cos[18(8)]^\circ = -4.0 \text{ m}$$

$$h(16) = 5 \cos[18(16)]^\circ = 1.5 \text{ m}$$

$$h(30) = 5 \cos[18(30)]^\circ = -5.0 \text{ m}$$

When the time is 8 s, 16 s and 30 s the rider is 4 m below, 1.5 m above and 5 m below the horizontal axis.

(b) When $h(t) = -4.5$ for the first time, $t \doteq 1.4$ s.

Verification:

$$5 \cos(18t)^\circ = 4.5$$

$$\cos(18t)^\circ = 0.9$$

$$(18t)^\circ = \cos^{-1}(0.9)$$

$$(18t)^\circ \doteq 25.84$$

$$t \doteq 1.4 \text{ s}$$

When $h(t) = -3.2$ for the first time, $t \doteq 7.2$ s.

Verification:

$$5 \cos(18t)^\circ = -3.2$$

$$\cos(18t)^\circ = -0.64$$

$$(18t)^\circ = \cos^{-1}(-0.64)$$

$$(18t)^\circ \doteq 129.79$$

$$t \doteq 7.2 \text{ s}$$

(c) When $h(t) = -2.5$ m for the third time, $t \doteq 6.67$ s.

Verification:

$$5 \cos(18t)^\circ = -2.5$$

$$\cos(18t)^\circ = -\frac{1}{2}$$

$$(18t)^\circ = \cos^{-1}\left(-\frac{1}{2}\right)$$

$$(18t)^\circ \doteq 120$$

$$t \doteq 6.67 \text{ s}$$

We need to determine the period of the Ferris wheel. The cos graph has a period of 360° .

$$360^\circ \div 18 = 20$$

Thus, the Ferris wheel has a period of 20 s. The rider is first at -2.5 m at 6.67 s. The second time is at:

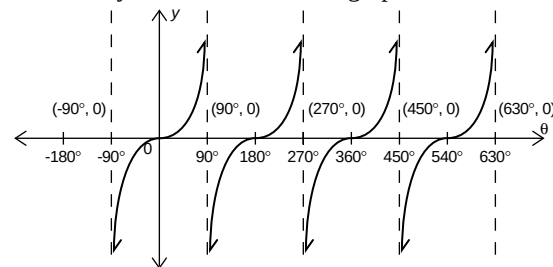
$$0 + (20 - 6.67) = 13.33 \text{ s and the third time is at:}$$

$$20 + 6.67 = 26.67 \text{ s.}$$

So $t \doteq 26.7$ s when $h(t) = -2.5$ for the third time.

20. Because $y = \tan \theta$ is undefined at $\theta = -90^\circ$ and $\theta = 90^\circ$ then there is a vertical asymptote at $\theta = -90^\circ$ and $\theta = 90^\circ$.

The function $y = \tan \theta$ is 180° periodic. That means it repeats itself every 180° . The extended graph becomes:



The points where the asymptotes cross the horizontal axis are when $t = -90^\circ, 90^\circ, 270^\circ, 450^\circ, 630^\circ, \dots$ or $t = 90^\circ n, n \in \mathbf{I}$.

The zeros are $(0^\circ, 0^\circ), (180^\circ, 0^\circ), (360^\circ, 0^\circ),$ and $(540^\circ, 0^\circ)$.

21. (a) A point in quadrant I has $(x, y) = (+, +)$. The radius r is always positive (+).

Then:

$$\sin \theta = \frac{y}{r} \quad \cos \theta = \frac{x}{r} \quad \tan \theta = \frac{y}{x}$$

$$= \frac{+}{+} \quad = \frac{+}{+} \quad = \frac{+}{+}$$

$$= + \quad = + \quad = +$$

A point in quadrant II has $(x, y) = (-, +)$.

Then:

$$\sin \theta = \frac{y}{r} \quad \cos \theta = \frac{x}{r} \quad \tan \theta = \frac{y}{x}$$

$$= \frac{+}{+} \quad = \frac{-}{+} \quad = \frac{+}{-}$$

$$= + \quad = - \quad = -$$

A point in quadrant III has $(x, y) = (-, -)$.

Then:

$$\begin{aligned}\sin \theta &= \frac{y}{r} & \cos \theta &= \frac{x}{r} & \tan \theta &= \frac{y}{x} \\ &= \frac{-}{+} & &= \frac{-}{+} & &= \frac{-}{-} \\ &= - & &= - & &= +\end{aligned}$$

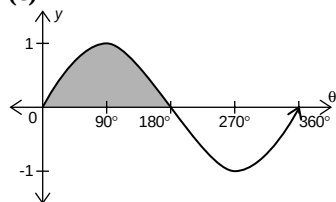
A point in quadrant IV has $(x, y) = (+, -)$.

