

## Wepierin luku e

- on päättymätön desimaaliluku  $e = 2,718\dots$
- eksponenttifunktion  $e^x$  derivaatan <sup>arvo</sup> kohdassa 0 on 1

$$\Rightarrow \boxed{D e^x = e^x}$$

Esim. Ratkaisu a)  $e^x = 3$

$$b) 5e^{4x} = 200 \quad || :5$$

$$e^{4x} = 40 \quad || \ln$$

$$4x = \ln 40 \quad || :4$$

$$\Leftrightarrow x = \frac{\ln 40}{4} \quad (\approx 0,92)$$

$$\boxed{a^x = y \Leftrightarrow x = \log_a y}$$

$$\boxed{e^x = y \Leftrightarrow x = \ln y} \quad (\log_e = \ln)$$

$a^x$ : m derivatla:

$$a = e^{\ln a}$$

$$D a^x = D(e^{\ln a})^x = D e^{(\ln a) \cdot x} = \underbrace{e^{(\ln a) \cdot x}}_{a^x} \cdot \ln a = \ln a \cdot a^x$$

yhdistetty funktio:

$$g(x) = e^x, f(x) = (\ln a) \cdot x$$

$$g'(x) = e^x, f'(x) = \ln a$$

$$\text{Esimä} D e^{5x} = e^{5x} \cdot 5 = \underline{\underline{5e^{5x}}}$$

$$\begin{aligned} M D 3e^{x^2-2x} &= 3(e^{x^2-2x} \cdot (2x-2)) \\ &= (6x-6)e^{x^2-2x} \\ &= \underline{\underline{6(x-1)e^{x^2-2x}}} \end{aligned}$$

$$\boxed{D a^x = a^x \cdot \ln a}$$

$$c) D 2^x = \underline{\underline{2^x \cdot \ln 2}}$$

$$\boxed{D e^{f(x)} = e^{f(x)} \cdot f'(x)}$$

21.8 Määritä funktion  $f$  derivaattafunktion nollakohdat.



a)  $f(x) = 2x - e^{3x}$       b)  $f(x) = x^2 e^{2x}$

a)  $y'(x) = 2 - e^{3x} \cdot 3$       a · b

nollakohdat:  $2 - 3e^{3x} = 0$

$$-3e^{3x} = -2 \quad || : (-3)$$

$$e^{3x} = \frac{2}{3} \quad || \ln$$

$$3x = \ln \frac{2}{3} \quad || : 3$$

$$x = \frac{\ln \frac{2}{3}}{3}$$

b)  $f'(x) = 2x e^{2x} + x^2 e^{2x} \cdot 2$   
 $a' \cdot b + a \cdot b'$

$$= e^{2x} (2x + 2x^2)$$

$$= 2e^{2x} (x + x^2)$$

nollakohdat:  $x + x^2 = 0$

$$x(1+x) = 0$$

$$\underline{x=0} \vee \underline{1+x=0}$$

$$\underline{\underline{x=-1}}$$