

Evaluate the following derivatives. You will have to make use of the chain rule, product rule, and quotient rule:

$$1. \frac{d}{dx} \sin 3x \quad \text{ans. } 3 \cos 3x$$

$$2. \frac{d}{dx} \ln \left(\frac{x}{2} \right) \quad \text{ans. } \frac{1}{x}$$

$$3. \frac{d}{dx} \ln \left(\frac{1}{x} \right) \quad \text{ans. } -\frac{1}{x}$$

$$4. \frac{d}{dx} \left(\frac{x}{\ln x} \right) \quad \text{ans. } \frac{\ln x - 1}{(\ln x)^2}$$

$$5. \frac{d}{dx} (3x^2 e^{-2x}) \quad \text{ans. } 6x e^{-2x} (1 - x)$$

$$6. \frac{d}{dx} \left(3x^3 - 2x + \frac{1}{2}x^{-1} \right) \quad \text{ans. } 9x^2 - 2 - \frac{1}{2}x^{-2}$$

$$7. \frac{d}{dx} [3 \sin (x^2)] \quad \text{ans. } 6x \cos (x^2)$$

$$8. \frac{d}{dx} (\sin x \cos x) \quad \text{ans. } \cos^2 x - \sin^2 x$$

$$9. \frac{d}{dx} (\sin^2 x \cos x) \quad \text{ans. } \sin x (2 \cos^2 x - \sin^2 x)$$

$$10. \frac{d}{dx} (e^{e^x}) \quad \text{ans. } e^{(x+e^x)}$$

$$11. \frac{d}{dx} [\ln (\sqrt{x})] \quad \text{ans. } \frac{1}{2x}$$

$$12. \frac{d}{dx} [\ln (2\sqrt{x})] \quad \text{ans. } \frac{1}{2x}$$

$$13. \frac{d}{dx} [\ln (\sqrt{2x})] \quad \text{ans. } \frac{1}{2x}$$

$$14. \frac{d}{dx} \left(\frac{\cos x}{\sin x} \right) \quad \text{ans. } -\frac{1}{\sin^2 x} = -\csc^2 x$$

$$15. \frac{d}{dx} [2e^{2x} \ln(x^2)] \quad \text{ans. } 4e^{2x} \left[\ln(x^2) + \frac{1}{x} \right]$$

Evaluate the following partial derivatives:

$$1. \frac{\partial}{\partial u} (uv^2) \quad \text{ans. } v^2$$

$$2. \frac{\partial}{\partial v} (uv^2) \quad \text{ans. } 2uv$$

$$3. \frac{\partial}{\partial u} [\sin^3(uv^2)] \quad \text{ans. } 3v^2 \sin^2(uv^2)$$

$$4. \frac{\partial}{\partial v} [\sin^3(uv^2)] \quad \text{ans. } 6uv \sin^2(uv^2)$$

$$5. \frac{\partial}{\partial u} (ue^{v^2} + e^{-1/u}) \quad \text{ans. } e^{v^2} + \frac{e^{-1/u}}{u^2}$$

$$6. \frac{\partial}{\partial v} (ue^{v^2} + e^{-1/u}) \quad \text{ans. } 2uv e^{v^2}$$

$$7. \frac{\partial}{\partial u} \left[\sin(3uv) \{ \exp[u(u + \ln v^2)] \}^4 \right] \quad \text{ans. } [3v \cos(3uv) + 4(2u + \ln v^2) \sin(3uv)] \exp(4u^2 + 4u \ln v^2)$$

$$8. \frac{\partial}{\partial v} \left[\sin(3uv) \{ \exp[u(u + \ln v^2)] \}^4 \right] \quad \text{ans. } \left[3u \cos(3uv) + \frac{8u}{v} \sin(3uv) \right] \exp(4u^2 + 4u \ln v^2)$$

Evaluate the following integrals:

$$1. \int_1^3 3x^2 dx \quad \text{ans. } 26$$

$$2. \int_1^3 (3x^2 - 4x) dx \quad \text{ans. } 10$$

$$3. \int_0^b \left(-\frac{1}{2}e^x \right) dx \quad \text{ans. } \frac{1}{2}(1 - e^b)$$

$$4. \int_1^2 \frac{1}{x} dx \quad \text{ans. } \ln(2)$$

5. $\int_{-\pi/4}^{\pi/2} \sin x \, dx$ ans. $\frac{1}{\sqrt{2}}$

6. $\int_{\pi/3}^{3\pi/4} \cos x \, dx$ ans. $\frac{\sqrt{2} - \sqrt{3}}{2}$

7. Given that $\frac{d}{dx} \left(\frac{x}{\ln x} \right) = \frac{\ln x - 1}{(\ln x)^2}$, use the fundamental theorem of calculus to evaluate $\int_2^5 \frac{\ln x - 1}{(\ln x)^2} \, dx$.
ans. $\frac{5 \ln 2 - 2 \ln 5}{(\ln 5)(\ln 2)}$