

A differentiation trick

$$\frac{d x^a}{d a} = x^a \log x \quad \text{--- (1)}$$

$$\Rightarrow \left. \frac{d x^a}{d a} \right|_{a=0} = x^0 \log x = \log x$$

$$\Rightarrow \boxed{\left. \frac{d x^a}{d a} \right|_{a=0} = \log x}$$

$$(1) \Rightarrow \frac{d^2 x^a}{d a^2} = \frac{d x^a}{d a} \log x = x^a (\log x)^2$$

$$\Rightarrow \left. \frac{d^2 x^a}{d a^2} \right|_{a=0} = x^0 (\log x)^2 = (\log x)^2$$

$$\Rightarrow \boxed{\left. \frac{d^2 x^a}{d a^2} \right|_{a=0} = (\log x)^2}$$

In general,

$$\boxed{\left. \frac{d^n x^a}{d a^n} \right|_{a=0} = (\log x)^n}$$