

1. Find the limit, if it exists.:

$$(a) \lim_{x \rightarrow -\infty} \frac{2-x}{\sqrt{7+6x^2}} \quad (b) \lim_{x \rightarrow \infty} \frac{\sqrt{3x^4+x}}{x^2-8}.$$

2. Find derivative,  $\frac{dy}{dx}$ , of the following functions.

(a)  $y = \frac{e^{-x}}{x^2}$

(b)  $y = \sin^2(3x^2 - 5x + 2)$

(c)  $y = 5 \tan^{-1}(3x)$

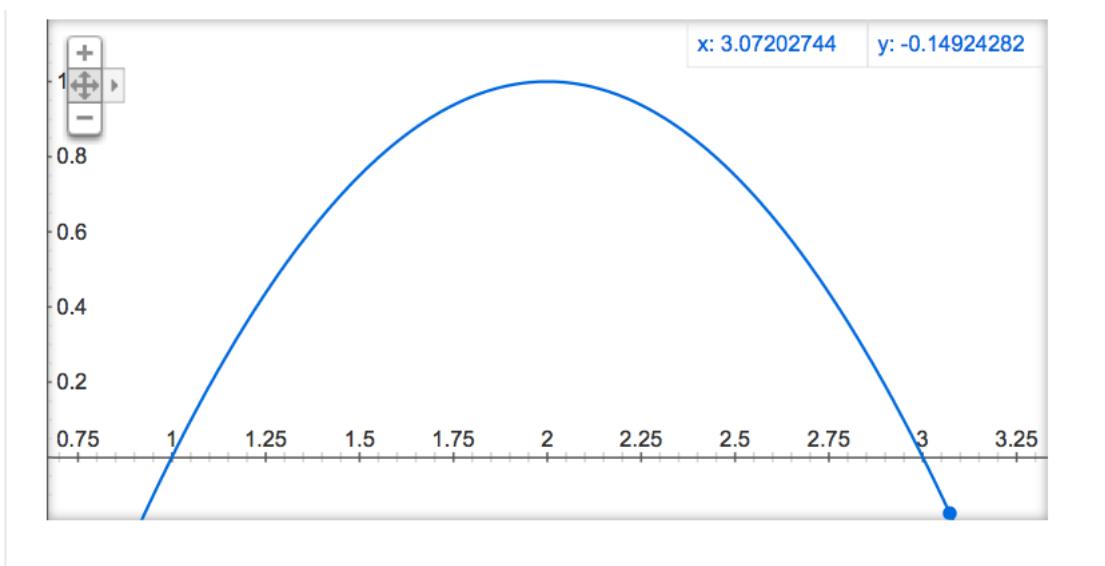
(d)  $y = (\ln x)^x$

3. Given that  $y = \int_0^x \sqrt{1+t^2} dt$  find  $dy/dx$ .

4. A conical water tank with vertex down has a radius of 10 feet at the top and is 24 feet high. If water flows into the tank at 20 cubic feet per minute, how fast is the depth of the water increasing when the water is 16 feet deep?

5. Use implicit differentiation to find an equation of the tangent line to the graph of  $x^3 + y^3 - 9xy = 0$  at the point (2, 4).

6. Use the graph of the derivative  $f'(x)$  of a function given below to estimate all values at which  $f$  (a) has a relative maximum (b) has a relative minimum (c) has an inflexion point (d) is increasing (e) is decreasing (f) is concave up (g) is concave down.



7. Find the area between the graph of  $f(x) = e^{2x}$  and the  $x$ -axis over the interval  $0 \leq x \leq 3$ .

8. Sketch the region whose area is represented by the definite integral and evaluate the integral using an appropriate formula from geometry:

$$(a) \int_1^2 2 dx \quad (b) \int_{-1}^2 (x+2) dx \quad (c) \int_0^1 \sqrt{1-x^2} dx.$$

9. Find the absolute maximum and minimum values of the function  $f(x) = -\frac{5}{x^2}$  on the interval  $1 \leq x \leq 5$ .

10. Assume a continuous function  $f$  which has derivatives

$$f'(x) = \frac{2-3x}{(x+2)^{1/3}} \quad \text{and} \quad f''(x) = \frac{-2(3x+10)}{3(x+2)^{4/3}}.$$

- (a) Find the open intervals on which  $f$  is increasing.
- (b) Find the open intervals on which  $f$  is decreasing.
- (c) Find the open intervals on which  $f$  is concave up.
- (d) Find the open intervals on which  $f$  is concave down.
- (e) Find the  $x$ -coordinate(s) of all points of inflection.
- (f) Sketch a graph of a function  $f$  that reflects *all* of the information requested in parts (a), (b), (c), (d), (e), and  $f(-2) = 0$ .

11. Evaluate:

$$(a) \int \left( 3\sqrt{t} + \frac{4}{t^2} \right) dt \qquad (b) \int \cos x \sin x \, dx$$

12. Given that  $y = \int_0^x \sqrt{1+t^2} \, dt$  find  $dy/dx$ .