

## Important Ideas - Differentiation (1 page; 22/10/20)

$$(1) \frac{d}{dx}(a^x)$$

Proof that  $\frac{d}{dx}(a^x) = \ln a \cdot a^x$  (for  $a > 0$ )

### Method 1

Let  $a = e^b$

$$\text{Then } \frac{d}{dx}(a^x) = \frac{d}{dx}(e^{bx}) = be^{bx} = \ln a \cdot a^x$$

### Method 2

Consider  $y = a^x$

Then  $\ln y = x \ln a$ ,

$$\text{and } \frac{d}{dx}(\ln y) = \ln a,$$

$$\text{so that } \frac{d}{dy}(\ln y) \cdot \frac{dy}{dx} = \ln a$$

$$\text{and } \frac{dy}{dx} = \frac{\ln a}{\left(\frac{1}{y}\right)} = \ln a \cdot a^x$$