Due Nov. 20

Math 1210 Pipeline Project

The U.S. Interior Secretary recently approved drilling of natural gas wells near Vernal, Utah. Your company has begun drilling and established a high-producing well on BLM ground. They now need to build a pipeline to get the natural gas to their refinery. While running the line directly to the refinery will be the least amount of pipe and shortest distance, it would require running the line across private ground and paying a right-of-way fee. There is a mountain directly east of the well that must be drilled through in order to run the pipeline due east. Your company can build the pipeline around the private ground by going 1 mile directly west and then 5 miles south and finally 21 miles east to the refinery (see figure below). Cost for materials, labor and fees to run the pipeline across BLM ground is \$300,000 per mile. For any pipeline run across private ground, your company incurs an additional \$200,000 per mile cost for right-of-way fees. Cost of drilling through the existing mountain would be \$500,000 on top of the normal costs of the pipeline itself. Also the BLM will require an environmental impact study before allowing you to drill through the mountain. Cost for the study is estimated to be \$100,000. Your company has asked you to do the following:

a) Determine the cost of running the pipeline strictly on BLM ground with two different cases, one heading east through the mountain and then south to the refinery and the other running west, south and then east to the refinery.

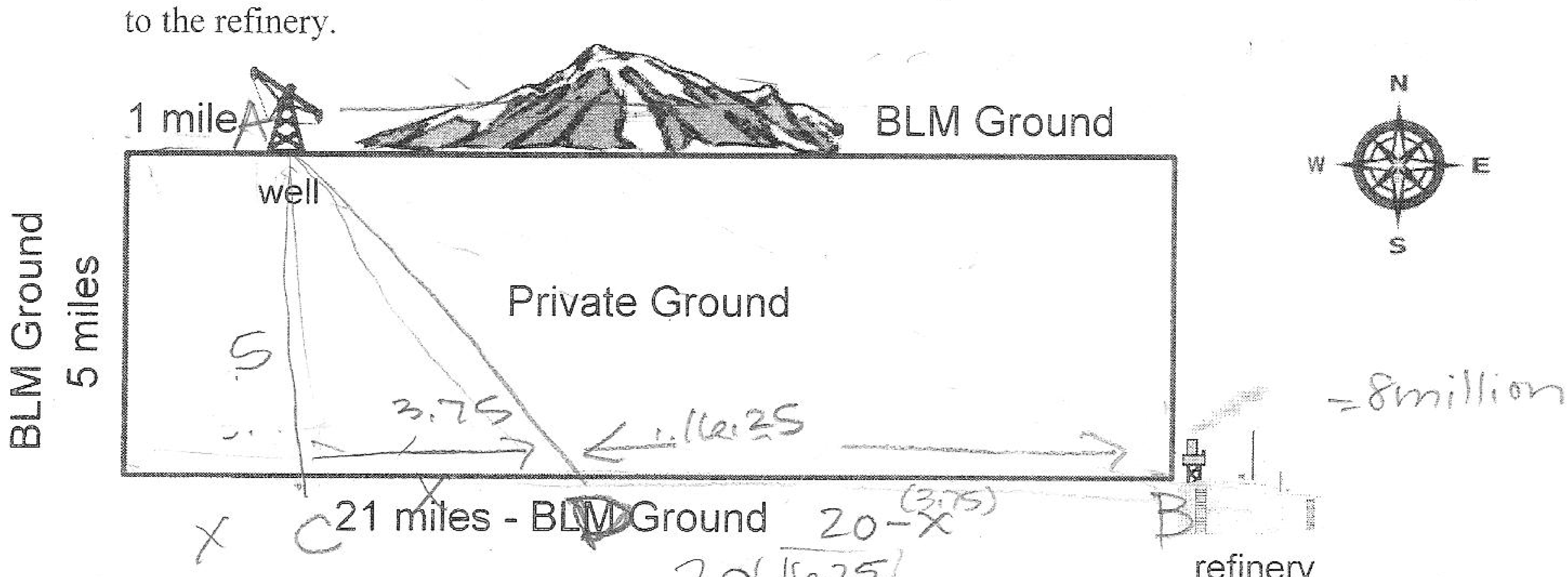
27(300,000) \$8,100,000 Mt = 8,100,000 25 + 500,00 + 100,000 (300,00) 2

b) Determine the cost of running the pipeline the shortest distance (straight line joining well to refinery across the private ground).

