Precalculus

Trigonometric equation that reduces to quadratic, masked by identity

Todor Miley

2019

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

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

 $\sin \theta = ?$

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

 $\sin \theta = 2\sin \theta \cos \theta$

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\begin{array}{rcl}
\sin \theta & = & \sin(2\theta) \\
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0 & = & 2\sin \theta \cos \theta - \sin \theta
\end{array}
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 $\sin \theta = 0$

Find all values of θ in the interval $[0, 2\pi]$ such that $\sin \theta = \sin(2\theta)$.

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0 & = & \sin \theta (2\cos \theta - 1) \\
2\cos \theta - 1 & = & 0
\end{array}$$

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Find all values of θ in the interval $[0, 2\pi]$ such that $\sin \theta = \sin(2\theta)$.

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

$$sin \theta = 2 sin \theta cos \theta$$

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

$$0 = sin \theta(2 cos \theta - 1)$$

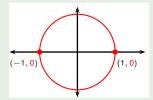
$$2 cos \theta - 1 = 0$$

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$$\sin \theta = 0$$

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

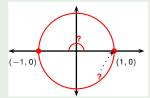


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\sin\theta & = & 0 \\
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\end{array}$$

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

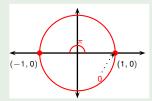


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$$sin \theta = 0
\theta = 0 + 2k\pi
or $\pi + 2k\pi$$$

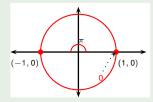
$$2\cos\theta-1 = 0$$



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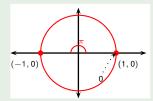


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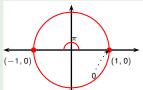
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\theta &=& 0 \text{ or } 2\pi \text{ or } \pi
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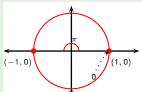


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or $\pi + 2k\pi$
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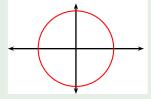
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$$2\cos\theta - 1 = 0$$

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



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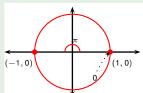
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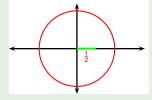
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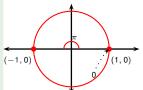
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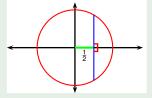
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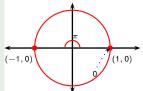
$$\theta = ?$$



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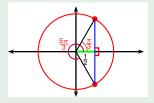
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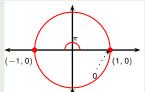
$$\theta = \frac{\pi}{3} + 2k\pi \text{ or } \frac{5\pi}{3} + 2k\pi$$



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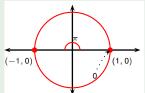
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Find all values of θ in the interval $\theta \in [0, 2\pi]$ for which $\cos(2\theta) = \cos\theta$

$$\cos(2\theta) = \cos\theta$$

? $-\cos\theta = 0$

$$cos(2\theta) = cos \theta$$
 $-cos \theta = 0$

$$\cos(2\theta) = \cos\theta$$
$$\cos^2\theta - \sin^2\theta - \cos\theta = 0$$

$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{ Express via } \cos\theta$$

$$\cos^2\theta - (?) - \cos\theta = 0$$

$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

$$\cos^2\theta - (1 - \cos^2\theta) - \cos\theta = 0$$

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$$\cos^2\theta - (1 - \cos^2\theta) - \cos\theta = 0$$

$$2\cos^2\theta - \cos\theta - 1 = 0 \qquad | \text{Set } \cos\theta = u$$

$$2u^2 - u - 1 = 0$$

$$\cos(2\theta) = \cos\theta$$

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$$(?)(?) = 0$$

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$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

Find all values of θ in the interval $\theta \in [0, 2\pi]$ for which

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$$2u + 1 = 0$$

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$$u - 1 = 0 \qquad 2u + 1 = 0$$

