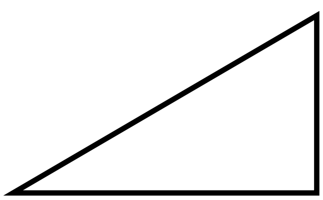
1. (30 points) The following problems are not related.
   (a) (10 points) Find the derivative of $g(x) = \sin\left(\dfrac{x^2+x}{3x-1}\right)$. Do not simplify your answer.
   (b) (14 points) Let $f(x) = \sqrt{4-x}$.
      i. State the limit definition of the derivative for a function $f(x)$.
      ii. Find $f'(x)$ by using the definition of the derivative. *You must use the limit definition to receive any credit.*
   (c) (6 points) If $f'(x) = \lim_{h\to 0} \dfrac{\sin(x+h)-\sin(x)}{h}$, find $f'(\pi/3)$.
2. (20 points) The following problems are not related.
   (a) (8 points) The side length h of a square is measured as 3 cm, with a maximum error of 0.1 cm. Use differentials to estimate:
      i. the maximum error for the area of the square;
      ii. the relative error for the area of the square.
   (b) (12 points) You are flying a kite which has a constant height of 4 meters above the ground. The wind is carrying the kite horizontally away from you, and you have to let out string at a rate of 2 meters/minute. What is the horizontal speed of the kite when you have let out 5 meters of string?



3. (16 points) Consider the function $s(x) = -x^3 + 3x + 2$.
   (a) Find the critical numbers of $s(x)$.
   (b) Use the first derivative test to determine the points where $s(x)$ has a local maximum or local minimum. *Give your answer as ordered pairs* (x, y).
   (c) Find the absolute maximum and minimum values for the function $s(x)$ on the interval $[0, 2]$.
4. (18 points) Suppose that y is defined implicitly as a function of x from the equation
$$\cos(\pi y) = \frac{1}{2}x + y\cos(\pi x).$$
   (a) Find the derivative $\frac{dy}{dx}$.
   (b) Give an equation for the tangent line to this curve at the point where $y = 0$.
5. (16 points) Consider the function $f(x) = \dfrac{1}{x}$ on the interval $[2, 4]$.
   (a) (8 points) State the Mean Value Theorem and verify that $f(x)$ satisfies the hypotheses on the given interval.
   (b) (8 points) Find all numbers c that satisfy the conclusion of the Mean Value Theorem for $f(x)$ on the interval $[2, 4]$.