\$16,300,000

c) Determine the optimal place to run the pipeline to minimize cost. This will likely be running across private ground to a point on the south side and then along the BLM ground to the refinery. Clearly show all work including drawing a sketch of where the optimal pipeline will run. Make it very clear how you use your knowledge of calculus to determine the optimal placement of the pipeline.

d) Include a sketch of the cost function for this pipeline for configurations involving crossing some private ground in a straight line that intersects the BLM ground to the south and then running east to the refinery.



Using the information given regarding the pipeline construction from the existing well to the existing refinery, the following calculations have been made:

a) Using only BLM land, we can head East through the mountain with an added cost of $500,000 for labor to drill through the mountain, and $100,000 for the environmental impact study on top of the cost of $300,000/mile. 300k(25miles) + 500k + 100k = **$8.1 million.**
   Another option for BLM only land is to head West, then South, then back East. That would give us a total of $300k(27miles) = **$8.1 million.**
b) To run a line directly through private ground would incur an additional $200,000/mile for right-of-way fees. To do this, the total would be 20.6 miles($500,000) = **$10.3 million.**
c) The most optimal place to go through the private land can save the company money. The calculations can be found on the attached notes. The optimal placement of the pipeline location will be 16.25 miles long, connecting with BLM land 16.25 miles West of the refinery. The total cost of this pipeline is $500,000(6.25miles) + $300,000(16.25miles) = **$8 million.**

The pipeline in part C would save the company at least $100,000. This would be our most cost effective place to construct the pipeline.

Annalee Schille

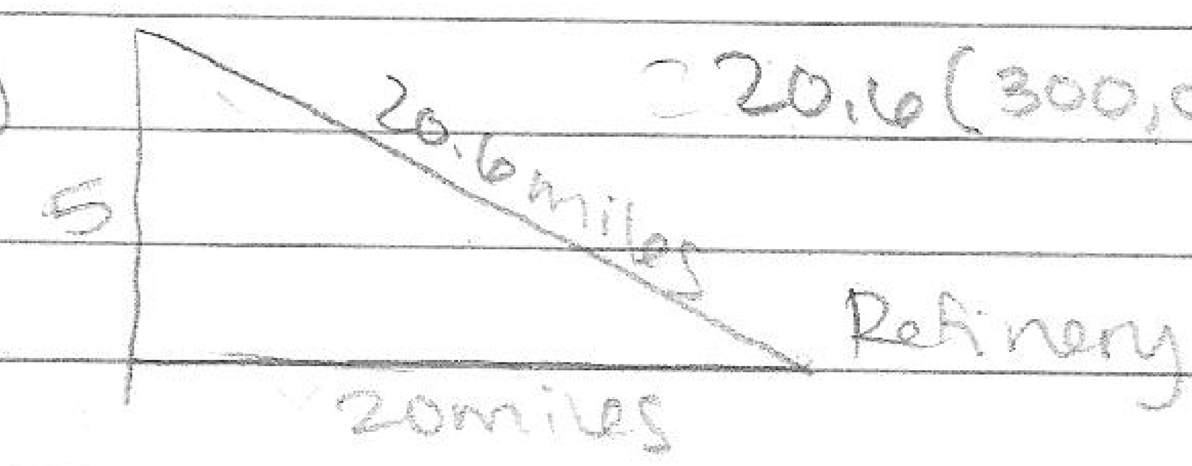
a) heading East through the mountain then South through Refinery:

