> *restart*

> *with*(*inttrans*) :

> $u := \text{Heaviside}(t-3)$

$$u := \text{Heaviside}(t-3) \tag{1}$$

> $plot(u, t=-2..10, y=-1..3)$
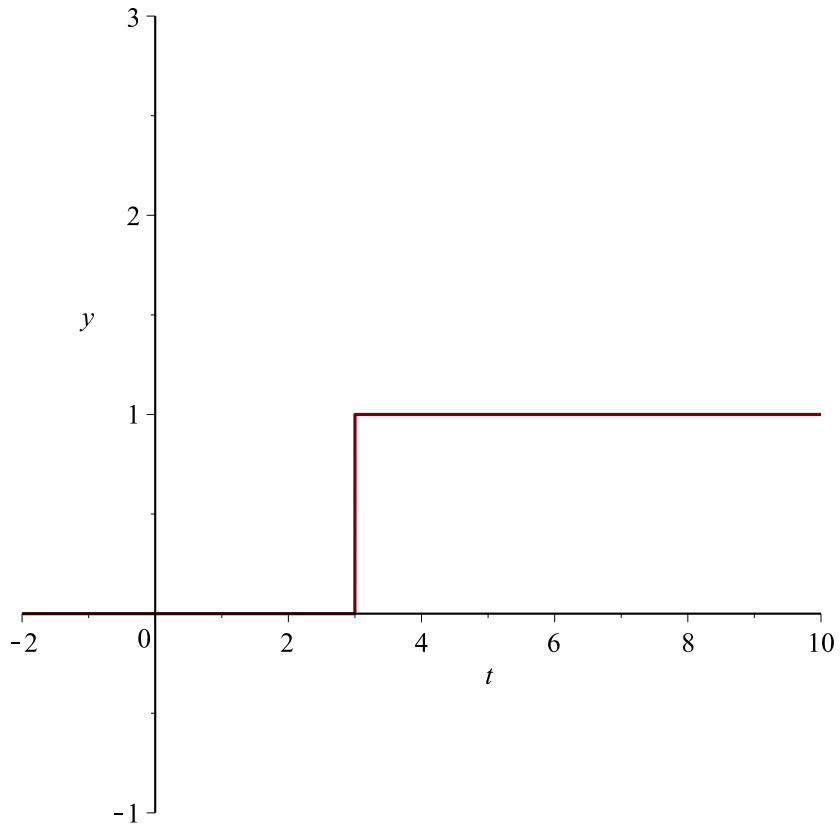
> $U := laplace(u, t, s)$

$$U := \frac{e^{-3s}}{s} \tag{2}$$

> $r := (t-3) \cdot \text{Heaviside}(t-3)$

$$r := (t-3)\,\text{Heaviside}(t-3) \tag{3}$$

> $plot(r, t=-2..10, y=-1..10)$
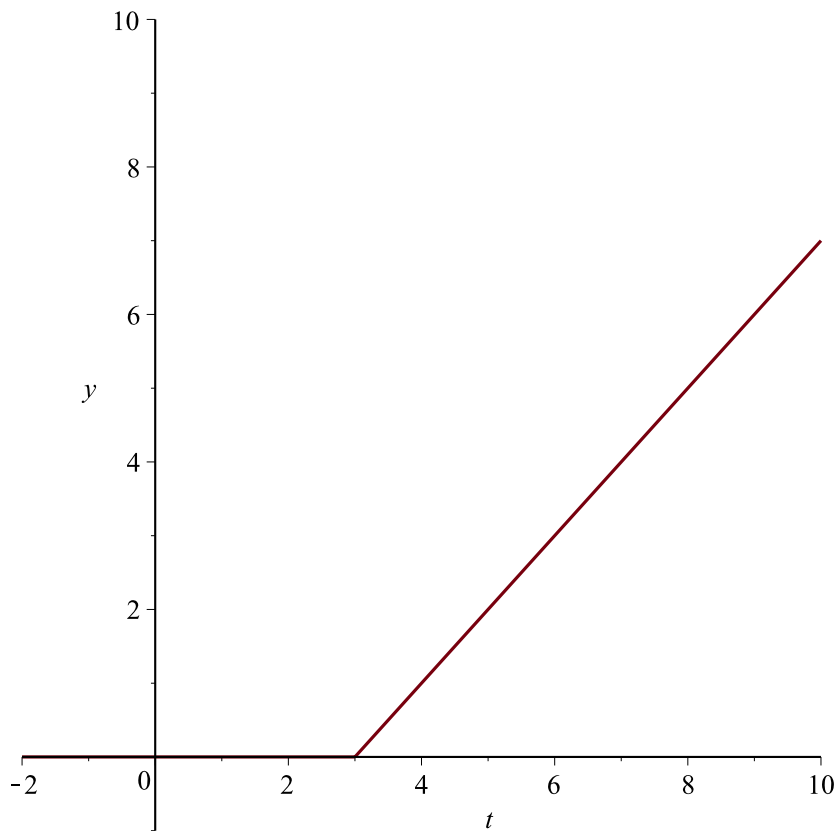
$>\ R := laplace(r, t, s)$

