

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 $f'(\pi/3)$.

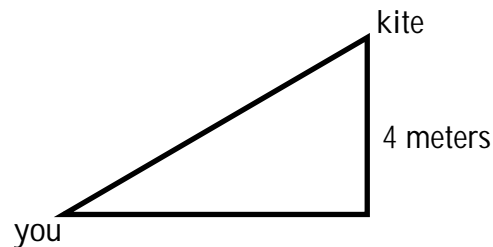
2. (20 points) The following problems are not related.

(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 $[2; 4]$.