Name____Related Rates Practice UCDAVIS

EXAMPLE 1: Consider a right triangle which is changing shape in the following way. The horizontal leg is increasing at the rate of $5\ in./min.$ and the vertical leg is decreasing at the rate of $6\ in./min.$ At what rate is the hypotenuse changing when the horizontal leg is $12\ in.$ and the vertical leg is $9\ in.$?

In the list of Related Rates Problems which follows, most problems are average and a few are somewhat challenging.

- PROBLEM 1 : The edge of a square is increasing at the rate of $3\ cm/sec.$ At what rate is the square's

  a.) perimeter changing
  b.) area changing

  when the edge of the square is $10\ cm.$?

- PROBLEM 2 : The length of a rectangle is increasing at the rate of $4\ ft/hr.$ and the width of the rectangle is decreasing at the rate of $3\ ft/hr.$ At what rate is the rectangle's

  a.) perimeter changing
  b.) area changing

  when the length is $8\ ft.$ and the width is $5\ ft.$?

- PROBLEM 3 : Leg one of a right triangle is decreasing at the rate of $5\ in/sec.$ and leg two of the right triangle is increasing at the rate of $7\ in/sec.$ At what rate is the triangle's

  a.) hypotenuse changing
  b.) perimeter changing
  c.) area changing

  when leg one is $8\ in.$ and leg two is $6\ in.$?

- PROBLEM 4 : The radius of a circular oil slick on the surface of a pond is increasing at the rate of $10\ meters/min.$ At what rate is the circle's

  a.) circumference changing
  b.) area changing

  when the radius of the oil slick is $20\ m.$?

- PROBLEM 5 : A big block of ice is in the shape of a perfect cube. As it melts, each edge of the cube is decreasing at the rate of $2\ cm/min.$ At what rate is the ice cube's

  a.) surface area changing
  b.) volume changing

  when the edge of the ice cube is $80\ cm.$?

- PROBLEM 6 : A ladder 13 feet long is leaning against a high wall. If the base of the ladder is pushed toward the wall at the rate of $2\ ft/sec.$, at what rate is the top of the ladder moving up the wall when the base of the ladder is

  a.) 5 feet
  b.) 1 foot

  from the wall ?

- PROBLEM 7 : The radius of a large sphere is increasing at the rate of $3\ ft/hr.$ At what rate is the sphere's

  a.) surface area changing
  b.) volume changing

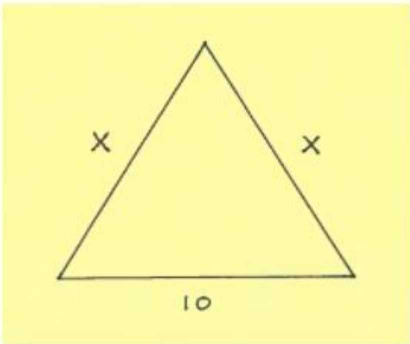
  when the radius of the sphere is $10\ ft.$?

- PROBLEM 8 : Consider a closed right circular cylinder of base radius r $cm.$ and height h $cm.$ If the radius of the cylinder is increasing at the rate of $5\ cm/hr.$ and the height of the cylinder is decreasing at the rate of $4\ cm/hr.$, at what rate is the cylinder's

  a.) surface area changing
  b.) volume changing

  when the radius of the cylinder is $20\ cm.$ and the height of the cylinder is $12\ cm.$?

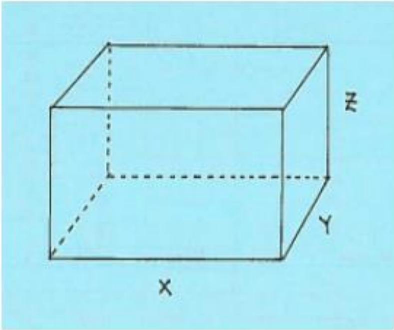
- PROBLEM 9 : Consider the given isosceles triangle of base 10 inches and side lengths x inches. If x is increasing at the rate of $4\ in/min.$, at what rate is the triangle's



  a.) perimeter changing
  b.) height changing
  c.) area changing

  when $x = 13\ in.$?

