

$$\begin{aligned} \Rightarrow \ln e^{x \ln x} &\geq \ln e^{x-1} \\ \Rightarrow x \ln x &\geq x-1 \\ \Rightarrow \underbrace{x \ln x - x + 1}_{= f(x)} &\geq 0 \end{aligned}$$

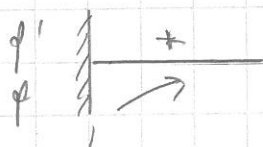
$$a < b \quad | \ln$$

$$\Rightarrow \ln a < \ln b$$

$\ln x$  on aidosti kasvava  
 $\rightarrow$  järjestys säilyy

$$f'(x) = 1 \cdot \ln x + x \cdot \frac{1}{x} - 1 = \ln x + 1 - 1 = \ln x = 0 \quad | e^{(\cdot)}$$

$$\Rightarrow e^{\ln x} = e^0 \quad \Rightarrow x = 1$$



$$f'(e) = \ln e = 1 > 0$$

$$\text{pienin arvo: } f(1) = |\ln 1| - 1 + 1 = \ln 1 = 0$$

$$\Rightarrow f(x) \geq 0 \text{ aina kun } x \geq 1 \quad \Rightarrow \text{väite}$$

$$= \text{pätee kun } x = 1$$

## 24. Sovellustehtäviä esp. j. log. funktioista

24.2 alusse (tolkullinen) sopeutuminen:

$$33 \text{ cl} \cdot 32 \frac{\text{mg}}{100 \text{ ml}} = 33 \cdot 0,01 \cdot 32 \frac{\text{mg}}{100 \cdot 0,001} = 105,6 \text{ mg}$$

$$\text{alussa: } 105,6 \text{ mg}$$

$$1 \text{ h:n kuluttua: } x \cdot 105,6 \text{ mg}$$

$$2 \text{ — — — — — : } x^2 \cdot 105,6 \text{ mg}$$

$$3 \text{ — — — — — : } x^3 \cdot 105,6 \text{ mg}$$

$$6 \text{ — — — — — : } x^6 \cdot 105,6 \text{ mg} = \frac{1}{2} \cdot 105,6 \text{ mg} \quad | : 105,6 \text{ mg}$$

$$\Rightarrow x^6 = \frac{1}{2} \quad | \sqrt[6]{\phantom{x}} \quad \Rightarrow x = \sqrt[6]{\frac{1}{2}} \quad (\approx 0,8909)$$

$$a) \text{ t h:n kuluttua: } f(t) = \left( \sqrt[6]{\frac{1}{2}} \right)^t \cdot 105,6 \text{ mg}$$

$$b) f'(t) = 105,6 \cdot \left( \sqrt[6]{\frac{1}{2}} \right)^t \cdot \ln \sqrt[6]{\frac{1}{2}} \frac{\text{mg}}{\text{h}}$$

$$\text{klo 23.30: } f'(4) = -7,685 \frac{\text{mg}}{\text{h}}$$

$$\Rightarrow \text{pienennee nopeudella: } 7,7 \frac{\text{mg}}{\text{h}}$$

$$\sqrt{Dx^3} = 3x^2$$

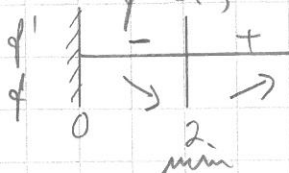
$$D3^x = 3^x \ln 3$$

24.5 janan pituus:

$$f(x) = (x - \ln x) - \ln x = x - 2 \ln x$$

$f$  j. j. deriiv. kun  $x > 0$

$$f'(x) = 1 - 2 \cdot \frac{1}{x} = 0 \quad | \cdot x \quad \Rightarrow x - 2 = 0 \quad \Rightarrow x = 2$$



$$f'(1) = -1 < 0, \quad f'(3) = \frac{1}{3} > 0$$

$$\text{pienin arvo: } f(2) = 2 - 2 \ln 2 \quad (\approx 0,61)$$