

(1) Find the limits if they exist. If a limit does not exist, explain why.

(a)  $\lim_{x \rightarrow 2} \frac{x^2 + 2x - 8}{x^2 - 4}$

(b)  $\lim_{x \rightarrow -1} \frac{x^2 + 5x + 4}{x^2 + 3x + 2}$

(c)  $\lim_{x \rightarrow 5} \frac{x - 5}{\sqrt{x} - \sqrt{5}}$

(2) Differentiate.

(a)  $f(x) = 2x^5 - \pi + \frac{2}{x^5}$

(b)  $y = x^7 \sin x$

(c)  $y = \ln(x^4 + x + 1)$

(d)  $h(x) = \frac{e^x}{x}$

(e)  $m(t) = \sqrt{t^2 + 4}$

(f)  $h(t) = t^7 + 7^t$

(g)  $f(x) = 2x^6 - \frac{1}{x^4}$

(h)  $y = \ln(2 + \cos x)$

(i)  $h(x) = \frac{x}{x^2 + 2}$

(j)  $m(t) = \sin(t^2 + t + 4)$

(3) Find the equation of the tangent line to the curve  $y = x^2 + x + 1$  at  $x = 2$ .

(4) Find the equation of the tangent line to the curve  $y = \sqrt{x}$  at  $x = 25$ .

(5) It costs \$2 apiece to make amulets. The number  $n$  of amulets that you can sell is related to the price  $x$  by  $n = 500 - x$ . Your fixed costs are \$200. What price should you charge to maximize your profit?

(6) Integrate.

(a)  $\int_1^2 x + \frac{1}{x} dx =$

(b)  $\int x \cos x^2 dx =$

(c)  $\int e^{5x} dx =$

(d)  $\int \frac{x+1}{x^2+4} dx =$

(7) Solve.

(a)  $y' - 5y = 0, y(0) = 4$

(b)  $y' = -0.2(y - 5), y(0) = 1$

(8) Find the local maxima and minima of the function  $f(x) = x^3 - 3x^2$ . Sketch the graph.

(9) It costs \$10 apiece to make widgets. The number  $n$  of widgets that you can sell is related to the price  $x$  by  $n = 500 - x^2$ . What price should you charge to maximize your profit?

(10) Integrate.

(a)  $\int_1^2 2^x + \frac{1}{x} dx =$

(b)  $\int_1^2 x\sqrt{x^2+1} dx =$

(c)  $\int \frac{x^2+1}{x^3+3x+1} dx =$

(d)  $\int \frac{2x - 1}{x^2 + 5} dx =$

(11) Approximate the integral  $\int_0^1 \cos x^2 dx$ .

(12) Approximate  $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \cdots + \frac{1}{1000}$

(13) Solve  $y' = 7y$ ,  $y(0) = 2$

(14) Find the partial derivatives.

(a)  $v = x^2 - 2x^5y^2 + 4y$

(b)  $w = st + \frac{s}{t}$

(15) Find the tangent plane to the surface  $z = x^2 + xy$  at the point  $(3, 2)$ .

(16) A year ago you had 3 grams of radioactive substance R. You currently have 1 gram of R. What is its half-life?

(17) If you invest \$100 with Steve at 5% annual interest compounded continuously, how long until you have \$200?

(18) Harry the Horse brings a cup of cold coffee into a warm room. The temperature of the coffee is (initially) 40 degrees, while the room is 80 degrees. After 10 minutes, the coffee is 50 degrees. When does it hit 60 degrees? 80 degrees?