- PROBLEM 10 : Consider the given closed rectangular box with dimensions x feet by y feet by z feet. Assume that x is increasing at the rate of $4\ ft/hr.$, y is decreasing at the rate of $6\ ft/hr.$, and z is increasing at the rate of $3\ ft/hr.$ At what rate is the box's



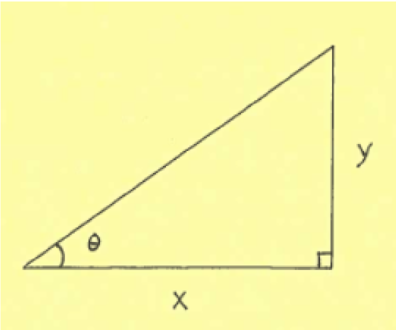
  a.) surface area changing
  b.) volume changing
  c.) main diagonal changing

  when $x = 5\ ft.$, $y = 4\ ft.$, and $z = 6\ ft.$?

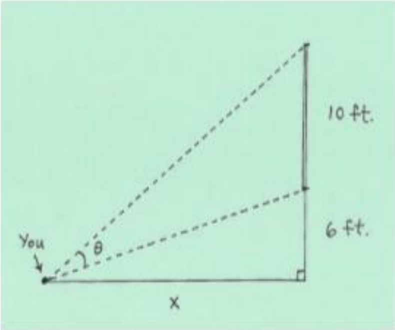
- PROBLEM 11 : The volume of a large spherical balloon is increasing at the rate of $64\pi\ meters^3/hr. \approx 201.06\ meters^3/hr.$ At what rate is the balloon's surface area changing when the radius of the balloon is $2\ m.$?

- PROBLEM 12 : The surface area of a cube is increasing at the rate of $600\ in^2/hr.$ At what rate is the cube's volume changing when the edge of the cube is $10\ in.$?

- PROBLEM 13 : Consider the given right triangle with legs of length $x\ cm.$ and $y\ cm.$ and angle θ radians. If x is decreasing at the rate of $3\ cm/min.$ and y is increasing at the rate of $4\ cm/min.$, at what rate is angle θ changing when $x = 5\ cm.$ and $y = 2\ cm.$?



- PROBLEM 14 : You are sitting x $ft.$ from a wall and watching a movie screen which is 10 feet high and is 6 feet above the floor. Your viewing angle is θ radians. (See the side view diagram below.)

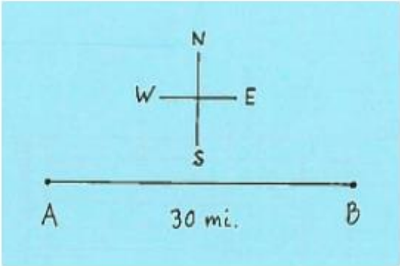


a.) Write your viewing angle θ as a function of x.
b.) If x is increasing at the rate of $10\ ft/min.$, at what rate is θ changing when

$i.)\ x = 8\ ft.$?
$i.)\ x = 20\ ft.$?

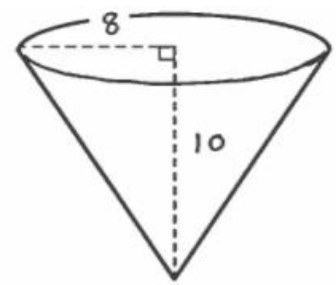
- PROBLEM 15 : Car B starts 30 miles directly east of car A and begins moving west at 90 mph. At the same moment car A begins moving north at 60 mph. At what rate is the distance between the cars changing after

a.) $t = 1/5\ hr.$?
b.) $t = 1/3\ hr.$?



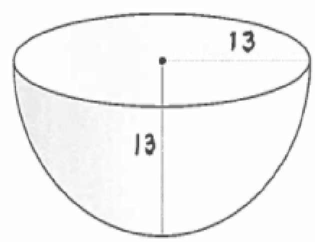
- PROBLEM 16 : An open right circular conical tank (vertex down) has height 10 meters and base radius 8 meters. Water begins flowing into the tank at the rate of $\pi\ meters^3/min$. At what rate is the depth h of the water in the tank changing when

  a.) $h = 1\ m.$?
  b.) $h = 9\ m.$?