$25(300{,}000) + 500{,}000 + 100{,}000 = \$8{,}100{,}000$

Running West, South, then East to the Refinery

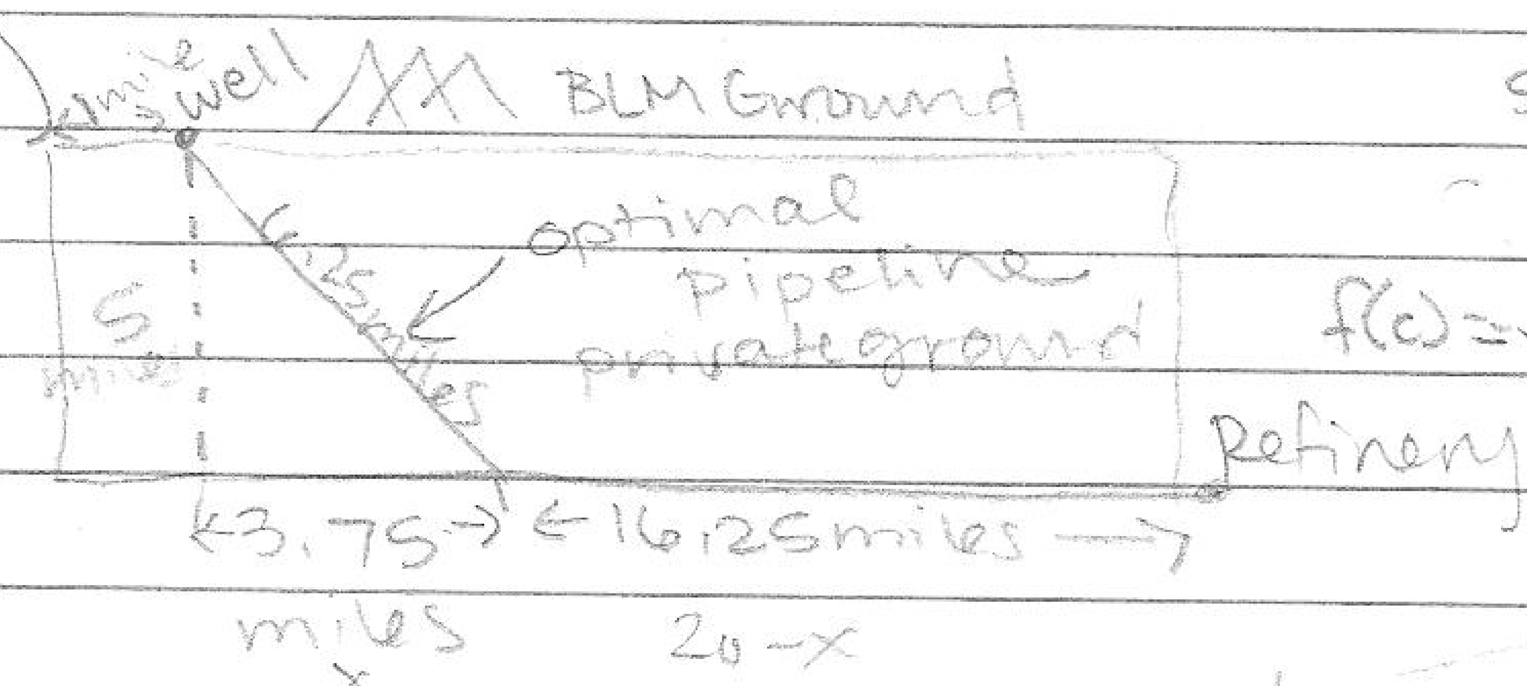
$27(300{,}000) = \$8{,}100{,}000$

b)



$\approx 20.6(300{,}000 + 200{,}000) = \$10{,}300{,}000$

c)



$500{,}000y + (20-x)300{,}000$

$x^2+y^2=5 \Rightarrow y^2=25-x^2$

$f(c)=\sqrt{x^2+25}\,(500{,}000)+(20-x)(300{,}000)$

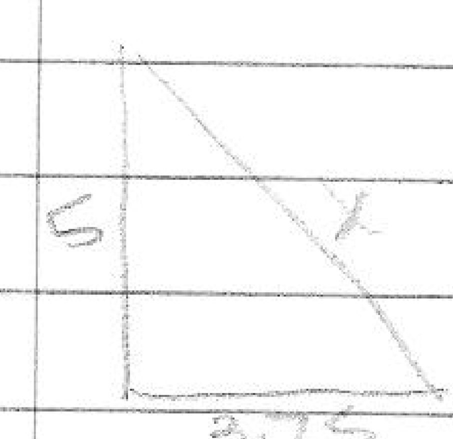
$f'(c) = \dfrac{500000}{\sqrt{x^2+25}} - 300{,}000 = 0$

$f'(c) = (500{,}000x)^2 = (300{,}000\sqrt{x^2+25})^2$

$\sqrt{(2.5\cdot10^{12} - 9\cdot10^{10})x^2} = \sqrt{2.25\cdot10^{12}}$

$\dfrac{400{,}000x}{400{,}000} = \dfrac{1{,}500{,}000}{400{,}000}$

$x = 3.75$ miles



$5^2+3.75^2=x^2$

$6.25(500{,}000)+16.25(300{,}000)=\$8$ million

Calculus has proven to be a challenge for me this semester. The ideas and concepts seemed to be very abstract compared to the algebra courses that I have been enrolled in. However, now that we are nearing the end of the course, I can see how the concepts may be the most useful tools in the business world. Rates and optimization is used in every aspect of building, sales, medicine, and planning. How can you build something using the least amount of material? At what rate will this medication change your blood pressure? And, as this signature project illustrates, what is the most cost effective path for a pipeline to be built? I am looking forward to completing the second semester of calculus to explore the integral calculus sections.