Then:

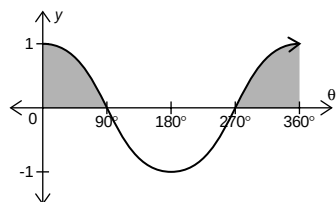
$$\begin{aligned}\sin \theta &= \frac{y}{r} & \cos \theta &= \frac{x}{r} & \tan \theta &= \frac{y}{x} \\ &= \frac{-}{+} & &= \frac{+}{+} & &= \frac{-}{+} \\ &= - & &= + & &= -\end{aligned}$$

(b) Quadrant I: all positive, Quadrant II: $\sin \theta$ is positive, Quadrant III: $\tan \theta$ is positive, Quadrant IV: $\cos \theta$ is positive

(c)

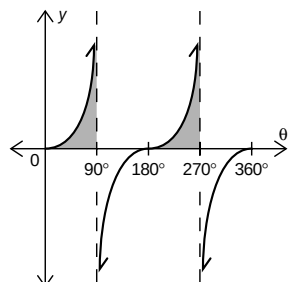


$\sin \theta \geq 0$ for $0^\circ \leq \theta \leq 180^\circ$. This is quadrant I and II.



$\cos \theta \geq 0$ for $0^\circ \leq \theta \leq 90^\circ$. This is quadrant I.

$\cos \theta \geq 0$ for $270^\circ \leq \theta \leq 360^\circ$. This is quadrant IV.



$\tan \theta \geq 0$ for $0^\circ \leq \theta \leq 90^\circ$. This is quadrant I.

$\tan \theta \geq 0$ for $180^\circ \leq \theta \leq 270^\circ$. This is quadrant III.

22. The functions $y = \cos \theta$, $y = \sin \theta$ and $y = \tan \theta$ are derived from the coordinates of a point $P(x, y)$ as the point rotates about a circle with radius r . Note: $x \in \mathbf{R}$, $y \in \mathbf{R}$ and

$$r = \sqrt{x^2 + y^2}, r \geq 0$$

As well, $x \leq r$ and $y \leq r$.

Then:

$$\sin \theta = \frac{y}{r} \leq 1, \text{ if } y \geq 0$$

$$\sin \theta = \frac{y}{r} \geq -1, \text{ if } y \leq 0$$

$$\therefore -1 \leq \sin \theta \leq 1$$

Then $y = \sin \theta$ has a maximum of 1 and a minimum of -1 .

And:

$$\cos \theta = \frac{x}{r} \leq 1, \text{ if } x \geq 0$$

$$\cos \theta = \frac{x}{r} \geq -1, \text{ if } x \leq 0$$

$$\therefore -1 \leq \cos \theta \leq 1$$

Then $y = \cos \theta$ has a maximum of 1 and a minimum of -1 .

And:

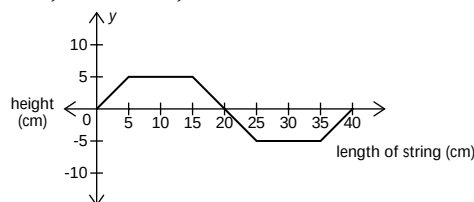
$$\tan \theta = \frac{y}{x}$$

when $x = 0$ and $y < 0$ then $\tan \theta \rightarrow -\infty$

when $x = 0$ and $y > 0$ then $\tan \theta \rightarrow +\infty$

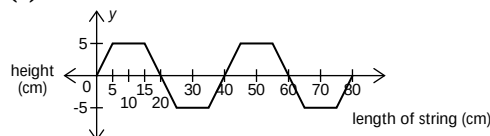
This means that $y = \tan \theta$ has no maximum or minimum value.

23. (a) The axes of the graph will be the height above the horizontal centre line and length of string. The key points to observe are: start, first turn, second turn, horizontal line, third turn, fourth turn, horizontal line



(b) Once around the cube uses 40 cm of string ($5 + 10 + 5 + 5 + 10 + 5$). The period of the graph is 40 cm. The perimeter of the cross-section of the cube and the period of the graph are both 40 cm.

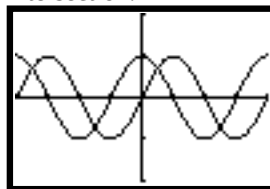
(c)



Twice around the cube uses 80 cm of string.

(d) The minimum value of the graph is -5 cm. To reach this with the least amount of string requires:
 $5 + 10 + 5 + 5 = 25$ cm of string.

24. Draw both graphs $y = \cos \theta$ and $y = \sin \theta$, $-360^\circ \leq \theta \leq 360^\circ$ on the same axes and mark the points of intersection.



Interpolate the value of θ for each intersection point.

