

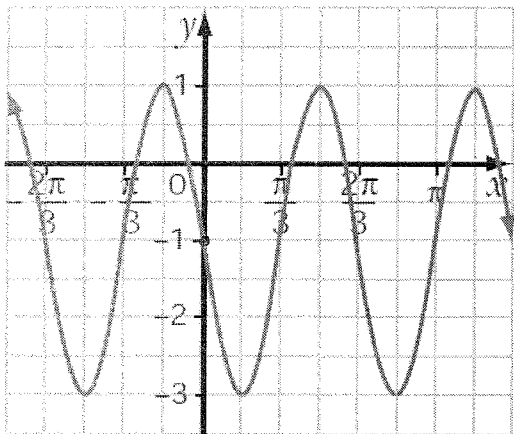
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Determining the Equation of Sinusoidal Functions

- ⇒ Every sinusoidal function can be written as $f(x) = a \sin[k(x - d)] + c$ or $f(x) = a \cos[k(x - d)] + c$
- ⇒ Recall the meaning of the parameters a, k, d, c:
- a: vertical stretch/compression by a factor of a
 - k: horizontal stretch/compression by a factor of $1/k$
 - d: phase shift
 - c: vertical translation
- ⇒ The parameter a gives the amplitude. Use the formula $amplitude = \frac{\max - \min}{2}$ to determine its value.
- ⇒ The parameter k can be determined by finding the period of the given function. Once you have the period, use the formula $period = \frac{360^\circ}{k}$ to determine the value of the parameter k.
- ⇒ The parameter c can be determined by finding the mean value of the function. Use the formula:
- $$mean_value = \frac{\max + \min}{2}$$
- ⇒ Different phase shifts may be possible resulting in multiple equations. Use care when determining the phase shift.

Example 1) Determine an equation in terms of sine and cosine for the following trigonometric function



$$\max = 1, \quad \min = -3$$

$$A = \frac{1 - (-3)}{2}$$

$$M.V = \frac{1 + (-3)}{2}$$

$$A = 2$$

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

$$= -1$$

$$period = 30 + 90 = 120^\circ = \frac{2\pi}{3}$$

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

$$\frac{2\pi/k}{2\pi} = \frac{6\pi}{2\pi}$$

$$k = 3$$

$$y = -2 \sin 3x - 1$$

or

$$y = -2 \cos \left[3 \left(x - \frac{\pi}{6} \right) \right] - 1$$

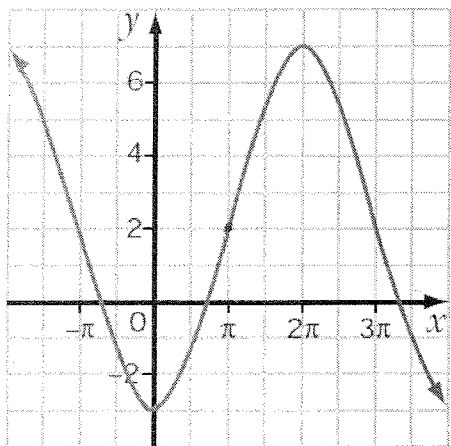
or

$$y = 2 \cos \left[3 \left(x - \frac{\pi}{2} \right) \right] - 1$$

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Example 2): Determine an equation in terms of sine and cosine for the following trigonometric function



$$\text{period} = 2\pi + 2\pi = 4\pi$$

$$A = \frac{7 - (-3)}{2}$$

$$= 5$$

$$M.V = \frac{7 + (-3)}{2}$$

$$= 2$$

$$4\pi = \frac{2\pi}{k}$$

$$4\pi k = 2\pi$$

$$k = \frac{2\pi}{4\pi}$$

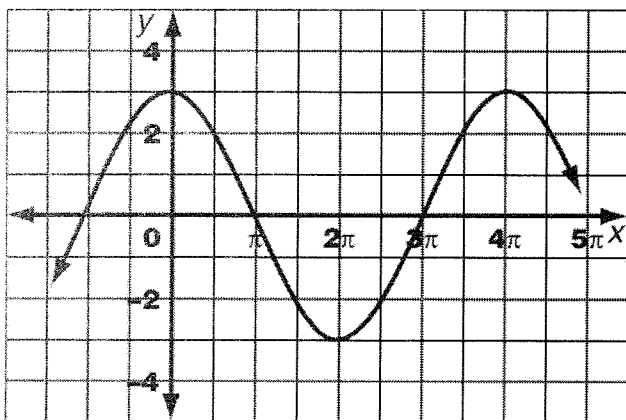
$$k = \frac{1}{2}$$

$$y = -5\cos\left(\frac{1}{2}x\right) + 2$$

or

$$y = 5\sin\left[\frac{1}{2}(x - \pi)\right] + 2$$

Example 3): Determine an equation in terms of sine and cosine for the following trigonometric function



$$A = 3$$

$$M.V = 0$$

$$\text{period} = 4\pi$$

$$k = \frac{1}{2}$$

$$\therefore y = 3\cos\left(\frac{1}{2}x\right)$$

or

$$y = -3\sin\left[\frac{1}{2}(x - \pi)\right]$$