

- If  $f(x) = \frac{x^3}{3} - 4x^2 + 12x - 5$  on  $[0,7]$ ,  $a$  is the absolute maximum value of  $f$  and  $b$  is the absolute minimum value of  $f$ , find  $a + b$ .
- Given that  $f(x) = (x^2 + 1)^{(3-2x)}$ . If  $f'(1) = a - b \ln 2$ , find  $a + b$  if  $a > 0$  and  $b > 0$ .
- Find the coordinates of the inflection point of  $y = x(\text{Arctan } x) + \text{Arctan } x$ .
- Evaluate:  $\lim_{x \rightarrow 0} \frac{\ln(\sec x + \tan x) - (x+1)\ln(x+1) + x - e^x + 1}{\sec x - 1}$
- A curve is defined parametrically by  $x = \frac{2t}{t^2+1}$  and  $y = \frac{2}{t^2+1}$ . Determine the distance of the curve from the point  $(1,0)$ .
- As sand leaks out of a hole in a container, it forms a conical pile whose altitude is always  $1/2$  the radius. The height of the pile is increasing at  $6$  in/minute.  
 $A$  = the height of the cone when the volume is  $36\pi$ .  
 $B$  = the rate at which sand is leaking out when the altitude is  $1/2$  in.  
 $C$  = the rate of change of the area of the base when the altitude is  $1/2$  in  
 $D$  = the area of the base when the altitude is  $1/2$  inch.

Evaluate:  $\frac{AD}{B + C}$

- If  $f(x) = \frac{1}{x^2 - 4}$  and  $g(x) = \sqrt{x}$ , let  $A$  = the domain of  $f(g(x))$  and  $B$  = the domain of  $g(f(x))$ . Express  $A \cap B$  in interval notation.
- Find  $f(\pi/6)$  if  $f''(x) = \sin x$ ,  $f'(\pi/3) = 1/2$ , and  $f(\pi/2) = -\pi/2$ .
- A 12-foot wire is cut into 12 pieces, which are soldered together to form a frame for a rectangular solid whose base is twice as long as it is wide. Find the dimensions of the solid so that the volume will be maximized.
- Evaluate:  $\lim_{x \rightarrow \infty} (x - \sqrt{x^2 - 3x}) + \lim_{x \rightarrow 0} \frac{\sin 2x}{3x} + \lim_{x \rightarrow 0} \frac{|x|}{x} + \lim_{x \rightarrow 0} \left[ \frac{1}{x} \right] \left[ \frac{1}{\sqrt{1+x}} - 1 \right]$
- If  $f(3) = 2$ ,  $f'(3) = -1$ ,  $g(3) = 3$ , and  $g'(3) = 4$ , find the derivative of the following expression at  $x = 3$ .  
 $(f \circ g)(x) + \frac{3}{f(x)} + [f(x)][g(x)]$
- Find the slope of the line tangent to the curve  $y^3 - xy^2 + \cos xy = 2$  at  $x = 0$ .
- The positions of two particles on a coordinate line at the end of  $t$  seconds are given by  $s_1 = 3t^3 - 12t^2 + 18t + 5$  and  $s_2 = -t^3 + 9t^2 - 12t$ . When do the particles have the same velocity?
- A woman standing on a cliff is watching a motorboat through a telescope as the boat approaches the shoreline directly below her. If the telescope is 250 feet above the water level and if the boat is approaching at 20 ft/sec, at what rate is the angle of the telescope decreasing when the boat is 250 feet from shore?
- Approximate the volume of material in a spherical shell of inner radius 6cm and outer radius 6.125 cm using differentials.