1. (a) If $A$ is the area of a circle with radius $r$ and the circle expands as time passes, find $\frac{dA}{dt}$ in terms of $\frac{dr}{dt}$.

(b) Suppose oil spills from a ruptured tanker and spreads in a circular pattern. If the radius of the oil spill increases at a constant rate of 1 m/s, how fast is the area of the spill increasing when the radius is 42 m?

2. If $y = x^3 + 4x$ and $\frac{dx}{dt} = 2$, find $\frac{dy}{dt}$ when $x = 5$.

3. If $x^2 + y^2 = 100$ and $\frac{dy}{dt} = 6$, find $\frac{dx}{dt}$ when $y = 8$.

4. A particle moves along the curve $y = \sqrt{19 + x^3}$. As it reaches the point (5, 12), the $y$-coordinate is increasing at a rate of 4 cm/s. How fast is the $x$-coordinate of the point changing at that instant?

$\frac{dx}{dt} = \ ?$ cm/s
5. A plane flying horizontally at an altitude of 2 mi and a speed of 490 mi/h passes directly over a radar station. Find the rate at which the distance from the plane to the station is increasing when it is 5 mi away from the station.

\[ ? \text{ mi/h} \]

6. A spotlight on the ground shines on a wall 12 m away. If a man 2 m tall walks from the spotlight toward the building at a speed of 1.2 m/s, how fast is the length of his shadow on the building decreasing when he is 4 m from the building?

The shadow is decreasing at a rate of \[ ? \text{ m/s} \].

7. Find the linearization \( L(x) \) of \( f(x) = \frac{1}{\sqrt{7} + x} \) at \( a = 0 \).

8. Find the linearization \( L(x) \) of \( f(x) = 3\sqrt{x} \) at \( a = 64 \).

9. (a) Find the linear approximation of the function \( g(x) = \frac{3}{\sqrt{1 + x}} \) at \( a = 0 \).

(b) Use the linear approximation from part (a) to approximate \( 3\sqrt{0.92} \).

(c) Use the linear approximation from part (a) to approximate \( 3\sqrt{1.04} \).

(d) Illustrate by graphing \( g \) and the tangent line.
10.

Find the linear approximation of the function \( g(x) = \sqrt[9]{1 + x} \) at \( a = 0 \).

a. \( \sqrt[9]{1 + x} \approx \frac{1}{9} x + 1 \)

b. \( \sqrt[9]{1 + x} \approx x + 9 \)

c. \( \sqrt[9]{1 + x} \approx 9x - 1 \)

d. \( \sqrt[9]{1 + x} \approx 9x + 1 \)
c. \[ \frac{9}{9} + x \approx \frac{1}{9} x - \frac{1}{9} \]

11. Find the differential of the function.

\[ y = x^4 + 4x \]

12. Find the differential of the function.

\[ y = \sin \pi x \]

13. Find the differential of the function.

\[ y = (1 + 6x)^{-4} \]

14. Let \( y = e^{x/8} \).

Find the differential \( dy \).

Evaluate \( dy \) at \( x = 0 \) if \( dx = 0.2 \).