

Learning outcomes

After completing this section, you will inshaAllah be able to

1. find derivatives of expressions involving $\ln u$
2. find derivatives of expressions involving $\log_b u$
3. explain what is logarithmic differentiation
4. find derivatives using method of logarithmic differentiation
5. differentiate functions of the form u^v

Recall the following properties

which are needed for this section

- $\ln(xy) = \ln x + \ln y$
- $\ln\left(\frac{x}{y}\right) = \ln x - \ln y$
- $\ln(x^r) = r \ln x$

Derivatives of functions involving $\ln u$ **Differentiation formula for $\ln u$**

$$\frac{d(\ln u)}{du} = \frac{1}{u} \cdot \frac{du}{dx}$$

Derivatives of functions involving $\log_b u$ **Differentiation formula for $\log_b u$**

$$\frac{d(\log_b u)}{du} = \frac{1}{\ln b} \left(\frac{1}{u} \cdot \frac{du}{dx} \right)$$

How?

$$\text{Using } \log_b u = \frac{\ln u}{\ln b}$$

See examples 1, 2, 3, 4, 5 done in class

How to perform logarithmic differentiation of $f(x)$?

Suitable when $f(x)$ involves
products, quotients or powers

Main idea

- Simplify before differentiating

How?

- Aim: To differentiate $y=f(x)$ (1)
- If $f(x)$ involves products, quotients or powers then
 - take 'ln' on both sides of (1)
 - simplify using properties of 'ln'
 - differentiate after simplification

- We learn more with the help of example.

See example 6 done in class

Important application of logarithmic differentiation

Differentiating functions of the form
 u^v where both u and v are functions of x

See examples 7, 8 done in class