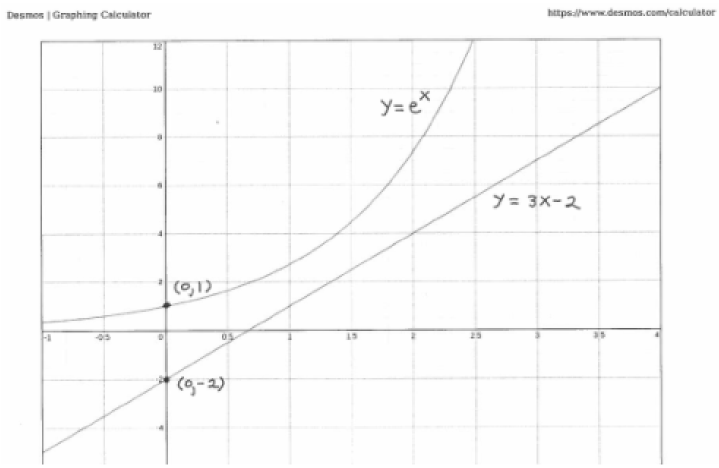
- PROBLEM 17 : An open hemispherical tank has radius 13 feet. Oil begins flowing into the tank in such a way that the depth h of the oil in the tank changes at the rate of 3 ft/hr. At what rate is the top circular surface area of the oil changing when the depth of oil is

  a.) $h = 1\ ft.$?
  b.) $h = 8\ ft.$?



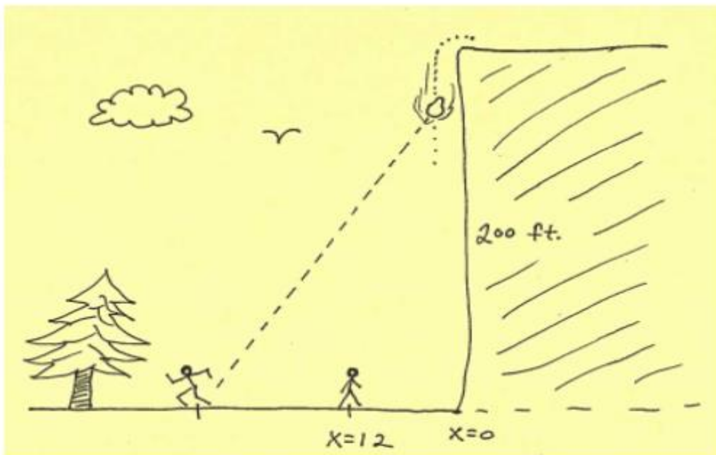
- PROBLEM 18 : Car 1 starts on the graph of $y = e^x$ at the point $(0,1)$, and car 2 starts on the graph of $y = 3x - 2$ at the point $(0,-2)$ and distance is measured in miles. If both cars start moving to the right at the same time in such a way that $\frac{dx}{dt} = 1\ mile/min.$, at what rate is the distance between the cars changing when

  a.) $t = 1\ min.$?
  b.) $t = 3\ min.$?



- PROBLEM 19 : You are standing 12 feet from the base of a 200-ft. cliff. As a boulder rolls off the cliff, you begin running away at $10\ ft/sec$. At what rate is the distance between you and the boulder changing after

  a.) $t = 1\ sec.$?
  b.) $t = 3\ sec.$?



I would do each problem set on a separate piece of paper and follow the suggestions below

- 1.) Read the problem slowly and carefully.
- 2.) Draw an appropriate sketch.
- 3.) Introduce and define appropriate variables. Use variables if quantities are changing. Use constants if quantities are not changing.
- 4.) Read the problem again.
- 5.) Clearly label the sketch using your variables.
- 6.) State what information is given in the problem.
- 7.) State what information is to be determined or found.
- 8.) Use a given equation or create an appropriate equation relating the given variables.
- 9.) Differentiate this equation with respect to the time variable t.
- 10.) Plug in the given rates and numbers to the differentiated equation.
- 11.) Solve for the unknown rate.
- 12.) Put proper units on your final answer.

I chose this practice set because it has many of the popular related rate problems Calculus 1 has to offer when considering geometric applications and is is fortunate that the website that I found these problems on has links to detailed solutions. I have not as of yet verified those solutions, but you are welcome to the link https://www.math.ucdavis.edu/~kouba/CalcOneDIRECTORY/relatedratesdirectory/RelatedRates.html