

1.) Determine the following limits.

a.)  $\lim_{x \rightarrow 2} \frac{x - 2}{x^2 + x - 6}$

b.)  $\lim_{x \rightarrow 0} \frac{\frac{1}{x+1} - 1}{x}$

c.)  $\lim_{h \rightarrow 0} \frac{\sin h^2}{h}$

d.)  $\lim_{x \rightarrow +3^-} \frac{x^2 - 5}{3 - x}$

e.)  $\lim_{x \rightarrow 1} \frac{2 - \sqrt{x+3}}{x-1}$

f.)  $\lim_{x \rightarrow \infty} \frac{\cos(3x+1)}{3x+1}$  (HINT : Use the Squeeze Principle.)

2.) Determine the domain for  $f(x) = \frac{3}{4 - \sqrt{x}}$ .

3.) Consider a three-dimensional cube with side length  $x$ .

a.) Write the volume  $V$  of the cube as a function of  $x$ .

b.) Write the surface area  $S$  of the cube as a function of  $x$ .

c.) Write the surface area  $S$  of the cube as a function of the volume  $V$ .

4.) Consider the following function  $f(x) = \begin{cases} \frac{x^2 - 3x}{x^2 - 9}, & \text{if } x \neq 3, -3 \\ \frac{1}{2}, & \text{if } x = 3 \\ 0, & \text{if } x = -3. \end{cases}$

Determine if  $f$  is continuous at  $x = 3$ .

5.) Using limits, determine the value(s) of constants  $A$  and  $B$  so that the following function is continuous for all values of  $x$  :

$$f(x) = \begin{cases} Ax + B, & \text{if } x < 0 \\ 12, & \text{if } 0 \leq x \leq 2 \\ Bx^2 - A, & \text{if } x > 2. \end{cases}$$

6.) Use the Intermediate Value Theorem to prove that the equation  $x^3 = x^2 + 5$  is solvable. This is a writing exercise.

7.) Give an  $\varepsilon, \delta$ -proof for the following limit. This is a writing exercise. :  
 $\lim_{x \rightarrow -1} (x^2 + 3) = 4$

2.) Use  $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$  to differentiate the function  $f(x) = \frac{x}{x+5}$ .

3.) You are standing on the top edge of a building which is 96 ft. high. You throw an apple straight UP at 80 ft./sec. and watch as it falls back to the ground.

a.) Assume that the acceleration due to gravity is  $s''(t) = -32 \text{ ft./sec.}^2$ . Derive velocity,  $s'(t)$ , and height (above ground),  $s(t)$ , formulas for this apple.

b.) In how many seconds will the apple strike the ground ?

c.) How high does the apple go ?

The following EXTRA CREDIT PROBLEM is worth      points. This problems is OPTIONAL.

1.) Determine the following limit :  $\lim_{x \rightarrow \infty} (x - \sqrt{x^2 + 9x})$