

1. (30 points) The following problems are not related.

(a) (10 points) Find the derivative of  $g(x) = \sin \frac{x^2 + x}{3x - 1}$ . Do not simplify your answer.

(b) (14 points) Let  $f(x) = \sqrt[3]{4 - x}$ .

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  $f'(x) = \lim_{h \rightarrow 0} \frac{\sin(x+h) - \sin(x)}{h}$ , find  $f'(\pi/3)$ .

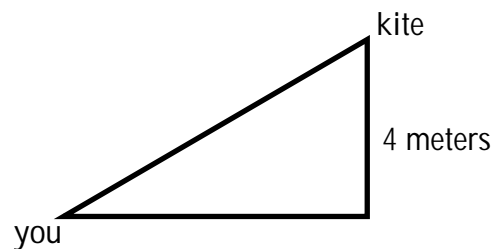
2. (20 points) The following problems are not related.

(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

$$\cos(y) = \frac{1}{2}x + y\cos(x):$$

(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  $f(x) = \frac{1}{x}$  on the interval  $[2; 4]$ .

(a) (8 points) State the Mean Value Theorem for the function  $f(x) = \frac{1}{x}$  on the interval  $[2; 4]$ .