

ECO 4401 / 5403
Additional Calculus Practice

Find all first and second derivatives as well as cross partial derivatives for the multi-variate functions.

1. $y = 4x^3$
2. $y = \frac{4}{x^3}$
3. $y = 2x^2(5 - x^5)^3$
4. $z = 4x^3 + \frac{2}{y^5}$
5. $z = x^2 + y^2x + x^5y - 4y^3$
6. $z = \frac{xy^2 - 4x + x^2y}{x+y}$
7. $y = 4e^{x^3}$
8. $y = (x^2 + 2x)(x + 1)$
9. $y = \frac{1}{3x^5}$
10. $\ln x$
11. $\ln x^5$
12. $\ln(x^2 + 3)$
13. $\ln x^2(x^3 + 4)$

1. $y = 4x^3$
 $\frac{dy}{dx} = 12x^2$ $\frac{d^2y}{(dx)^2} = 24x$
2. $y = \frac{4}{x^3}$
 $\frac{dy}{dx} = -\frac{12}{x^4}$ $\frac{d^2y}{(dx)^2} = \frac{48}{x^5}$
3. $y = 2x^2(5 - x^5)^3$
 $\frac{dy}{dx} = 2x^2(3)(-5x^4)(5-x^5)^2 + (5-x^5)^3 4x = 4x(5-x^5)^3 - 30x^6(5-x^5)^2$
 $\frac{d^2y}{(dx)^2} = 4(5-x^5)^3 - 240x^5(5-x^5)^2 + 300x^{10}(5-x^5)$
4. $z = 4x^3 + \frac{2}{y^5}$
 $\frac{\partial z}{\partial x} = 12x^2$ $\frac{\partial^2 z}{(\partial x)^2} = 24x$ $\frac{\partial z}{\partial y} = \frac{-10}{y^6}$ $\frac{\partial^2 z}{(\partial y)^2} = \frac{60}{y^7}$ $\frac{\partial^2 z}{\partial x \partial y} =$
- 0
5. $z = x^2 + y^2x + x^5y - 4y^3$
 $\frac{\partial z}{\partial x} = 2x + y^2 + 5x^4y$ $\frac{\partial^2 z}{(\partial x)^2} = 2 + 20x^3y$ $\frac{\partial z}{\partial y} = 2yx + x^5 -$
 $12y^2$ $\frac{\partial^2 z}{(\partial y)^2} = 2x - 24y$ $\frac{\partial^2 z}{\partial x \partial y} = 2y + 5x^4$
6. $z = \frac{xy^2 - 4x + x^2y}{x+y}$
 $\frac{\partial z}{\partial x} = y \frac{2xy + y^2 - 4 + x^2}{(x+y)^2}$ $\frac{\partial^2 z}{(\partial x)^2} = 8 \frac{y}{(x+y)^3}$ $\frac{\partial z}{\partial y} = x \frac{2xy + y^2 + x^2 + 4}{(x+y)^2}$ $\frac{\partial^2 z}{(\partial y)^2} =$
 $-8 \frac{x}{(x+y)^3}$ $\frac{\partial^2 z}{\partial x \partial y} = \frac{3x^2y + 3xy^2 + y^3 - 4x + 4y + x^3}{(x+y)^3}$
7. $y = 4e^{x^3}$
 $\frac{dy}{dx} = 12x^2e^{x^3}$ $\frac{d^2y}{(dx)^2} = 24xe^{x^3} + 36x^4e^{x^3}$
8. $y = (x^2 + 2x)(x + 1)$
 $\frac{dy}{dx} = (2x + 2)(x + 1) + x^2 + 2x$ $\frac{d^2y}{(dx)^2} = 6x + 6$
9. $y = \frac{1}{3x^5}$
 $\frac{dy}{dx} = -\frac{5}{3x^6}$ $\frac{d^2y}{(dx)^2} = \frac{30}{3x^7} = \frac{10}{x^7}$
10. $y = \ln x$
 $\frac{dy}{dx} = \frac{1}{x}$ $\frac{d^2y}{(dx)^2} = -\frac{1}{x^2}$
11. $y = \ln x^5$
 $\frac{dy}{dx} = \frac{5}{x}$ $\frac{d^2y}{(dx)^2} = \frac{-5}{x^2}$
12. $y = \ln(x^2 + 3)$
 $\frac{dy}{dx} = 2 \frac{x}{x^2+3}$ $\frac{d^2y}{(dx)^2} = -2 \frac{x^2-3}{(x^2+3)^2}$
13. $y = \ln x^2(x^3 + 4)$
 $\frac{dy}{dx} = \frac{2x(x^3+4) + 3x^4}{x^2(x^3+4)}$ $\frac{d^2y}{(dx)^2} = -\frac{1}{x^2} \frac{5x^6 - 8x^3 + 32}{(x^3+4)^2}$