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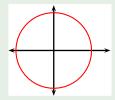
$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0 \qquad 2u + 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 2 + 2k\pi$$



$$\cos(2\theta) = \cos\theta$$

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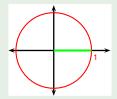
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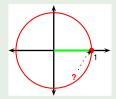
$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0 \qquad 2u + 1 = 0$$

$$\cos\theta = 1$$

$$\theta = \frac{2}{3} + 2k\pi$$



$$\cos(2\theta) = \cos\theta$$

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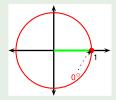
$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0 \qquad 2u + 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi$$



$$\cos(2\theta) = \cos\theta$$

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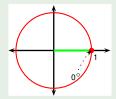
$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

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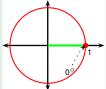
$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0 \qquad 2u + 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi$$

$$\theta = 0 \text{ or } 2\pi$$



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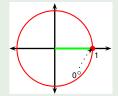
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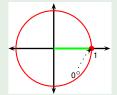
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$$2\cos^2\theta - \cos\theta - 1 = 0 \qquad | \text{Set } \cos\theta = u$$

$$2u^2 - u - 1 = 0$$

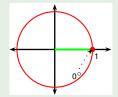
$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi$$

$$\theta = 0 \text{ or } 2\pi$$



Find all values of θ in the interval $\theta \in [0, 2\pi]$ for which

$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

$$\cos^2\theta - (1 - \cos^2\theta) - \cos\theta = 0$$

$$2\cos^2\theta - \cos\theta - 1 = 0 \qquad | \text{Set } \cos\theta = u$$

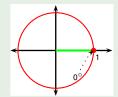
$$2u^2 - u - 1 = 0$$

$$(u - 1)(2u + 1) = 0$$

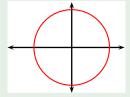
$$u - 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi$$
or
$$\cos\theta$$



 $\theta = 0 \text{ or } 2\pi$



Find all values of θ in the interval $\theta \in [0, 2\pi]$ for which

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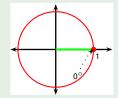
$$2u^2 - u - 1 = 0$$

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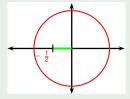
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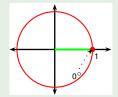
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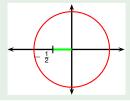
$$(u - 1)(2u + 1) = 0$$

$$u - 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi \qquad \text{or} \qquad \theta = ?$$





$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

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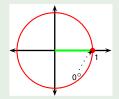
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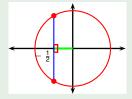
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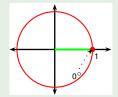
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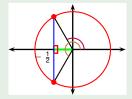
$$u - 1 = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi \qquad \text{or} \qquad \theta = \frac{1}{2}$$

$$\theta = 0 \text{ or } 2\pi$$





$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

$$\cos^2\theta - (1 - \cos^2\theta) - \cos\theta = 0$$

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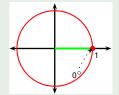
$$2u^2 - u - 1 = 0$$

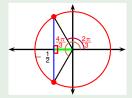
$$(u - 1)(2u + 1) = 0$$

$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi \qquad \text{or} \qquad \theta = \frac{2\pi}{3} + 2k\pi \text{ or } \frac{4\pi}{3} + 2k\pi$$

$$\theta = 0 \text{ or } 2\pi$$





$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

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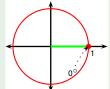
$$(u - 1)(2u + 1) = 0$$

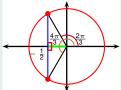
$$\cos\theta = 1$$

$$\theta = 0 + 2k\pi \qquad \text{or}$$

$$\theta = 0 \text{ or } 2\pi$$

$$\cos\theta = \frac{2\pi}{3} \text{ or } \frac{4\pi}{3}$$





$$\cos(2\theta) = \cos\theta$$

$$\cos^2\theta - \sin^2\theta - \cos\theta = 0 \qquad | \text{Express via } \cos\theta$$

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$$u - 1 = 0$$

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$$\theta = 0 + 2k\pi \qquad \text{or} \qquad \theta = \frac{2\pi}{3} + 2k\pi \text{ or } \frac{4\pi}{3} + 2k\pi$$

$$\theta = 0 \text{ or } 2\pi \qquad \theta = \frac{2\pi}{3} \text{ or } \frac{4\pi}{3}$$