$$R := \frac{e^{-3s}}{s^2} \qquad\qquad (4)$$

$>\ h := \mathrm{Heaviside}(t-1) - \mathrm{Heaviside}(t-2) - \mathrm{Heaviside}(t-3) + \mathrm{Heaviside}(t-4)$
$\qquad + \mathrm{Heaviside}(t-5) - \mathrm{Heaviside}(t-6) - \mathrm{Heaviside}(t-7) + \mathrm{Heaviside}(t-8); plot(h, t = -2 ..10, y = -3 ..3)$

$h := \mathrm{Heaviside}(t-1) - \mathrm{Heaviside}(t-2) - \mathrm{Heaviside}(t-3) + \mathrm{Heaviside}(t-4)$
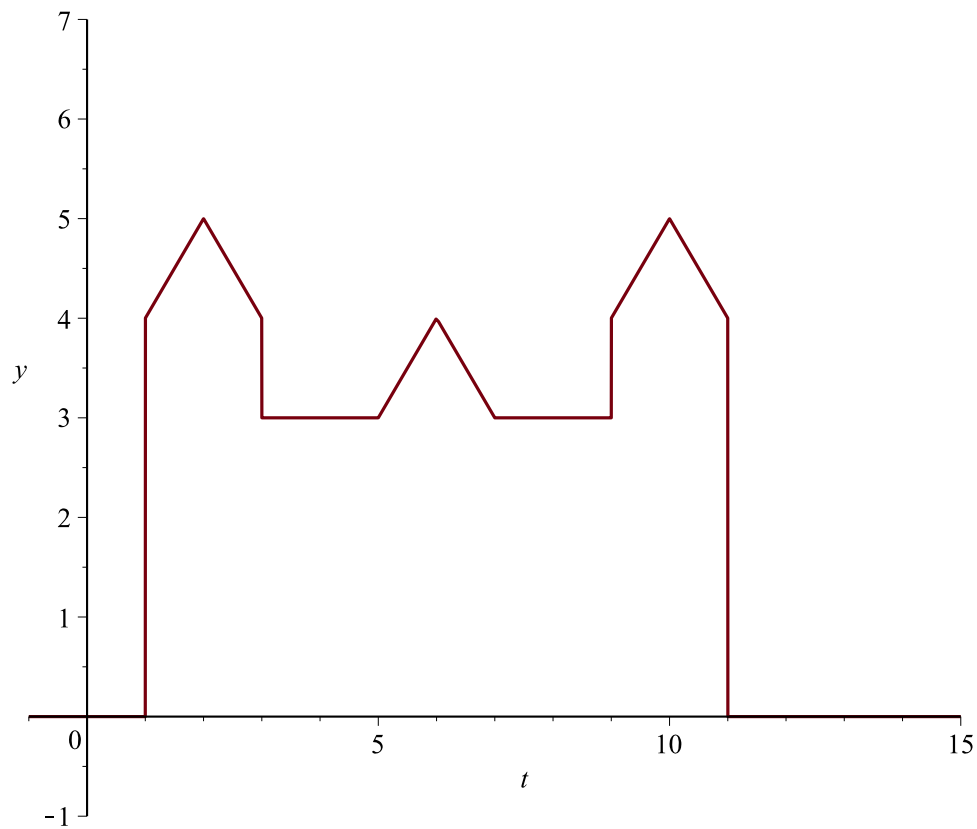$\qquad + \mathrm{Heaviside}(t-5) - \mathrm{Heaviside}(t-6) - \mathrm{Heaviside}(t-7) + \mathrm{Heaviside}(t-8)$
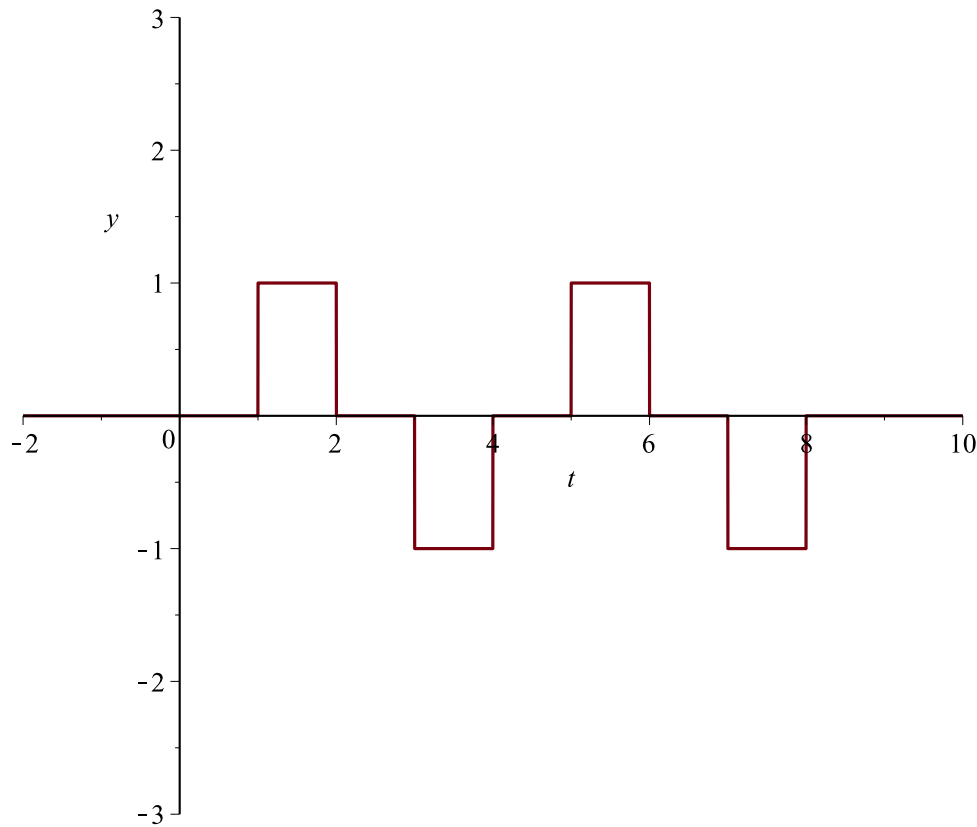
> $H := laplace(h, t, s)$

