Activity 4: Dot Product

Assignment

Click to take the Quiz.

Complete the following assignment and submit your work to the dropbox.

1. If $\vec{a}$ = (5, -5, 3), $\vec{b}$ = (1, 2, 3), determin *proj* = ($\vec{a}$ *onto* $\vec{b}$).
2. If $\vec{a}$ = (2, 2*k*), $\vec{b}$ = (4, -*k*), are perpendicular, solve for *k*.
3. Suppose a box on a frictionless ramp is being pulled by a rope with a tension of *350 N* making an angle of *50°* to the horizontal ground. If the angle of incline of the ramp is *20°*, and the box is pulled *5 m*, determine the amount of work done. Hint: Draw a diagram and use vectors to represent the situation.
4. Two math students erect a sun shade on the beach. The shade is 1.5 m tall, 2 m wide, and makes an angle of 60° with the ground. What is the area of shade that the students have to sit in at 12 noon (that is, what is the projection of the shade onto the ground)? (Assume the sun's rays are shining directly down).
5. Show that $\overrightarrow{proj_{\vec{a}}\vec{b}} = \left(\frac{\vec{a}\cdot\vec{b}}{\vec{b}\cdot\vec{b}}\right)\vec{b}$.

Activity 5: Derivatives

Assignment

Complete the following assignment and submit your work to the dropbox.

Before you upload your file, ensure your name appears at the top of every page of your document. You may submit a scanned copy of handwritten pages, or solutions typed on a word processor. Make sure you show your steps and submit full solutions to multi-step problems.

1. Use the limits definition $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ to find an expression for the derivative to the functions;
   a. $f(x) = 3x$
   b. $f(x) = 3/x$
   c. $f(x) = 3x^2$
2. a. Use the limits definition $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ to find an expression for the derivative to the curve $y = (1/3)x^3$.
   b. Using your answer to a) find the slope of the tangent to the curve $y = (1/3)x^3$ to complete the following table.

x	Slope of tangent
-3	
-2	
-1	
0	
1	
2	
3	

3. a. After looking closely at the problems and solutions presented in this activity, describe the patterns that you see emerge as you find the derivatives of simple functions like $y = x^2$, $y = x^3$, and $y = 1/x$ or $y = x^{-1}$.
   b. Using the patterns that you described in a), find the function that would produce a derivative of $y = x$. Prove your results.
4. a. Find an expression for the instantaneous rate of change of distance with respect to time (velocity) of a falling object if $s = -4.9t^2$ (where s is distance (meters) and t is time (seconds)). (Ignore the effect of air resistance)
   b. Use your answer for a) to find the velocity at the times listed on the table below.

Time	Velocity
1 sec	
5 sec	
1 min	

Activity 3: Application

Assignment

Discussion

Research and identify applications where exponential functions are used. Identify their use in this application and the form of the exponential equation if possible. Try to come up with something new, or as an addition to an application that has already been posted by others in our class.

Click here to enter the discussion.

Complete the following assignment and submit your work to the dropbox.

1. If you invest $5000 compounded continuously at 4% p.a. how much will this investment be worth in 5 years?
2. A population of 500 E. coli bacteria doubles every 15 minutes. Use this information to find an expression for this population growth. Using this expression, find what the population would be in 87 minutes. Use an exponential model.
3. Using the curve that you constructed for the decomposition of Carbon 14, find the age of a prehistoric cave painting discovered in the Lascaux Caves in southern France if the amount of Carbon 14 has decayed to 14.29%

Activity 4: The Chain Rule and its Applications

Assignment

Complete the following assignment and submit your work to the dropbox.

1. Find the derivative of the following function. Show your work.
   a. $f(x)=\sqrt{7+\sqrt{x^3}}$
2. The world's growing population can be modelled by an exponential equation. If we assume the world's population was approximately 4 billion in the year 1975, then the population at a time *t years* after 1975 can be found by the equation $P = 4e^{0.019t}$.
   c. Estimate the world's population when you are 30 years old.
   d. At what rate is the population changing at this time?
3. The height of the tides at a certain spot in Nova Scotia can be found by the equation $h(t) = 5\sin(0.5t + 2) + 6$, where t is the time in hours (using a 24 hour clock) and h is the height in metres. What is the rate of change of height at a time of *07:00 h*?
4. An apple orchard now has 60 trees planted per hectare and the average yield is 500 apples per tree. For each additional tree planted per hectare, the average yield per tree is reduced by approximately five apples. How many trees per hectare will give the largest crop of apples?

Activity 5: Inflection Points and the Second Derivative

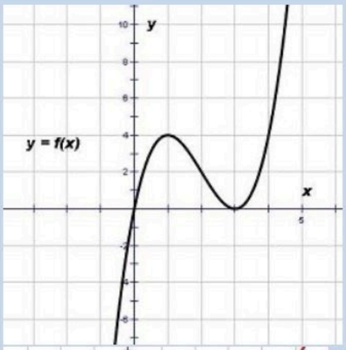
Assignment

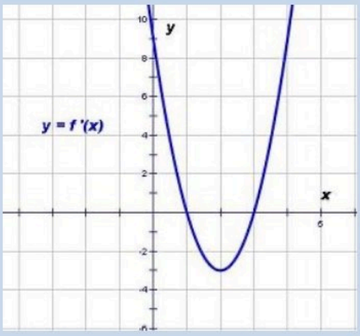
Complete the following assignment and submit your work to the dropbox.

