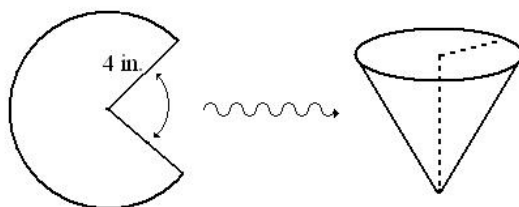


1. If the hour and minute hands of a clock are 3 and 4 inches long, respectively, how quickly are the tips of the hands moving toward each other at 3pm?
2. A cone shaped drinking cup is made from a disk of paper by cutting a sector from the disk and connecting the edges of the cut. If the disk has radius 4 inches, what is the maximum possible volume of the cup?



3. Find the equation of the line with slope  $-1$  that is tangent to the curve  $x^3 + y^3 = 9xy$ .
4. Suppose that  $f$  is a differentiable function with  $f(2) = 5$  and  $f'(x) \leq 3$  for all  $x$ . Show that  $f(x) \leq 3x - 1$  for all  $x \geq 2$ . [*Hint*: Use the Mean Value Theorem.]
5. Compute  $\frac{dy}{dx}$ .
 

(a) $y = (\cos x)^{\sin x}$	(b) $y = (\tan x)^2 e^{x^2+3-4}$
(c) $x^2 y^2 = x + y$	(d) $y = \ln(x + e^{-x})$
6. At noon, ship  $A$  is 90 km west of ship  $B$ . Ship  $A$  is sailing east at 30 km/h and ship  $B$  is sailing north at 20 km/h. How fast is the distance between the ships changing at 2 PM?

7.

- (a) Find the linear approximation  $L(x)$  to the function

$$f(x) = (1 + x)^{100}$$

near the point  $a = 0$ .

- (b) Use part (a) to estimate  $1.001^{100}$ .

8. An open-topped cylindrical pot is to have volume  $125 \text{ in.}^3$ . What dimensions will minimize the total amount of material used in making this pot?

9. Find and classify the critical points of the following functions.

(a)  $f(x) = x^3 + x^2 - 5x + 3$

(b)  $g(x) = x\sqrt[3]{4-x}$

10. Find the intervals of increase and decrease for the function  $h(x) = x(x^2 + x - 2)^2$ .