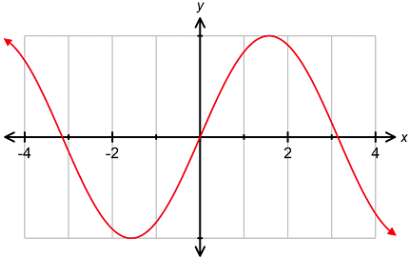
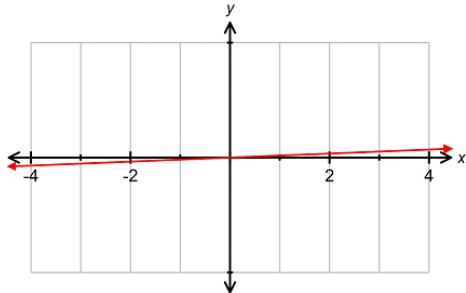


Section 6.3 Related Rates Involving Trigonometry

Section 6.3 Related Rates using Trigonometry

↳ Calculus deals with radian measure due to the simple ratio being unitless.

Radians	Degrees												
$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$ <table border="1"> <thead> <tr> <th>x</th> <th>$\lim_{x \rightarrow 0} \frac{\sin x}{x}$</th> </tr> </thead> <tbody> <tr> <td>0.1</td> <td>0.998</td> </tr> <tr> <td>0.2</td> <td>0.993</td> </tr> </tbody> </table>	x	$\lim_{x \rightarrow 0} \frac{\sin x}{x}$	0.1	0.998	0.2	0.993	$\lim_{x \rightarrow 0} \frac{\sin x}{x} = \frac{\pi}{180}$ <table border="1"> <thead> <tr> <th>x</th> <th>$\lim_{x \rightarrow 0} \frac{\sin x}{x}$</th> </tr> </thead> <tbody> <tr> <td>10°</td> <td>0.01736</td> </tr> <tr> <td>20°</td> <td>0.01710</td> </tr> </tbody> </table>	x	$\lim_{x \rightarrow 0} \frac{\sin x}{x}$	10°	0.01736	20°	0.01710
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$\frac{d}{dx}(\sin x) = \cos x$	$\frac{d}{dx}(\sin x) = \left(\frac{\pi}{180}\right) \cos x$												
													

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Section 6.3 Related Rates Involving Trigonometry

Example 1

A video camera at ground level is taping the release and rise of a weather balloon. The camera is located 500 m from the release point. As the balloon rises, the camera operator observes that when the angle of elevation between the camera and the balloon is $\frac{\pi}{4}$ radians, the angle of elevation is increasing at a rate of $0.2 \frac{\text{rad}}{\text{min}}$. How fast is the balloon rising at this time?

Example 2

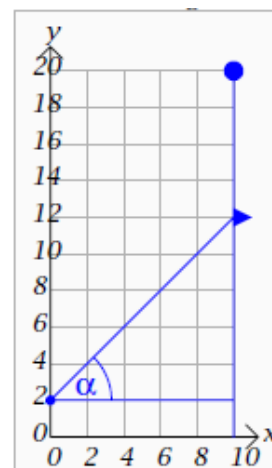
Two sides of a triangle measure 5 m and 8 m in length. The angle between them is increasing at a rate of $\frac{\pi}{45} \frac{\text{rad}}{\text{sec}}$. How fast is the length of the third side changing when the contained angle is $\frac{\pi}{3}$?



Section 6.3 Related Rates Involving Trigonometry

Example 3

A flag is being raised on a 20 metre high flagpole at the rate of 0.6 metres per minute. An observer is standing 10 metres away, with his eyes 2 metres above ground level. How fast is the angle of elevation of the flag increasing when the flag is 12 metres above ground level?



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Example 4



A man stands 12 metres away from a flagpole. He holds onto a long rope attached to the flag. As the flag is raised at a rate of 10 metres per minute, the rope runs tautly through the man's hands (so that it always keeps straight). Find the rate of change of the angle between the rope and the flagpole, at the moment when there is 24 metres of rope between the flag and the man.