MATH 131: ASSIGNMENT 6

Please complete the following problems on separate paper. Submit to SQRC by Tuesday 29 March. We will discuss some of these in class on Monday 28 March

(1) Find the point on the parabola $y = x^2 - 4x$ that is closest to the point $(1, 1)$.

(2) Suppose we have a rectangular piece of cardboard that is 30cm wide and 50 cm long. We want to make a box (with no lid) by cutting out a square of cardboard from each of the corners of the cardboard, then folding the sides. How big should the squares be in order to maximize the volume of the resulting box?

(3) In order to get from BoDine to the SQRC, Paul needs to cross from one corner of the rectangular piece of grass to the opposite corner. The rectangle of grass is 30 meters long and 15 meters wide. Paul's plan is the following: First he will walk some distance on the pavement along the long edge of the grass. Then at some point he will turn and walk directly across the grass to the far corner. Paul walks at 2 meters per second on the pavement, but only 1 meter per second on the grass. How far should he walk along the edge of the grass before cutting across?

(4) (Famous ladder problem) Suppose that two hallways meet at a right angle. The first hallway is 10 feet wide, the second is 8 feet wide. What is the longest ladder that can successfully carried around the corner?

(5) What are the following derivatives? These need to be memorized!

(a) $\frac{d}{dx}\left[e^x\right]$

(b) $\frac{d}{dx}\left[\ln(x)\right]$

(c) $\frac{d}{dx}\left[\sin^{-1}(x)\right]$

(d) $\frac{d}{dx}\left[\tan^{-1}(x)\right]$

(6) Compute the following

(a) $\frac{d}{dx}\left[e^{-x^2}\right]$

(b) $\frac{d}{dx}\left[\tan(x^2+1)\right]$

(c) $\frac{d}{dx}\left[\ln(\sqrt{x}+1)\right]$

(d) $\frac{d}{dx}\left[x\sin^{-1}(x^2)\right]$

For more practice, see sections 2.7 and 2.8 of the text.

(7) Consider the function $f(x) = \ln(1+x^2)$.

(a) Where are the roots of $f(x)$? What are the limits as $x \to \pm\infty$?

(b) Find the critical points of $f(x)$. Where is f increasing/decreasing?

(c) Find the inflection points of $f(x)$. Where is the graph of f concave up/down?

(d) Make a rough sketch of the graph of $f(x)$.