Math 1431

Section 14839
M 6:00 PM – 7:30 PM
TH 4:00 PM - 5:30 PM Online

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Office Hours:
5:30 - 6:15 pm M Th Online or by appointment
Wed 6:00 – 7:00 PM Online
The Exam Scheduler for Test 2 Should BE Open 9/17
Schedule your TEST 2 Date

IF you are a DISTANT EDUCATION STUDENT,
More than 100 miles away
Please email me your arrangements for TEST 2 and
Contact the Distance Education Office to Complete the
Scheduling Process

TEST 2 MUST BE TAKEN Oct 1 - 3
**Implicit Differentiation**

If we can’t solve, or can’t solve easily, for $y$ as a function of $x$, use implicit differentiation to find the derivative of $y$.

**“Rules” for implicit differentiation**

1) Differentiate both sides of the equation with respect to $x$.

2) Collect all $\frac{dy}{dx}$ (or $y'$) terms.

3) Factor out $\frac{dy}{dx}$ (or $y'$).

4) Solve for $\frac{dy}{dx}$ (or $y'$).

If solving in terms of $x$, take the derivative as usual.

If solving in terms of $y$, use the chain rule.
\[
\frac{d}{dx} y
\]

\[
\frac{d}{dx} y^3
\]
8. Given \( x^2 + 3xy + y^3 = 10 \) Find \( \frac{dy}{dx} \).
9. Find $dy/dx$ for $2\sin x \cos y = 1$
10. Find the slope of the graph at the given point, then find the equation of the tangent line at \((1, 1)\) for \(x^3 + y^3 = 2xy\).
11. Find the second derivative of $x^2 - y^2 = 16$ in terms of $y$. 
Related Rates & Rates of Change
Section 3.1

Identify the formula and then take the derivative with respect to time.

1. \( a^2 + b^2 = c^2 \)

2. \( A = \pi r^2 \)

3. \( A = \frac{1}{2} b h \)
4. \( V = \frac{1}{3} \pi r^2 h \)

5. \( V = \frac{4}{3} \pi r^3 \)

6. \( S = 2 \pi r h + 2 \pi r^2 \)
Related Rates:

- Draw a “picture”.

- What do you know?

- What do you need to find?

- Write an equation involving the variables whose rates of change either are given or are to be determined. (This is an equation that relates the parts of the problem.)

- Implicitly differentiate both sides of the equation with respect to time. This FREEZES the problem.

- Solve for what you need.
1. Assume that oil spilled from a ruptured tanker spreads in a circular pattern whose radius increases at a constant rate of 2 ft/sec. How fast is the area of the spill increasing when the radius of the spill is 60 feet?
2. A 5 foot ladder, leaning against a wall, slips so that its base moves away from the wall at a rate of 2 ft/sec. How fast will the top of the ladder be moving down the wall when the base is 4 feet from the wall?
3. If a rocket is rising vertically at the rate of 880 ft/sec when it is 4000 feet up, how fast is the camera-to-rocket distance changing at the instant?
4. Using the same conditions for the rocket in #3, how fast must the camera elevation angle change at the instant to keep the rocket in sight?
5. A point moves along the curve \( y = 2x^2 + 1 \) in such a way that the \( y \) value is decreasing at the rate of 2 units per second. At what rate is \( x \) changing when \( x = \frac{3}{2} \)?
6. Suppose a spherical balloon is inflated at the rate of 10 cubic centimeters per minute. How fast is the radius increasing when the radius is 5 centimeters?
7. A man standing 3 feet from the base of a lamppost casts a shadow 4 feet long. If the man is 6 feet tall and walks away from the lamppost at a speed of 400 feet per minute, at what rate will his shadow lengthen? How fast is the tip of his shadow moving?
Rates of Change Examples:
1. A body moves along a horizontal line according to
   \( x(t) = t^3 - 9t^2 + 24t \), where \( t \) is in seconds.
   a) When is \( x \) increasing, and when is it decreasing?

   b) When is \( v \) increasing, and when is it decreasing?

   c) When is the speed of the body increasing?
2. If \( x(t) = \frac{1}{2} t^4 - 5t^3 + 12t^2 \), find the velocity of the moving object when its acceleration is zero.
Free Fall of an object: \[ y(t) = -\frac{1}{2}gt^2 + v_0 t + y_0 \]

where \( g \) is the gravitational constant (32 feet per second per second, or 9.8 meters per second per second).

So... in feet ...
\[ y(t) = -16t^2 + v_0 t + y_0 \]

and in meters....
\[ y(t) = -4.9t^2 + v_0 t + y_0 \]
3. An object is dropped from a height of 20 feet. If we neglect air friction, how long will it take for the object to hit the ground? Give the velocity of the object on impact.
4. Supplies are dropped from a stationary helicopter and seconds later hit the ground at 98 meters per second. How high was the helicopter?
5. A stone, projected upward with an initial velocity of 112 ft/sec, moves according to $x(t) = -16t^2 + 112t$, where $x$ is the distance from the starting point.

a) Compute the velocity and acceleration when $t = 3$ and when $t = 4$.

b) Determine the greatest height the stone will reach.

c) Determine when the stone will have a height of 96 ft.