
Find the derivatives. Simplify the answers. Use math symbols properly.

a) \( y = \frac{x^3 + 2x + 1}{x} \)

b) \( f(x) = (14x - 3)^4 \)

c) \( y = \frac{2 - x^2}{3 + x^2} \)

d) \( y = \frac{1 - 3x}{2x + 5} \)

e) \( \left(\frac{1 - 3x}{2x + 5}\right)^4 \)

f) \( f(x) = \frac{2}{9x^3} + \frac{\sqrt{x}}{4} - \frac{4}{\sqrt{x}} + \frac{17}{24} \)

m) \( y = 3\sqrt{7x^2} \)

n) \( y = 15\left(\frac{1}{2x^4 - 13}\right)^3 \)

p) \( f(x) = \frac{x}{(2x^3 + 1)^2} \)

g) \( f(x) = \frac{x}{(2x + 1)^2} \)

h) \( h(x) = \frac{1}{(3x - x^2 + x^3)^2} \)

i) \( y = \frac{(1 + 2x)^3}{(2 - 3x)^2} \)

k) \( y = x^2 \cdot \sqrt{1 + x^2} \)

l) \( f(x) = \frac{x}{x + 3} - \frac{(1 - 3x)^4}{4} + 100 \)

Find the derivatives for the following two functions a) by the quotient rule and b) by the chain rule. Are the answers the same when done by different rules?

r) \( f(x) = \frac{1}{2 - 3x^2} \)

s) \( f(x) = \frac{12}{\sqrt{1 + x^2}} \)

Find the second derivative for the following functions

a) \( f(x) = x^3 + \frac{1}{x - 2} \)

b) \( f(x) = \frac{12}{\sqrt{1 + x^2}} \)

Part 2. Find the domains. Use the domain rules! Always write the opening statement (that is the appropriate rule of domain) first.

1) \( f(x) = \frac{5x}{x^2 - 4} \)

2) \( f(x) = 5x(x^2 - 4) \)

3) \( f(x) = \sqrt{5x - 4} \)

4) \( f(x) = \frac{\sqrt{x}}{X - 3} \)

Create compositions from

a) \( f(x) = 3x^2 + 1, \quad g(x) = \sqrt{x - 1} \)

\[ f \left[ \frac{g(x)}{x} \right] = \]

\[ g \left[ \frac{f(x)}{x} \right] = \]

Create the same compositions from
\( f(x) = \frac{1}{x}, \quad g(x) = 50x + 4 \)

**Part 3.**

Find points of discontinuity for the following functions. Use mathematically correct procedures. (In cases (d) and (e) present LIMIT work.)

a) \( f(x) = \frac{1-3x}{1+3x} \)  
b) \( f(x) = (1-3x)(1+3x) \)  
c) \( f(x) = \frac{14}{x^3} \)

d) \( f(x) = \begin{cases} 2x - 3 & \text{if } x \leq 2 \\ x^2 & \text{if } x > 2 \end{cases} \)  
e) \( f(x) = \begin{cases} 2x + 3 & \text{if } x < 4 \\ 7 + \frac{16}{x} & \text{if } x \geq 4 \end{cases} \)

**Part 4. Limits**

Show work in a mathematically correct manner. Use symbols \( \lim \) as \( x \to \ldots \) properly.

(Unfortunately I could not put limit symbols in their usual form. For ex. normally you would see \( x \to 6 \) written under the word lim. But the computer I am using cannot do this. So if you would look like \( \lim(x \to 6) \). Sorry about that.)

a) \( \lim(x \to 6) \frac{x - 6}{36 - x^2} \)  
b) \( \lim(x \to 4) \frac{4 - x}{2 - \sqrt{x}} \)  
c) \( \lim(x \to -\infty)(2x^3 - 100x) \)

d) \( \lim(x \to -\infty) \frac{5 - 3x^3}{x^2 - x} \)  
e) \( \lim(x \to \infty) \frac{x^2 - x}{5 - 3x^3} \)