Section 4.5 Graphs of Sine and Cosine Functions

Course Number
Instructor
Date

Objective: In this lesson you learned how to sketch the graphs of sine and cosine functions and translations of these functions.

Important Vocabulary	Define each term or concept.
Amplitude	
Phase shift	

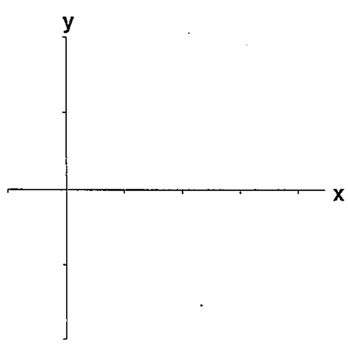
I. Basic Sine and Cosine Curves (Pages 321–322)

What you should learn
How to sketch the graphs of basic sine and cosine functions

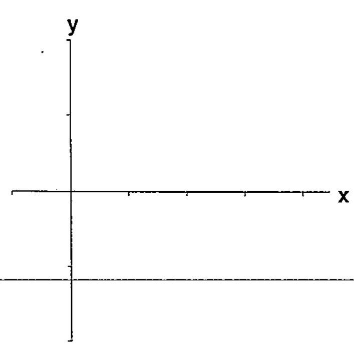
For $0 \le x \le 2\pi$, the sine function has its maximum point at ________________, its minimum point at ________________, and its intercepts at ________________________________.

For $0 \le x \le 2\pi$, the cosine function has its maximum points at ______________________, its minimum point at ___________, and its intercepts at ________________________________.

Example 1: Sketch the basic sine curve on the interval [0, 2π].



Example 2: Sketch the basic cosine curve on the interval [0, 2π].



II. Amplitude and Period (Pages 323–324)

> *What you should learn*
> How to use amplitude and period to help sketch the graphs of sine and cosine functions

The constant factor a in $y = a\sin x$ acts as . . .

If $|a| > 1$, the basic sine curve is ____________________. If $|a| < 1$, the basic sine curve is ________________. The result is that the graph of $y = a\sin x$ ranges between ________________ instead of between -1 and 1. The absolute value of a is the ________________ of the function $y = a\sin x$.

The graph of $y = 0.5\sin x$ is a(n) ____________________ in the x-axis of the graph of $y = -0.5\sin x$.

Let b be a positive real number. The **period** of $y = a\sin bx$ and $y = a\cos bx$ is ________________. If $0 < b < 1$, the period of $y = a\sin bx$ is ________________ than 2π and represents a ____________________________ of the graph of $y = a\sin x$.
If $b > 1$, the period of $y = a\sin bx$ is ________________ than 2π and represents a ____________________________ of the graph of $y = a\sin x$.

Example 3: Find the amplitude and the period of $y = -4\cos 3x$.

Example 4: Find the five key points (intercepts, maximum points, and minimum points) of the graph of $y = -4\cos 3x$.

III. Translations of Sine and Cosine Curves (Pages 325–326)

> ***What you should learn***
> How to sketch translations of the graphs of sine and cosine functions

The constant c in the general equations $y = a\sin(bx - c)$ and $y = a\cos(bx - c)$ creates . . .

Comparing $y = a\sin bx$ with $y = a\sin(bx - c)$, the graph of $y = a\sin(bx - c)$ completes one cycle from ______________ to ________________. By solving for x, the interval for one cycle is found to be _____________ to ____________________. This implies that the graph of $y = a\sin(bx - c)$ is the graph of $y = a\sin bx$ shifted by the amount ______________.

The period of the graph of $y = a\cos(bx - c)$ is ________________.

Example 5: Find the amplitude, period, and phase shift of $y = 2\sin(x - \pi/4)$.

Example 6: Find the five key points (intercepts, maximum points, and minimum points) of the graph of $y = 2\sin(x - \pi/4)$.

