

Answer each question to the best of your ability. Show all work clearly and in order, and circle your final answers. Final answers MUST be supported in order to receive credit. Good luck!

1.  $y = 5x^3 - 3x^2 + e^2$

$$y' = 15x^2 - 6x$$

2.  $y = \sin^2(3x + 4x^2)$

$$\begin{aligned} y' &= 2\sin(3x+4x^2) \cdot \frac{d}{dx}(\sin(3x+4x^2)) \\ &= 2\sin(3x+4x^2) \cdot \cos(3x+4x^2) \cdot \frac{d}{dx}(3x+4x^2) \\ &= 2\sin(3x+4x^2)\cos(3x+4x^2)(3+8x) \end{aligned}$$

3.  $y = \ln\left(\frac{\sqrt{x^3+2x}}{4x^3}\right)$

$$\begin{aligned} y &= \ln\sqrt{x^3+2x} - \ln 4x^3 \\ y &= \frac{1}{2}\ln(x^3+2x) - \ln 4 - \ln x^3 \\ y &= \frac{1}{2}\ln(x^3+2x) - \ln 4 - 3\ln x \end{aligned}$$

$$\begin{aligned} y' &= \frac{1}{2} \left( \frac{1}{x^3+2x} \right) \frac{d}{dx}(x^3+2x) - \frac{3}{x} \\ y' &= \frac{3x^2+2}{2(x^3+2x)} - \frac{3}{x} \end{aligned}$$

4.  $y = \frac{x^2 + 2x - 1}{3 - \sqrt{x}}$

$$\begin{aligned} y' &= \frac{(3-\sqrt{x}) \frac{d}{dx}(x^2+2x-1) - (x^2+2x-1) \frac{d}{dx}(3-\sqrt{x})}{(3-\sqrt{x})^2} \\ y' &= \frac{(3-\sqrt{x})(2x+2) - (x^2+2x-1)(-\frac{1}{2}x^{-1/2})}{(3-\sqrt{x})^2} \end{aligned}$$

5.  $y = (3x^2 + 4x - 1)^5$

$$\begin{aligned} y' &= 5(3x^2+4x-1)^4 \frac{d}{dx}(3x^2+4x-1) \\ y' &= 5(3x^2+4x-1)^4(6x+4) \end{aligned}$$

6.  $y = \sin(\tan(3x))$

$$y' = \cos(\tan(3x)) \cdot \frac{d}{dx}(\tan(3x))$$

$$y' = \cos(\tan(3x)) \cdot \sec^2(3x) \cdot \frac{d}{dx}(3x)$$

$$y' = 3 \cos(\tan(3x)) \cdot \sec^2(3x)$$

7.  $3xy = \sin 2y$

$$\frac{d}{dx}(3xy) = \frac{d}{dx}(\sin 2y)$$

$$3xy' + 3y = (\cos 2y)(2y')$$

$$3xy' - 2(\cos 2y)y' = -3y$$

$$y'(3x - 2\cos 2y) = -3y$$

$$y' = \frac{-3y}{3x - 2\cos 2y}$$

8.  $y = (3x - 2)^{2x}$

$$\ln y = \ln(3x - 2)^{2x}$$

$$\ln y = 2x \cdot \ln(3x - 2)$$

$$\frac{d}{dx}(\ln y) = \frac{d}{dx}(2x \ln(3x - 2))$$

$$\frac{y'}{y} = 2x \frac{d}{dx} \ln(3x - 2) + \ln(3x - 2) \frac{d}{dx}(2x)$$

$$\frac{y'}{y} = \frac{2x}{3x - 2} \cdot 3 + 2 \ln(3x - 2)$$

$$y' = (3x - 2)^{2x} \left( \frac{6x}{3x - 2} + 2 \ln(3x - 2) \right)$$

9.  $y = x^2 \sqrt{5 - x^2}$

$$y' = x^2 \frac{d}{dx}(\sqrt{5 - x^2}) + \sqrt{5 - x^2} \frac{d}{dx}(x^2)$$

$$y' = x^2 \cdot \frac{1}{2\sqrt{5 - x^2}} \cdot \frac{d}{dx}(5 - x^2) + 2x\sqrt{5 - x^2}$$

$$y' = \frac{-2x^3}{2\sqrt{5 - x^2}} + 2x\sqrt{5 - x^2}$$

10.  $y = \sqrt{x^3 \cos x}$

$$y' = \frac{1}{2\sqrt{x^3 \cos x}} \cdot \frac{d}{dx}(x^3 \cos x)$$

$$y' = \frac{1}{2\sqrt{x^3 \cos x}} (x^3 \cdot (-\sin x) + \cos x \cdot 3x^2)$$

$$y' = \frac{3x^2 \cos x - x^3 \sin x}{2\sqrt{x^3 \cos x}}$$