

# Solving Trig Equations Solutions

## Section 1

1.  $x = \pi/2, 5\pi/2, 9\pi/2$

2.  $x = \pi/2, 3\pi/2, 5\pi/2$

3.  $x = 3\pi/2, 7\pi/2, 11\pi/2, 15\pi/2, 19\pi/2$

4.  $x = \pi, 3\pi, 5\pi, 7\pi$

5.  $\cos(\pi x + 2) = 0$

$\cos(\theta) = 0$  where  $\theta = \frac{\pi}{2}, \frac{3\pi}{2}, 5\pi/2$

$\theta = \pi x + 2$

$\pi x + 2 = \pi/2$  or  $\pi x + 2 = \frac{3\pi}{2}$  or  $\pi x + 2 = 5\pi/2$

$\pi x = \pi/2 - 2$

$x = \frac{\pi/2 - 2}{\pi}$

$\pi x = \frac{3\pi}{2} - 2$

$x = \frac{3\pi/2 - 2}{\pi}$

$\pi x = \frac{5\pi}{2} - 2$

$x = \frac{5\pi/2 - 2}{\pi}$

6.  $x = \frac{\pi/2 + 3}{2}, x = \frac{5\pi/2 + 3}{2}, x = \frac{9\pi/2 + 3}{2}, x = \frac{13\pi/2 + 3}{2}$

7.  $x = 1 - \frac{2}{\pi}, x = 3 - \frac{2}{\pi}, x = 5 - \frac{2}{\pi}$

8.  $x = \pi/4, x = 3\pi/4$

9.  $5\sin(3x) + 3 = 3$

$5\sin(3x) = 0$

$\sin(3x) = 0 \Rightarrow \sin(\theta) = 0$  where  $\theta = 0, \pi, 2\pi$

$\theta = 3x$

$3x = 0$

$x = 0$

or  $3x = \pi$

$x = \frac{\pi}{3}$

or  $3x = 2\pi$

$x = \frac{2\pi}{3}$



$$10. \quad x = \frac{3\pi}{4}, \quad x = \frac{7\pi}{4}, \quad x = \frac{11\pi}{4}$$

$$11. \quad A) \quad 5 = 5 + 2 \cos\left(\frac{\pi}{6}t\right)$$

$$0 = \cos\left(\frac{\pi}{6}t\right)$$

$$\cos(\theta) = 0 \quad \text{where } \theta = \frac{\pi}{2}, \frac{3\pi}{2}, \dots$$

$$\text{Let } \theta = \frac{\pi}{6}t$$

$$\frac{\pi}{6}t = \frac{\pi}{2}$$

$$t = \frac{\pi}{2} \cdot \frac{6}{\pi} = \underline{\underline{3}} \text{ hours after high tide.}$$

$$B) \quad t = \underline{\underline{6}} \text{ hours after high tide.}$$

$$C) \quad 6 = 5 + 2 \cos\left(\frac{\pi}{6}t\right)$$

$$\frac{1}{2} = \cos\left(\frac{\pi}{6}t\right)$$

$$\cos(\theta) = \frac{1}{2} \quad \text{where } \theta = \frac{\pi}{3}$$

$$\text{Let } \theta = \frac{\pi}{6}t$$

$$\frac{\pi}{6}t = \frac{\pi}{3}$$

$$t = \frac{\pi}{3} \cdot \frac{6}{\pi} = \underline{\underline{2}} \text{ hours after high tide}$$

$$12. \quad t = 0, \quad t = \frac{1}{30}, \quad t = \frac{1}{15}$$

$$13. \quad x = .78$$

$$14. \quad x = 2.3$$

$$15. \quad 5 \sin(3x) = 1$$

$$\sin(3x) = .2$$

or

$$\sin(\theta) = .2$$

$$\theta = \sin^{-1}(.2) \approx .2$$

$$\text{But } \theta = 3x$$

$$3x = .2$$

$$x \approx \underline{\underline{.07}}$$



$$16. 4 \cos(5x+2) = 1$$

$$\cos(5x+2) = .25 \quad \text{changing to } \theta \Rightarrow \cos(\theta) = .25$$

$$\theta = \cos^{-1}(.25)$$

$$\theta \approx 1.32$$

$$5x + 2 \approx 1.32$$

$$x \approx \underline{\underline{-.14}}$$

$$17. x \approx -.4$$

$$18. x \approx .52$$

$$19. \tan(x) = \frac{3}{5}$$

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

$$x = \underline{\underline{.54}} \text{ radians or } \underline{\underline{31^\circ}}$$

$$20. 20 \sin(30\pi t) = 12$$

$$\sin(30\pi t) = .6 \quad \text{changing to } \theta \Rightarrow \sin(\theta) = .6$$

$$\theta = \sin^{-1}(.6)$$

$$30\theta \approx .64$$

$$30\pi t \approx .64$$

$$t \approx \underline{\underline{.007}}$$

$$21. x = \frac{\pi}{2} \text{ why?}$$

$$22. x = \pi \text{ why?}$$



$$23. \quad x \approx \underline{.2}, \quad x \approx \pi - .2 \approx \underline{2.94} \quad (\text{because of symmetry})$$

$$24. \quad \sin(4x) = 0.6$$

$$\sin(\theta) = 0.6$$

$$\theta \approx .64$$

$$4x \approx .64$$

$$x \approx \underline{.16}$$

$$\text{or } \theta \approx \pi - .64 \approx 2.5$$

$$4x \approx 2.5$$

$$x \approx \underline{.63}$$

$$25. \quad x \approx \underline{.93}, \quad x \approx 2\pi - .93 \approx \underline{5.38} \quad (\text{because of symmetry})$$

$$26. \quad 5 \cos(2x) + 1 = 4$$

$$\cos(2x) = .6$$

$$\cos(\theta) = .6$$

$$* \quad \theta \approx .93 \quad \text{or} \quad * \quad \theta \approx 2\pi - .93 \approx 5.38 \quad (\text{symmetry})$$

$$2x \approx .93$$

$$x \approx \underline{.46}$$

$$2x \approx 5.38$$

$$x \approx \underline{2.69}$$

To get 2 more solutions go back to \* and add  $2\pi$  (the period of cosine) to each branch.

$$\theta \approx .93 + 2\pi \approx 7.21$$

$$2x \approx 7.21$$

$$x \approx \underline{3.6}$$

$$\text{or } \theta \approx 5.38 + 2\pi \approx 11.66$$

$$2x \approx 11.66$$

$$x \approx \underline{5.83}$$



27. No Solution

$$28. 20 \cos(\pi x) = 7$$

$$\cos(\pi x) = \frac{7}{20}$$

$$\cos(\pi x) = .35$$

$$\cos(\theta) = .35$$

$$\theta = \cos^{-1}(.35) \approx 1.21$$

$$* \theta \approx 1.21$$

$$\pi x \approx 1.21$$

$$x \approx \underline{\underline{.39}}$$

$$\text{or } * \theta \approx 2\pi - 1.21 \approx 5.07 \text{ (symmetry)}$$

$$\pi x \approx 5.07$$

$$x \approx \underline{\underline{1.61}}$$

To get more solutions go back to \* and add  $2\pi$  (the period of cosine) to each branch.

$$\theta \approx 1.21 + 2\pi \approx 7.49$$

$$\pi x \approx 7.49$$

$$x \approx \underline{\underline{2.38}}$$

$$\text{or } \theta \approx 5.07 + 2\pi \approx 11.35$$

$$\pi x \approx 11.35$$

$$x \approx \underline{\underline{3.61}}$$