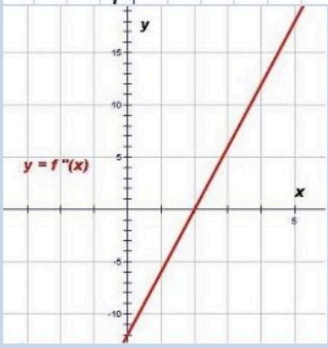
For each of the following questions use the equations and graphs of the function, its first derivative and its second derivative to determine:

a. the points of inflection;
b. intervals of concavity.

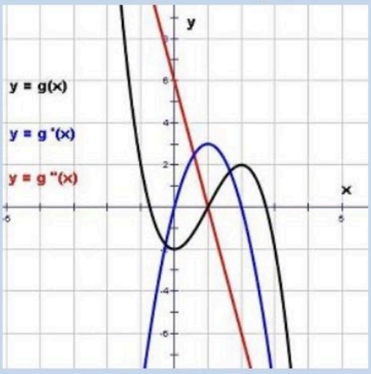
1. The graphs of the function $f(x) = x^3 – 6x^2 + 9x$, its first derivative $f'(x) = 3x^2 -12x +9$, and its second derivative $f''(x) = 6x - 12$ are shown.



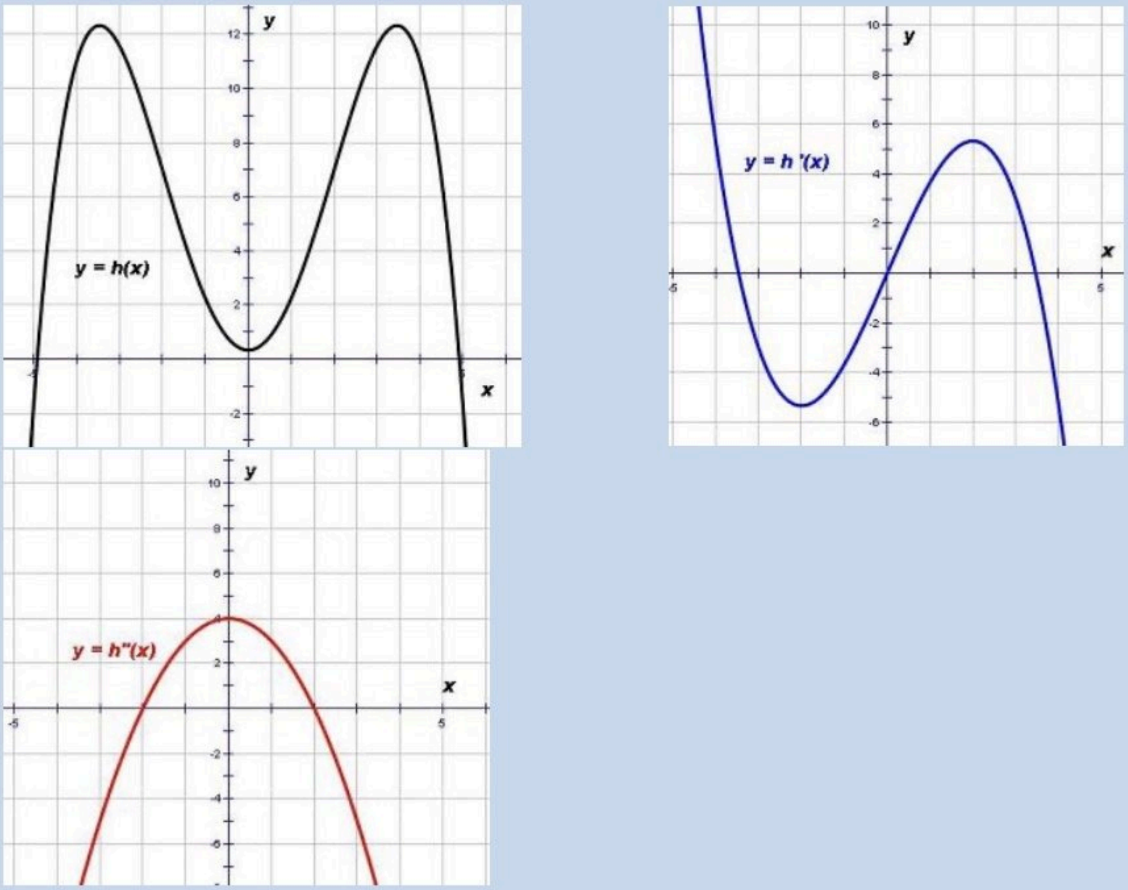




2. The graphs of the function $g(x) = -x^3 + 3x^2 - 2$, its first derivative $g'(x)$ and its second derivative $g''(x)$ are shown.



3. The graphs of the function $h(x) = -\frac{1}{12}x^4 + 2x^2 + \frac{1}{3}$, its first derivative h', and its second derivative h'' are shown.



4. The graphs of the function $p(x) = x^4 - 4x^3$, its first derivative P', and its second derivative P'' are shown.