IV. Mathematical Modeling (Page 327)

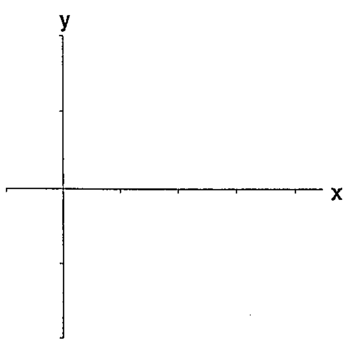
> ***What you should learn***
> How to use sine and cosine functions to model real-life data

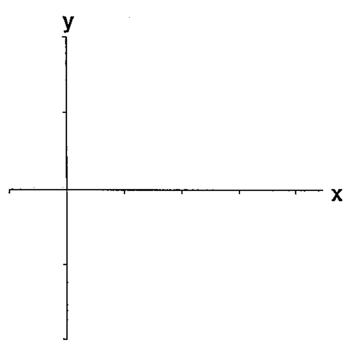
Describe a real-life situation which can be modeled by a sine or cosine function.

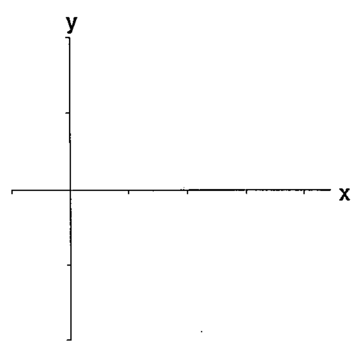
Example 7: Find a trigonometric function to model the data in the following table.

x	0	$\pi/2$	π	$3\pi/2$	2π
y	2	4	2	0	2

Additional notes







Homework Assignment

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Exercises 89 – 97

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Section 4.6 Graphs of Other Trigonometric Functions

Objective: In this lesson you learned how to sketch the graphs of other trigonometric functions.

Important Vocabulary	Define each term or concept.
Damping factor	

I. Graph of the Tangent Function (Pages 332–333)

What you should learn
How to sketch the graphs of tangent functions

Because the tangent function is odd, the graph of $y = \tan x$ is symmetric with respect to the ______________. The period of the tangent function is ___________. On the interval [0, π], the tangent function is undefined, and thus has a vertical asymptote, at $x =$ ____________. The domain of the tangent function is ____________________________, and the range of the tangent function is ______________________.

Describe how to sketch the graph of a function of the form $y = a\tan(bx - c)$.

II. Graph of the Cotangent Function (Page 334)

What you should learn
How to sketch the graphs of cotangent functions

The graph of $y = \cot x$ is symmetric with respect to the ______________. The period of the cotangent function is ___________. On the interval (0, π], the cotangent function is undefined, and thus has a vertical asymptote, at $x =$ __________.

The domain of the cotangent function is ________________,
and the range of the cotangent function is ________________.

III. Graphs of the Reciprocal Functions (Pages 335–336)

What you should learn
How to sketch the graphs of secant and cosecant functions

At a given value of x, the y-coordinate of csc x is the reciprocal of the y-coordinate of ________________.
The graph of $y = \csc x$ is symmetric with respect to the ________________. The period of the cosecant function is ____________. On the interval $(0, \pi]$, the cosecant function is undefined, and thus has a vertical asymptote, at $x =$ __________.
The domain of the cosecant function is ________________,
and the range of the cosecant function is ________________.

At a given value of x, the y-coordinate of sec x is the reciprocal of the y-coordinate of ________________.
The graph of $y = \sec x$ is symmetric with respect to the ________________. The period of the secant function is ______.
On the interval $[0, \pi]$, the secant function is undefined, and thus has a vertical asymptote, at $x =$ ____________. The domain of the secant function is ________________________, and the range of the secant function is ________________.

To sketch the graph of a secant or cosecant function, . . .

