Quiz 6: Inverses and Related Rates **MATH 2554 (Calculus I)**
§3.10-3.11 **due Tues 15 Mar 2016**

Directions: This quiz is due on Tuesday, 15 March, 2016 at the beginning of your drill. You may use your brain, notes, book, or other humans to complete your work. **Your solutions must be on a separate sheet of paper, in order, stapled, de-fringed, and legible with your name on the top right corner of the first page.** If you fail to meet any of these requirements, you will receive a zero. Each question is worth one point, and will be graded as correct or not correct (all or nothing).

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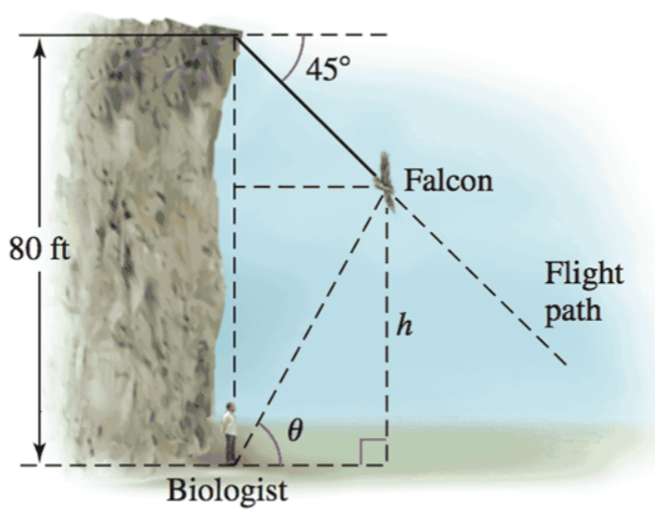
1. **(1 pt)** Find $f'(x)$, given $f(x) = \dfrac{\sec x \sin^2\left(\tan^{-1}(\ln x)\right)}{\log_6\left(e^{x^2 \csc^{-1}(\pi x)}\right)}$. You don't have to simplify.

2. Let $g(x) = \dfrac{x}{x+5}$.

   (a) **(1 pt)** Find $g^{-1}(x)$.

   (b) **(1 pt)** Find $(g^{-1})'(x)$ and check that it is equal to $\dfrac{1}{g'(u)}$, where, after taking the derivative substitute $g^{-1}(x)$ for u.

3. *(§3.10 #68)* A biologist standing at the bottom of an 80-foot vertical cliff watches a peregrine falcon dive from the top of the cliff at a 45° angle from the horizontal.



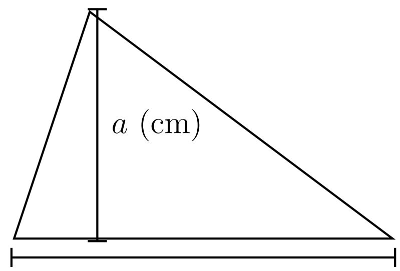
   (a) **(1 pt)** Use the picture to write an expression for θ as a function of h.

   (b) **(1 pt)** What is the rate of change of θ with respect to the bird's height when it is 60 feet above ground?

4. The altitude (height) of a triangle is increasing at a rate of 1 cm/min while the area of the triangle is increasing at a rate of 2 cm^2/min. Go through the following steps to answer:

What is the rate at which the base of the triangle is changing, when the altitude is 10 cm and the area is 100 cm^2?

Let t denote time (min) and let A denote the area of the triangle (cm^2/min). Below is the triangle with the altitude and base named:



(a) **(1 pt)** Translate the following information into mathematical expressions using the variables b, a, t, A.

- "The altitude (height) of a triangle is increasing at a rate of 1 cm/min"
- "the area of the triangle is increasing at a rate of 2 cm^2/min"
- "rate at which the base of the triangle is changing"
- "altitude is 10 cm"
- "area is 100 cm^2"

(b) **(1 pt)** Use the picture to write an equation that includes the variables a, b, A. Solve for b. Then use implicit differentiation to solve for $\frac{db}{dt}$.

(c) **(1 pt)** What is $\left.\frac{db}{dt}\right|_{\substack{h=10\text{ cm}\\ A=100\text{ cm}^2}}$?

Use related rates, as above, to solve the following problems:

5. **(1 pt)** A ladder 10 ft long leans against a vertical wall. If the bottom of the ladder slides away from the base of the wall at a speed of 2 ft/sec, how fast is the angle between the ladder and the wall changing when the bottom of the ladder is 6 ft from the base of the wall?

6. **(1 pt)** The minute hand on a clock is 8 in long and the hour hand is 4 in long. How fast is the distance between the tips of the hands changing at 1 o'clock? *Hint: Use the Law of Cosines.*