

# Precalculus

## Conversions between degrees and radians

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2019

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- The relationship between degrees and radians is:

$$\begin{aligned}\pi \text{ rad} &= 180^{\circ} \\ 1 \text{ rad} &= \frac{180^{\circ}}{\pi} \approx 57.3^{\circ}\end{aligned}$$

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- In other words, a half-turn is measured by  $\pi \text{ rad}$  or  $180^{\circ}$ .
- Degrees are useful because the most frequently encountered fractions of a half turn are measured by a whole number of degrees.
- If a measurement unit is not specified, it is implied to be radians. For example, in  $\sin 5$ , the number 5 stands for 5 radians.

$$t^{\circ} = \frac{t}{180}\pi \text{ (radians).}$$

### Example

Convert from degrees to radians.

Deg.	45°	36°	-20°	360°	-720°	-225°	2015°
Rad.							

$$x = \frac{x}{\pi} 180^{\circ}.$$

### Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.								

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Rad.	$\frac{\pi}{4}$						

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Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$				

$$x = \frac{x}{\pi} 180^{\circ}.$$

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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
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Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
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Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$							

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

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Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	?						

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

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## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$						

$$t^\circ = \frac{t}{180} \pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	?					

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$					

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	?				

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	45°	36°	-20°	360°	-720°	-225°	2015°
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	60°	18°	330°	315°				



$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	?			

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi}180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$			

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	?		

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

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Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	$390^\circ$		

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	$390^\circ$	?	

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Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	$390^\circ$	$-225^\circ$	

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Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
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Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	$390^\circ$	$-225^\circ$	?

$$t^\circ = \frac{t}{180}\pi \text{ (radians).}$$

## Example

Convert from degrees to radians.

Deg.	$45^\circ$	$36^\circ$	$-20^\circ$	$360^\circ$	$-720^\circ$	$-225^\circ$	$2015^\circ$
Rad.	$\frac{\pi}{4}$	$\frac{\pi}{5}$	$-\frac{\pi}{9}$	$2\pi$	$-4\pi$	$-\frac{5\pi}{4}$	$\frac{403}{36}\pi$

$$x = \frac{x}{\pi} 180^\circ.$$

## Example

Convert from radians to degrees.

Rad.	$\frac{\pi}{3}$	$\frac{\pi}{10}$	$\frac{11\pi}{6}$	$\frac{7\pi}{4}$	$\frac{\pi}{7}$	$\frac{13\pi}{6}$	$-\frac{5\pi}{4}$	2
Deg.	$60^\circ$	$18^\circ$	$330^\circ$	$315^\circ$	$\frac{180^\circ}{7} \approx 25.7^\circ$	$390^\circ$	$-225^\circ$	$\frac{2}{\pi} 180^\circ \approx 114.6^\circ$