



**Exercise 1.** Find  $y'$ .

a.  $y = \ln |\sec 5x + \tan 5x|$

b.  $\sin(xy) = x^2 - y$

c.  $y = (\arcsin(2x))^2$

d.  $y = \sin^2 \left( \cos \sqrt{\sin \pi x} \right)$

e.  $y = \frac{\sqrt{x+1}(2-x)^5}{(x+3)^7}$

f.  $y = \ln(x \ln x)$

**Exercise 2.** Find  $y''$  if  $x^6 + y^6 = 1$ .

**Exercise 3.** Find equations for the tangent lines to the ellipse  $x^2 + 2y^2 = 1$  that have slope 1.

**Exercise 4.** Use a linear approximation to estimate  $\tan 44^\circ$ .

**Exercise 5.** The circumference of a sphere was measured to be 84 cm with a possible error of 0.5 cm.

- Use differentials to estimate the maximum error in the calculated surface area. What is the percentage error?
- Use differentials to estimate the maximum error in the calculated volume. What is the percentage error?

**Exercise 6.** A plane flies horizontally at an altitude of 5km and passes directly over a tracking telescope on the ground. When the angle of elevation is  $\pi/3$ , this angle is decreasing at a rate of  $\pi/6$  rad/min. How fast is the plane traveling at that time?

**Exercise 7.** A balloon is rising at a constant speed of 5 ft/s. A girl is cycling along a straight road at a speed of 15 ft/s. When she passes under the balloon, it is 45 ft above her. How fast is the distance between the girl and the balloon increasing 3 s later?

**Exercise 8.** Find the absolute maximum and minimum values of  $f$  on the given interval.

a.  $f(x) = x\sqrt{4-x^2}$ ,  $[-1, 2]$

b.  $f(t) = t^{2/3}(10-t)$ ,  $[-2, 8]$

c.  $f(\theta) = \theta - 2\arctan(\theta)$ ,  $[0, 4]$

d.  $f(x) = xe^{-x^2/8}$ ,  $[-1, 4]$

**Exercise 9.** Is there a differentiable function  $f$  such that  $f(0) = 2$ ,  $f(2) = -5$  and  $f'(x) \geq -3$  for all  $x$ ?

**Exercise 10.** Let  $f(x) = x^4(x-1)^3$ .

- Find the intervals on which  $f$  is increasing or decreasing.
- Find the local extreme values of  $f$ .
- Find the intervals on which the graph of  $f$  is concave up or concave down.
- Find the  $x$ -coordinates of the inflection points of the graph of  $f$ .

**Exercise 11.** Evaluate the following limits.

a.  $\lim_{x \rightarrow 0} \frac{1 - 8x^2 - \cos 4x}{x^4}$

b.  $\lim_{x \rightarrow 0^+} x(\ln x)^2$

c.  $\lim_{x \rightarrow 4} \left( \frac{1}{\sqrt{x}-2} - \frac{4}{x-4} \right)$

d.  $\lim_{x \rightarrow 0^+} x^{\sin x}$