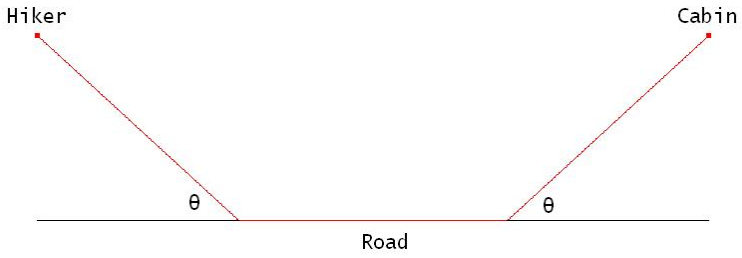
Extra Credit Problems
Math 205
Mammenga

The purpose of these extra credit problems is to raise the score of your worst exam. You may turn in at most 7 of the following 10 problems for extra credit (which seven problems you choose to do is entirely up to you). For each correct solution, you will earn 10% of the percentage points you missed off of your worst exam. For example, if your worst exam was the in-class portion of Exam 2 on which you received a 60%, then for each correct solution you will earn back $(10\% \cdot 40\%) = 4\%$ *on that exam. Your solutions must be turned in by the due-date of the 4th take-home exam.*

1. Write an equation for the circle with center $(2, 3)$ that is tangent to the line $y = -x - 3$.

2. A hiker finds herself in a forest 2 km due north of a long straight road that runs east and west. She wants to walk to her cabin, which is 10 km due east of her current position. She can walk at a rate of 8 km/hr along the road, but only 3 km/hr through the forest. So she decides to walk first to the road, then along the road, and finally through the forest to the cabin. What angle θ (shown in the sketch below) would minimize the total time required for the hiker to reach her cabin? How much time is saved in comparison with the straight route through the forest?



3. Sketch the graph of $\dfrac{x^3}{x^2 - 1}$ by hand, labeling all stationary points, inflection points, and asymptotes. Also show the concave structure clearly.

4. Sketch the graph of $f(x) = 8x^5 - 5x^4 - 20x^3$, indicating local maxima/minima, inflection points, and concave structure.

5. A circle of radius r is dropped into the parabola $y = x^2$. If r is too large, the circle will not fall all the way to the bottom; if r is sufficiently small, the circle

will touch the parabola at its vertex $(0, 0)$. Find the largest value of r so that the circle will touch the vertex of the parabola.

6. A 41-ft-long ladder leaning against a vertical wall begins to slip. Its top slides down the wall while its bottom moves along the level ground at a constant speed of 4 ft/s. How fast is the top of the ladder moving when it is 9 ft above the ground?

7. Find an equation of the line tangent to the curve $\dfrac{1}{x+1} + \dfrac{1}{y+1} = 1$ at the point $(1, 1)$.

8. Compute $\displaystyle\int x^2 \sin x \, dx$ without using Derive (you must explain your steps).

9. Let $A(x) = \displaystyle\int_0^x \left(\frac{3}{2}t - 3\right) dt$. Compute $A(0)$, $A(6)$, and $A(10)$.

10. Find the average value of the function $g(x) = \sqrt{x}$ over the interval $[1, 4]$.