

1. Let $\vec{a} = \langle 2, 1 \rangle$ and $\vec{b} = \langle 1, 3 \rangle$
 - (a) Evaluate $\|\vec{a} + \vec{b}\|$.
 - (b) Find the unit vector in the direction of \vec{b} .
 - (c) Find all values of t such that \vec{a} is perpendicular to $\vec{c} = \langle -4, 8t \rangle$.

2. (a) Give a parametric vector equation for a circle of radius 9 with the center at the point $P(1, -2)$.
- (b) The trajectory of an object is determined by $\vec{r}(t) = \langle 2t, -2t^2 + 16t \rangle$ where $-\infty \leq t \leq \infty$.
Eliminate the parameter t and find an equation in x and y that determines the curve on which the object moves.

3. Let $f(x) = x(x - 1)^2$, where $-\infty \leq x \leq \infty$.
 - (a) Find all points where f has a local maximum or local minimum. Justify your answers.
 - (b) Find all inflection points. Justify your answer.
 - (c) Graph the function.

4. Find x_2 , the second iterate in Newton's method, to find an approximate value for the negative solution of $x^4 = 10100$. Assume that $x_1 = -10$. Show all details.

5. (a) Find the equation for the line tangent to $y = x^{1/4}$ at $x = 10000$. Hint: $(10000)^{1/4} = 10$.
- (b) Use the tangent line found in part (a) to obtain an approximate value for $(10100)^{1/4}$.

6. (a) Evaluate $\lim_{x \rightarrow 0} \frac{x}{\sqrt{x+4} - 2}$
- (b) Evaluate $\lim_{x \rightarrow 3^-} \frac{|x-3|}{x-3}$
- (c) Evaluate $\lim_{x \rightarrow 1} \frac{\arctan(\tan(2x-5))}{2x-5}$

(d) Evaluate $\lim_{x \rightarrow -\infty} \frac{\ln\left(1 + \frac{3}{x^3}\right)}{\sin\left(\frac{4}{x^2}\right)}$

(e) Evaluate $\lim_{x \rightarrow 0} x^2 \ln(x^2)$

7. (a) Evaluate $\int \frac{dx}{4 + 25x^2} dx$

(b) Evaluate $\int (12^x + x^{1/2}) dx$

(c) Evaluate Let $f(x) = \int_0^{2x} \frac{dt}{\sqrt{1+t^2}}$. Find $\frac{df}{dx}$

8. (a) Find $\frac{dy}{dx}$ at the point $(x, y) = (0, 1)$ on the curve defined by the equation $y^2 + xe^{y^2} = 1$.

(b) Let $y = \arctan(3 \sin^2(x))$. Find $y' \left(\frac{\pi}{4}\right)$.

(c) Let $y = x^{2x}$. Find $\frac{dy}{dx}$.

9. A particle moves along the curve $2x^2 - xy + 3y^2 = 24$. If at a given time, the particle is at position $(-3, 1)$ and the x coordinate of its velocity at this point is 5, then find the y coordinate of the velocity.