Then $\sin \theta = \cos \theta$ when $\theta = -315^\circ, -135^\circ, 45^\circ, 225^\circ$

$$25. (a) \csc \theta = \frac{1}{\sin \theta} \quad \sec \theta = \frac{1}{\cos \theta} \quad \cot \theta = \frac{1}{\tan \theta}$$

(b)

$$\csc \theta = \frac{1}{\frac{y}{r}} \quad \sec \theta = \frac{1}{\frac{x}{r}} \quad \cot \theta = \frac{1}{\frac{y}{x}}$$

$$\csc \theta = \frac{r}{y}, y \neq 0 \quad \sec \theta = \frac{r}{x}, x \neq 0 \quad \cot \theta = \frac{x}{y}, y \neq 0$$

(c)

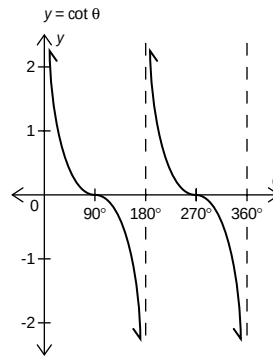
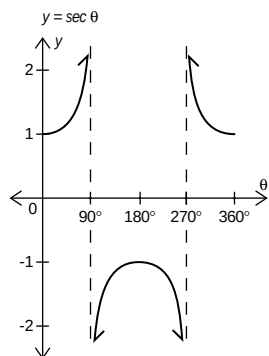
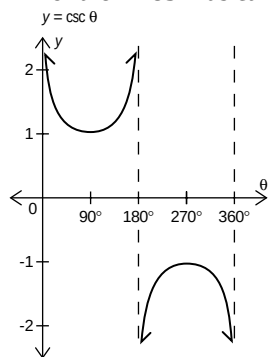
θ	0°	30°	60°	90°	120°	150°
$\csc \theta$	—	2	1.2	1	1.2	2
θ	180°	210°	240°	270°	300°	330°
$\csc \theta$	—	-2	-1.2	-1	-1.2	-2
θ	360°					
$\csc \theta$	—					

θ	0°	30°	60°	90°	120°	150°
$\sec \theta$	1	1.2	2	—	-2	-1.2
θ	180°	210°	240°	270°	300°	330°
$\sec \theta$	-1	-1.2	-2	—	2	1.2
θ	360°					
$\sec \theta$	1					

θ	0°	30°	60°	90°	120°	150°
$\cot \theta$	—	1.7	0.6	0	-0.6	-1.7
θ	180°	210°	240°	270°	300°	330°
$\cot \theta$	—	1.7	0.6	0	-0.6	-1.7
θ	360°					
$\cot \theta$	—					

Be sure that the calculator is set to degree mode. To calculate the value of a secondary trigonometric function, determine the value of the primary trigonometric function and then

apply the reciprocal key $\frac{1}{x}$ key for a scientific calculator and x^{-1} for the TI-83 Plus calculator).



(d) The restrictions are shown as vertical asymptotes on the graphs.

(e) For $y = \csc \theta$:

$$D = \{\theta \mid \theta = m^\circ, m \in \mathbf{R}, \theta \neq 180^\circ n, n \in \mathbf{I}\}$$

$$R = \{y \mid y \leq -1 \text{ or } y \geq 1, y \in \mathbf{R}\}$$

For $y = \sec \theta$:

$$D = \{\theta \mid \theta = m^\circ, m \in \mathbf{R}, \theta \neq -90^\circ + 180^\circ n, n \in \mathbf{I}\}$$

$$R = \{y \mid y \leq -1 \text{ or } y \geq 1, y \in \mathbf{R}\}$$

For $y = \cot \theta$:

$$D = \{\theta \mid \theta = m^\circ, m \in \mathbf{R}, \theta \neq 180^\circ n, n \in \mathbf{I}\}$$

$$R = \{y \mid y \in \mathbf{R}\}$$

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1. The circumference of a circle of radius 1 is $C = 2\pi r$.

$$C = 2\pi$$

A complete rotation about a circle is 360° .

A counterclockwise rotation is positive.

A clockwise rotation is negative.

(a) positive rotation $\frac{1}{2}$ circle, $\frac{1}{2}(2\pi) = \pi$, $\frac{1}{2}(360^\circ) = 180^\circ$

(b) positive rotation $\frac{1}{4}$ circle, $\frac{1}{4}(2\pi) = \frac{\pi}{2}$, $\frac{1}{4}(360^\circ) = 90^\circ$

(c) negative rotation $\frac{1}{2}$ circle, $-\frac{1}{2}(2\pi) = -\pi$,
 $-\frac{1}{2}(360^\circ) = -180^\circ$

(d) negative rotation $\frac{3}{4}$ circle, $-\frac{3}{4}(2\pi) = -\frac{3\pi}{2}$,
 $-\frac{3}{4}(360^\circ) = -270^\circ$

(e) negative rotation full circle, $-(2\pi) = -2\pi$, $-(360^\circ) = -360^\circ$

(f) positive rotation $\frac{3}{4}$ circle, $\frac{3}{4}(2\pi) = \frac{3\pi}{2}$, $\frac{3}{4}(360^\circ) = 270^\circ$

(g) negative rotation $\frac{4}{6}$ circle, $-\frac{4}{6}(2\pi) = -\frac{4\pi}{3}$,
 $-\frac{4}{6}(360^\circ) = -240^\circ$

(h) positive rotation $\frac{3}{8}$ circle, $\frac{3}{8}(2\pi) = \frac{3\pi}{4}$, $\frac{3}{8}(360^\circ) = 135^\circ$