The figure below shows the graph of a curve and its tangent line at the location \(x = 3\). Answer the questions below. **Warning!** Submissions are limited. Be sure before you click.

What is the **x-intercept** of the tangent line?

What is the **y-intercept** of the tangent line?

What is the **x-intercept** of the curve?

What is the **y-intercept** of the curve?

What is the **slope** of the tangent line?

What is the x-coordinate of the **point of tangency**?

What is the y-coordinate of the **point of tangency**?
2. **Question Details**

Suppose that \( y = x^3 - 5x + 3 \).

Find the slope of the tangent line at the point \( x = 2 \).

Write an equation for the tangent line at the point \( (2, 1) \). You do not need to simplify, but your answer must be an equation involving \( x \) and \( y \).

---

3. **Question Details**

Suppose that \( y = \sin(\pi(x-1)) \).

Find the slope of the tangent line at the point \( x = 1 \). Give an exact symbolic answer. (No decimals. No rounding.)

Write an equation for the tangent line at the point \( (1, 0) \). Your answer must be an equation involving \( x \) and \( y \), and it should be written with exact symbols. You do not need to simplify.

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4. **Question Details**

Suppose that \( y = -1.5x^2 + 3x + 4 \), and you are asked to find the slope of the tangent line at the location \( x = 2 \). Which of the following are correct answers? Select all that apply. **Warning!** Submissions are limited. Be sure before you click.

- \( y = -3 \)
- \( x = 2 \)
- \( 3x + y - 10 = 0 \)
- \( y = 4 \)
- \( y - 4 = -3(x - 2) \)
- \( y = -3x + 10 \)
5. Question Details
Suppose that \( y = -1.5x^2 + 3x + 4 \), and you are asked to find an equation of the tangent line at the location \( x = 2 \). Which of the following are correct answers? Select all that apply. **Warning!**
Submissions are limited. Be sure before you click.

- \( y - 4 = -3(x - 2) \)
- \( -3 \)
- \( x = 2 \)
- \( y = 4 \)
- \( 3x + y - 10 = 0 \)
- \( y = -3x + 10 \)

6. Question Details
Suppose that \( y = x \ln(x) - 2x + 1 \). Write an equation for the tangent line at the location where \( x = 1 \).

**Required Graphing Exercise:** Graph the function and the tangent line on one set of axes with domain \( 0 < x \leq 4 \).

7. Question Details
Find an equation of the tangent line to \( y = \frac{6x}{x^2 + 2} \) at the location \( x = 1 \). Give an exact symbolic answer.
(You may need to use some fractions.)

**Required Graphing Exercise:** Graph the function and the tangent line on one set of axes with domain \( -3 \leq x \leq 3 \). Then answer the remaining questions.

Find the \( x \)-intercept of the tangent line. Give an exact answer.

\[ x = \]

Find the acute angle between the tangent line and the \( x \)-axis. Write your answer in radians with three decimal places of accuracy.

\[
\text{radians}
\]

Find the acute angle between the tangent line and the \( y \)-axis. This time write your answer in **degrees** with one decimal place of accuracy.

\[
\text{degrees}
\]
8. Question Details

Find an equation of the tangent line to \( y = xe^{0.1x} \) at the location \( x = 3.5 \). You can use decimals in the equation of the tangent line, but you should keep at least 4 decimal places of accuracy until you finish the entire problem. You can also use exact methods, but you have to convert your answers to decimals before you enter them.

**Required Graphing Exercise:** Graph the function and the tangent line on one set of axes with domain \(-8 \leq x \leq 8\). Then answer the remaining questions.

What is the slope of the tangent line? Be accurate to three decimal places.

Find the y-intercept of the tangent line, accurate to three decimal places.

\[ y = \]

Find the x-intercept of the tangent line, accurate to three decimal places.

\[ x = \]

Find the acute angle between the tangent line and the x-axis. Write your answer in **degrees** with one decimal place of accuracy.

degrees

Find the acute angle between the tangent line and the y-axis. Write your answer in **degrees** with one decimal place of accuracy.

degrees

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9. Question Details

The height above ground of falling object is given by

\[ h(t) = 383 - 39t - 156e^{-0.25t} \]

where \( t \) is measured in seconds and \( h \) is measured in meters. Assume \( t \geq 0 \). Find an equation for the tangent line at \( t = 4 \) seconds. You will not get feedback on your equation. You can check if your equation is correct by completing the...

**Required Graphing Exercise:** Graph the function and the tangent line on one set of axes. Use the domain \([0,12]\).

When does the tangent line cross the t-axis? Be accurate to two decimal places and include correct units.

**Warning:** If you are not careful you will get significant roundoff error while you work this problem. Although the answer only requires two decimal places, you should keep at least four decimal places for all your work.
10. Question Details

The height above ground of falling object is given by

$$h(t) = 383 - 39t - 156e^{-0.25t}$$

where \(t\) is measured in seconds and \(h\) is measured in meters. Assume \(t \geq 0\). Answer all of the questions below. All answers must be accurate to two decimal places and must have correct units.

**Warning!** If you are not careful you will get significant roundoff error while you work this problem. Although the answer only requires two decimal places, you should keep at least four decimal places for all your work.

1. Recall your answer from the last problem, \(t = 10.88\) seconds. Find the equation of the tangent line at this point. Then find where the tangent line crosses the \(t\)-axis. Write your answers in the table below.

<table>
<thead>
<tr>
<th>initial (t)</th>
<th>tangent crosses at</th>
</tr>
</thead>
</table>

2. Write your answer for the tangent line crossing (from above) in the box for **initial time** below. Find the equation of the tangent line at that point. Find where this new line crosses the \(t\)-axis. Put the new crossing point in the table below.

<table>
<thead>
<tr>
<th>initial (t)</th>
<th>tangent crosses at</th>
</tr>
</thead>
</table>

3. Write your answer for the tangent line crossing (from 2) in the box for **initial time** below. Find the equation of the tangent line at that point. Find where this new line crosses the \(t\)-axis. Put the new crossing point in the table below.

<table>
<thead>
<tr>
<th>initial (t)</th>
<th>tangent crosses at</th>
</tr>
</thead>
</table>

4. When does the falling object hit the ground?

\(t = \) 

**Remark:** This is the process that your calculator uses when you ask it for a decimal solution to an equation. You can read more in your text, Section 4.8, or here.

11. Question Details

A bridge has a curved support arch in the shape of an inverted catenary:

$$y = 10.21 - 3.06 e^{0.11x} + e^{-0.11x}$$

where \(x\) and \(y\) are in meters. The approach ramps are tangent to the curve at the locations \(x = 4\) and \(x = -4\), as shown in the figure below.

![Catenary curve with approach ramps](image)

Answer these questions about the right hand approach ramp. That is, the one that touches the catenary at \(x = 4\).

Where does this ramp touch the ground? (The ground is the \(x\)-axis.) Be accurate to one decimal place and include units.

\(x = \)

What angle does the ramp make with the ground? (There are two angles; your answer should be the acute angle.) Convert your answer to **degrees**, rounded to one decimal place of accuracy.

degrees
A bridge has a curved support arch in the shape of an inverted catenary:

\[ y = 10.21 - 3.06 \left( e^{0.11x} + e^{-0.11x} \right) \]

where \( x \) and \( y \) are in meters. You must design approach ramps that are tangent to the catenary as shown in the figure below.

The design requires that the ramps each make a 10 degree angle with the ground (the \( x \)-axis). Where will the right hand ramp touch the catenary? An \( x \)-coordinate is sufficient. Be accurate to three decimal places and include units.

\[ x = \]