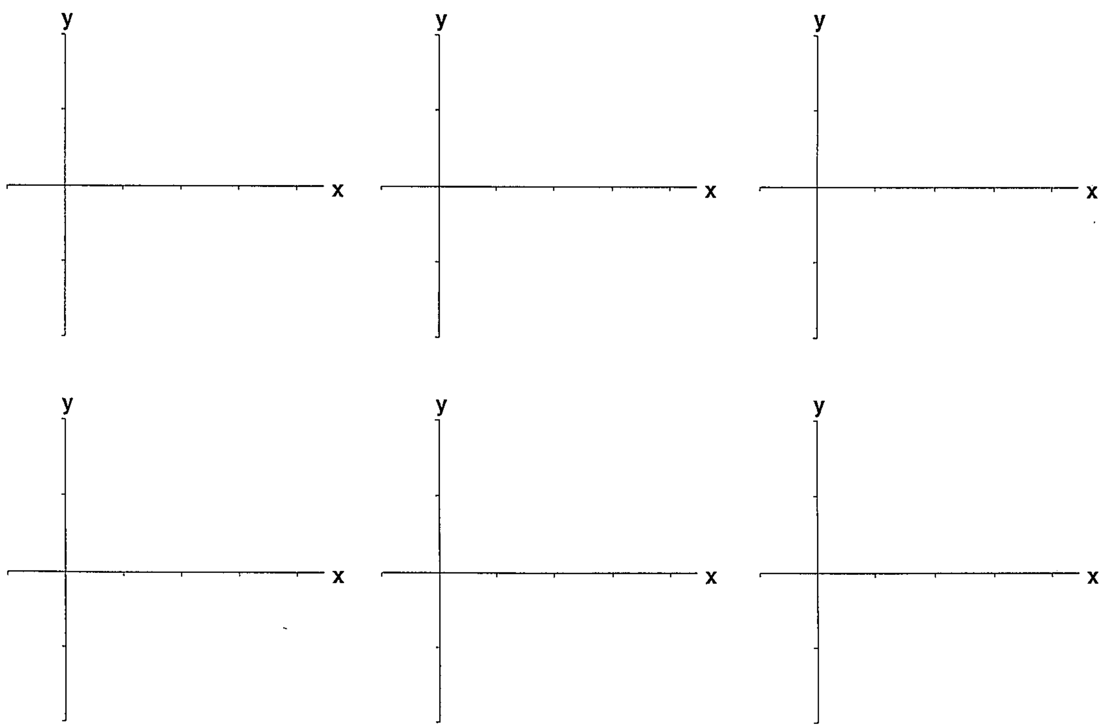
IV. Damped Trigonometric Graphs (Pages 337–338)

What you should learn
How to sketch the graphs of damped trigonometric functions

Explain how to sketch the graph of the damped trigonometric function $y = f(x)\cos x$, where $f(x)$ is the damping factor.

Additional notes

Additional notes



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Exercises 99 – 107

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Section 4.7 Inverse Trigonometric Functions

Objective: In this lesson you learned how to evaluate the inverse trigonometric functions and compositions of trigonometric functions with inverse trigonometric functions.

I. Inverse Sine Function (Pages 343–344)

What you should learn
How to evaluate and graph the inverse sine function

The **inverse sine function** is defined by . . .

The domain of $y = \arcsin x$ is ________________. The range of $y = \arcsin x$ is ______________________.

Example 1: Find the exact value: $\arcsin(-1)$.

II. Other Inverse Trigonometric Functions (Pages 345–346)

What you should learn
How to evaluate and graph the other inverse trigonometric functions

The **inverse cosine function** is defined by . . .

The domain of $y = \arccos x$ is ________________. The range of $y = \arccos x$ is ___________________.

Example 2: Find the exact value: $\arccos \frac{1}{2}$.

The **inverse tangent function** is defined by . . .

The domain of $y = \arctan x$ is ________________. The range of $y = \arctan x$ is ________________________.

Example 3: Find the exact value: $\arctan(\sqrt{3})$.

