```
> dsolve(D*diff(diff(C(x),x),x)-k*C(x));
```

$$C(x) = \_C1\, e^{\left(\frac{\sqrt{k}\, x}{\sqrt{D}}\right)} + \_C2\, e^{\left(-\frac{\sqrt{k}\, x}{\sqrt{D}}\right)}$$

```
> C(x) := simplify((C1-Cb)*exp(alpha*x/L_tau)+(Cb)*exp(-  alpha*x/L_tau ));
```

$$C(x) := -\frac{e^{\left(-\frac{\alpha\,(-x+L)}{L\_tau}\right)} C1 - e^{\left(\frac{\alpha\, x}{L\_tau}\right)} C2 - e^{\left(\frac{\alpha\,(-x+L)}{L\_tau}\right)} C1 + e^{\left(-\frac{\alpha\, x}{L\_tau}\right)} C2}{e^{\left(\frac{\alpha\, L}{L\_tau}\right)} - e^{\left(-\frac{\alpha\, L}{L\_tau}\right)}}$$

```
> Cb := simplify(solve((subs(x=L,C(x)))=C2,Cb));
```

$$Cb := \frac{e^{\left(\frac{\alpha\, L}{L\_tau}\right)} C1 - C2}{e^{\left(\frac{\alpha\, L}{L\_tau}\right)} - e^{\left(-\frac{\alpha\, L}{L\_tau}\right)}}$$

```
> clear;
```

clear

```
> dCdx := simplify(diff(C(x),x));
```

$$dCdx := -\frac{\alpha \left(e^{\left(-\frac{\alpha\,(-x+L)}{L\_tau}\right)} C1 - e^{\left(\frac{\alpha\, x}{L\_tau}\right)} C2 + e^{\left(\frac{\alpha\,(-x+L)}{L\_tau}\right)} C1 - e^{\left(-\frac{\alpha\, x}{L\_tau}\right)} C2\right)}{L\_tau \left(e^{\left(\frac{\alpha\, L}{L\_tau}\right)} - e^{\left(-\frac{\alpha\, L}{L\_tau}\right)}\right)}$$

```
> dCdx_L := simplify(subs(x=L,dCdx)/((C2-C1)/L));
```

$$dCdx\_L := \frac{\alpha \left(2\, C1 - e^{\left(\frac{\alpha\, L}{L\_tau}\right)} C2 - e^{\left(-\frac{\alpha\, L}{L\_tau}\right)} C2\right) L}{L\_tau \left(e^{\left(\frac{\alpha\, L}{L\_tau}\right)} - e^{\left(-\frac{\alpha\, L}{L\_tau}\right)}\right)(-C2 + C1)}$$

```
> dCdx_L := beta*(2*C1-exp(beta)*C2-exp(-beta)*C2)/((exp(beta)-exp(-beta))
  *(-C2+C1));
```

$$dCdx\_L := \frac{\beta \left(2\, C1 - e^{\beta}\, C2 - e^{(-\beta)}\, C2 \right)}{\left(e^{\beta} - e^{(-\beta)} \right) (-C2 + C1)}$$

```
> solve(dCdx_L,beta);
```

$$\ln\left(\frac{2\, C1 + 2\sqrt{C1^2 - C2^2}}{2\, C2} \right), \ln\left(\frac{2\, C1 - 2\sqrt{C1^2 - C2^2}}{2\, C2} \right)$$

```
> beta_max := simplify(ln(1/2*(2*C1+2*(C1^2-C2^2)^(1/2))/C2));
```

$$beta\_max := \ln\left(\frac{C1 + \sqrt{C1^2 - C2^2}}{C2} \right)$$

```
> simplify(subs(C1 = Cratio * C2, beta_max));
```

$$\ln\left(\frac{Cratio\ C2 + \sqrt{C2^2 (Cratio^2 - 1)}}{C2} \right)$$

```
> simplify(dsolve(Ndot/V - (K)*C(t) - diff(C(t),t)));
```

$$C(t) = \frac{Ndot + e^{(-K\, t)}\, \_C1\ V\, K}{V\, K}$$

```
> Ndot/V - (K2 + K1)*C(t) - diff(C(t),t)
Warning, inserted missing semicolon at end of statement, ... diff(C(t),t);
```

$$\frac{Ndot}{V} - (K2 + K1) \left(\frac{Ndot}{V} - (K2 + K1)\, C2 \right)$$

```
> diff((Ndot+exp(-K*t)*(C2-Ndot/(V*(K)))*V*K)/(V*K),t);
```

$$-K\, e^{(-K\, t)} \left(C2 - \frac{Ndot}{V\, K} \right)$$

```
>
```