



Problems:

- A particle moves according to the motion $s = f(t) = t^3 - 8t^2 + 24t$, $t \geq 0$, where t is measured in seconds and s in feet.
 - Find the velocity at time t .
 - What is the velocity after 1 second?
 - When is the particle at rest?
 - When is the particle moving in the positive direction?
 - Find the total distance traveled during the first 6 seconds.
 - Find the acceleration at time t and after 1 second.
 - When is the particle speeding up? When is it slowing down?
- The height (in meters) of a projectile shot vertically upward from a point 2 m above ground level with an initial velocity of 24.5 m/s is $h = 2 + 24.5t - 4.9t^2$ after t seconds.
 - Find the velocity after 2 seconds and after 4 seconds.
 - When does the projectile reach its maximum height?
 - What is the maximum height?
 - When does it hit the ground?
 - With what velocity does it hit the ground?
- Let A be the area of a circle with radius r .
 - Find the average rate of change of A as r changes from 2 to 3; from 2 to 2.5; from 2 to 2.1.
 - Find the instantaneous rate of change when $r = 2$.
- A spherical balloon is being inflated. Find the rate of increase of the surface area with respect to the radius r , when r is
 - 1 ft;
 - 2 ft;
 - 3 ft.
- In lab, there is a culture of bacteria. After one hour, there were 1000 bacteria. Then after five hours, the number of bacteria has increased to 3500. Assume the bacteria culture has constant relative growth rate. Find a formula for the number of bacteria after t hours. Find the number of bacteria and the growth rate after 2 hours.
- A particular drug has half life of 15 hours. If we begin with a sample size of mass 500 mg, how long will it take for this sample to decay to a mass of 125 mg? Assume the rate of change is proportional to the remaining amount of the drug.
- A pie is taken from an oven where the temperature has reached 375° F and is placed on a counter in a room with temperature 75° F. If the temperature of the pie is 175° F after 30 minutes, when will the pie have cooled to 90° F?
- When a cold drink is taken from a refrigerator, its temperature is 5° C. After 25 minutes in a 20° C room its temperature has increased to 10° C.
 - What is the temperature of the drink after 50 minutes?
 - When will its temperature be 15° C?
- The length of a rectangle is increasing at a rate of 8 cm/s and its width is increasing at a rate of 3 cm/s. When the length is 20 cm and the width is 10 cm, how fast is the area of the rectangle increasing?



10. A cylindrical tank with radius 5 m is being filled with water at a rate of $3 \text{ m}^3/\text{min}$. How fast is the height of the water increasing?
11. The radius of a spherical ball is increasing at a rate of 2 cm/min. At what rate is the surface area of the ball increasing when the radius is 8 cm?
12. A particle is moving along a hyperbola $xy = 8$. As it reaches the point (4,2), the y -coordinate is decreasing at a rate of 3 cm/s. How fast is the x -coordinate of the point changing at that instant?
13. The altitude of a triangle is increasing at a rate of 1 cm/min while the area of the triangle is increasing at a rate of $2 \text{ cm}^2/\text{min}$. At what rate is the base of the triangle changing when the altitude is 10 cm and the area is 100 cm^2 ?
14. Water is leaking out of an inverted conical tank at a rate of $10,000 \text{ cm}^3/\text{min}$ at the same time that water is being pumped into the tank at a constant rate. The tank has height 6 m and the diameter at the top is 4 m. If the water level is rising at a rate of 20 cm/min when the height of the water is 2m, find the rate at which water is being pumped into the tank.