Example 4: Use a calculator to approximate the value (if possible). Round to four decimal places.
(a) arcos 0.85 (b) arcsin 3.1415

III. Compositions of Functions (Pages 347–348)

> ***What you should learn***
> How to evaluate and graph the compositions of trigonometric functions

State the Inverse Property for the Sine function.

State the Inverse Property for the Cosine function.

State the Inverse Property for the Tangent function.

The inverse properties do not apply for arbitrary values of x and y. For example, the inverse property for the sine function is not value for values of y outside the interval

____________________________.

Example 5: If possible, find the exact value:
(a) $\arcsin(\sin 3\pi/4)$ (b) $\cos(\arccos 0)$

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Exercises 109 – 131 odd

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Section 4.8 Applications and Models

Objective: In this lesson you learned how to use trigonometric functions to solve real-life problems.

Important Vocabulary	Define each term or concept.
Simple harmonic motion	

I. Applications Involving Right Triangles (Pages 353–354)

What you should learn How to solve real-life problems involving right triangles

Example 1: A ladder leaning against a house reaches 24 feet up the side of the house. The ladder makes a 60° angle with the ground. How far is the base of the ladder from the house? Round your answer to two decimal places.

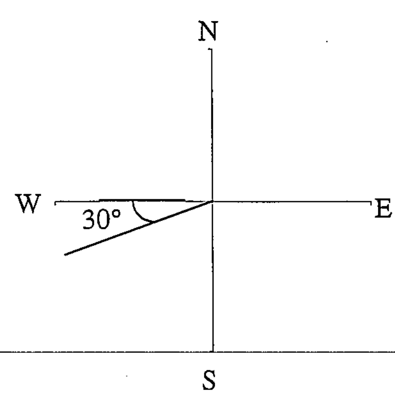
II. Trigonometry and Bearings (Page 355)

What you should learn How to solve real-life problems involving directional bearings

In surveying and navigation, a directional **bearing** measures . . .

The bearing N 70° E means . . .

Example 2: Write the bearing for the path shown in the diagram below.



III. Harmonic Motion (Pages 356–358)

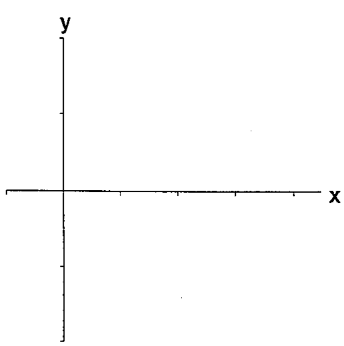
> ***What you should learn***
> How to solve real-life problems involving harmonic motion

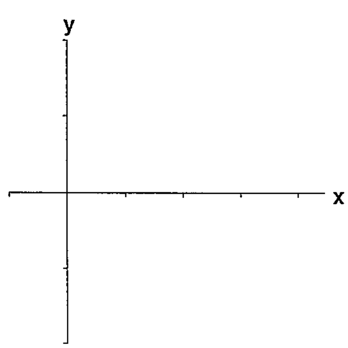
A point that moves on a coordinate line is said to be in simple harmonic motion if . . .

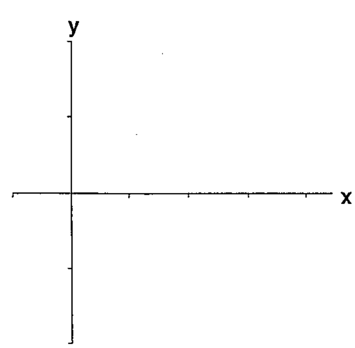
The simple harmonic motion has amplitude __________, period __________, and frequency ________________.

Example 3: Given the equation for simple harmonic motion $d = 3\sin\frac{t}{2}$, find:

(a) the maximum displacement,
(b) the frequency of the simple harmonic motion, and
(c) the period of the simple harmonic motion.







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Exercises 133 – 135