Refer to our in-class activity about rephrasing and negating implications to complete this assignment. It is due Wednesday, Sept. 14, 2011. Please work on a separate sheet of paper.

1. Rewrite each statement below in grammatically correct “if-then” form.
   (a) $f$ can only be differentiable if it is also continuous.
      If $f$ is differentiable, then it is also continuous.
   (b) $f$ failing to be differentiable is a necessary condition for $f$ not to be continuous.
      If $f$ is not continuous, then $f$ fails to be differentiable.
   (c) $\theta$ being in Quadrant I is sufficient for $\sin \theta$ to be positive.
      If $\theta$ is in Quadrant I, then $\sin \theta$ is positive.
   (d) $\theta$ lies on the $x$-axis only if $\sin \theta = 0$.
      If $\theta$ lies on the $x$-axis, then $\sin \theta = 0$.
   (e) Only if $\tan \theta$ is undefined can $\theta$ lie on the $y$-axis.
      If $\theta$ lies on the $y$-axis, then $\tan \theta$ is undefined.
   (f) A sufficient condition for $\cos \theta$ to be positive is that $\theta$ is in Quadrant IV.
      If $\theta$ is in Quadrant IV, then $\cos \theta$ is positive.
   (g) $\sin \theta$ and $\cos \theta$ both being negative is necessary for $\theta$ to be in Quadrant III.
      If $\theta$ is in Quadrant III, then $\sin \theta$ and $\cos \theta$ are both negative.
   (h) $\sin \theta$ and $\tan \theta$ having opposite signs implies that $\theta$ is in Quadrant II or III.
      If $\sin \theta$ and $\tan \theta$ have opposite signs, then $\theta$ is in Quadrant II or III.

2. Refer to your answers to Problem #1 to write the negation of each statement. Phrase your responses in the simplest language possible, and use deMorgan’s Laws where possible.
   (a) $f$ can only be differentiable if it is also continuous.
      Negation: $f$ is differentiable, but it is not also continuous.
   (b) $f$ failing to be differentiable is a necessary condition for $f$ not to be continuous.
      Negation: $f$ is not continuous, but it is differentiable.
   (c) $\theta$ being in Quadrant I is sufficient for $\sin \theta$ to be positive.
      Negation 1: $\theta$ is in Quadrant I, but $\sin \theta$ is not positive.
      (The opposite of “positive” is not plain “negative.” It’s “negative or zero.” It’s okay, then, to use the shorter phrase “not positive.”)
      Negation 2: $\theta$ is in Quadrant I, but $\sin \theta \leq 0$.
      (Because “positive” means “greater than 0,” we can use symbols to condense the writing even more.)
   (d) $\theta$ lies on the $x$-axis only if $\sin \theta = 0$.
      Negation: $\theta$ lies on the $x$-axis, but $\sin \theta \neq 0$.
   (e) Only if $\tan \theta$ is undefined can $\theta$ lie on the $y$-axis.
      Negation: $\theta$ lies on the $y$-axis and $\tan \theta$ is defined.
   (f) A sufficient condition for $\cos \theta$ to be positive is that $\theta$ is in Quadrant IV.
      Negation 1: $\theta$ is in Quadrant IV, but $\cos \theta$ is not positive.
      Negation 2: $\theta$ is in Quadrant IV, but $\cos \theta \leq 0$.
   (g) $\sin \theta$ and $\cos \theta$ both being negative is necessary for $\theta$ to be in Quadrant III.
      Negation: $\theta$ is in Quadrant III, but $\sin \theta$ and $\cos \theta$ aren’t both negative.
      (This “and” isn’t a logical “and” that joins two STATEMENTS, so it doesn’t become an “or” upon negation.)
      (Also beware that “aren’t both” means something different from “both aren’t.”)
   (h) $\sin \theta$ and $\tan \theta$ having opposite signs implies that $\theta$ is in Quadrant II or III.
      Negation: $\sin \theta$ and $\tan \theta$ have opposite signs, but $\theta$ isn’t in Quadrant II nor is it in Quadrant III.

3. Rework Problem #20d-g on page 48 with deMorgan’s Laws in mind.
   These are textbook problems, so I won’t publish the solutions.