MATH 31 **Name** ___________________

Date ___________________

Applications of Derivatives Unit Assignment

Section A

1. Find two positive numbers whose sum is 36 and the square of one number plus twice the square of the other number is a minimum.

2. A farmer wants to fence a rectangular enclosure along a straight river. It is not necessary to fence the side bordering the river. The farmer wants to use a minimum amount of fencing material to enclose an area of 3200 m^2. What dimensions should the rectangular field be?

3. Find the points on $y = 4 - x^2$ that are closets to the point (0,2). $d = \sqrt{\left(x_2 - x_1\right)^2 + \left(y_2 - y_1\right)^2}$

Section B

1. The motion of a particle on the x-axis is described by the position function $s(t) = 2t^3 - 21t^2 + 60t$, $t \geq 0$ where t is measured in seconds and s in metres.
   a) When is the particle at rest?

   b) Sketch a graph to show the displacement of the particle for the first 6 seconds and find the total **distance** traveled by the particle during the first 6 seconds.

2. The position of a particle, in metres at time *t* seconds, is given by $s(t) = 2t^3 - 48t^2$.
   Determine the velocity of a particle when its acceleration is zero.

3. The position function $s = \sqrt{t^2 + 1}$, gives the displacement *s* in metres, as a function of time *t*, in seconds.
   a) Find the velocity and acceleration as functions of *t*.

   b) Find the acceleration when $t = \sqrt{3}$ seconds, rounded to the nearest hundredth.

Section C

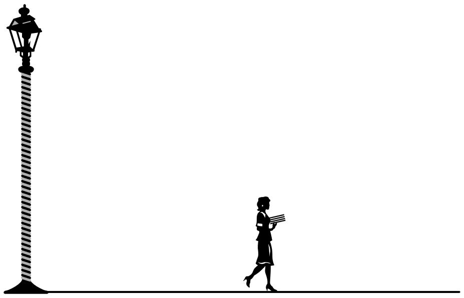
1. $N = -0.025m^2 + 12m + 3500$ represents the number of insects in a closed environment as a function of the amount of food, in grams, provided.

   a) What is the rate of change of number of insects with respect to the amount of food when 200 g is provided?

   b) Is the population of the insects increasing or decreasing when 200 g of food is provided. Use your answer from a) to justify your response.

2. A small stone is dropped into a pond creating a circle with a radius change of 5 cm/s. Determine the change in area of a circle, with respect to its radius, 4 seconds after the stone hits the water. [$A = \pi r^2$ Express your answer in terms of π .]

3. A lady, 5.5 feet tall, is walking away from a lamppost that is 22 feet high. The lady is 12 feet from the lamppost and walking at a rate of 4.4 feet/second. At what rate is her shadow increasing? [Round your answer to the nearest tenth feet/second.]

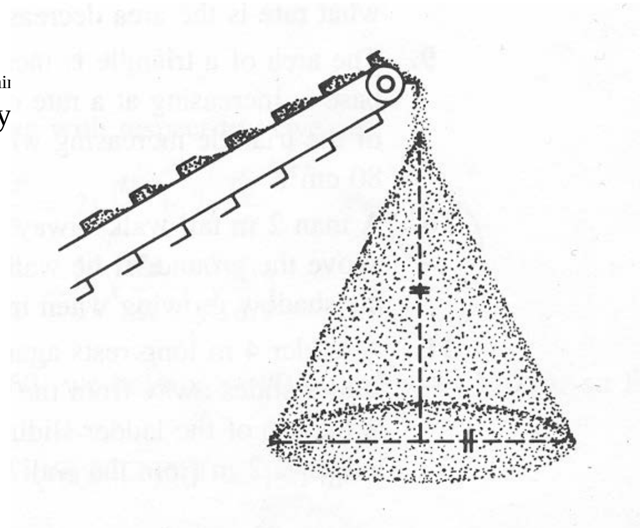


Section D

1. The length of a rectangle is increasing at a rate of $3cm/s$ and the width is decreasing at a rate of $2cm/s$. At what rate is the area of the rectangle changing when the length is $40cm$ and the width is $20cm$?

2. Gas is escaping from a spherical hot air balloon at a rate of $1.6\,{}^{m^3}\!/_{\min}$. How fast is the surface area, *SA*, shrinking when the radius is 4.0 meters? $V = \frac{4}{3}\pi r^3$ and $SA = 4\pi r^2$

3. Sand pouring from a conveyor belt at a rate of $0.75\,{}^{m^3}\!/\!_{\text{mi}}$ and forms a conical pile. The radius of the pile is alway $\frac{3}{5}$ of the height.



At what rate is the height of the pile growing 10 minutes after the pouring starts?

The volume of a cone is given by: $V = \frac{1}{3}\pi r^2 h$