$$H := \frac{e^{-s} - e^{-2s} - e^{-3s} + e^{-4s} + e^{-5s} - e^{-6s} - e^{-7s} + e^{-8s}}{s}$$ **(5)**

> $castillo := 4 \cdot \text{Heaviside}(t-1) + (t-1) \cdot \text{Heaviside}(t-1) - 2 \cdot (t-2) \cdot \text{Heaviside}(t-2) + (t-3) \cdot \text{Heaviside}(t-3) - \text{Heaviside}(t-3) + (t-5) \cdot \text{Heaviside}(t-5) - 2 \cdot (t-6) \cdot \text{Heaviside}(t-6) + (t-7) \cdot \text{Heaviside}(t-7) + \text{Heaviside}(t-9) + (t-9) \cdot \text{Heaviside}(t-9) - 2 \cdot (t-10) \cdot \text{Heaviside}(t-10) + (t-11) \cdot \text{Heaviside}(t-11) - 4 \cdot \text{Heaviside}(t-11); plot(castillo, t=-1..15, y=-1..7)$

$castillo := 4\,\text{Heaviside}(t-1) + (t-1)\,\text{Heaviside}(t-1) - 2\,(t-2)\,\text{Heaviside}(t-2) + (t-3)\,\text{Heaviside}(t-3) - \text{Heaviside}(t-3) + (t-5)\,\text{Heaviside}(t-5) - 2\,(t-6)\,\text{Heaviside}(t-6) + (t-7)\,\text{Heaviside}(t-7) + \text{Heaviside}(t-9) + (t-9)\,\text{Heaviside}(t-9) - 2\,(t-10)\,\text{Heaviside}(t-10) + (t-11)\,\text{Heaviside}(t-11) - 4\,\text{Heaviside}(t-11)$

```
> 
> CASTILLO := laplace(castillo, t, s)
```

$$CASTILLO := \frac{e^{-s} + e^{-11\,s} - 2\,e^{-10\,s} + e^{-9\,s} + e^{-7\,s} - 2\,e^{-6\,s} + e^{-5\,s} + e^{-3\,s} - 2\,e^{-2\,s}}{s^2}$$

$$+ \frac{4\,e^{-s} - 4\,e^{-11\,s} + e^{-9\,s} - e^{-3\,s}}{s}$$

(6)

```
> F := exp(-2·s)·s / (s^2 + 2·s + 2)
```

$$F := \frac{e^{-2\,s}\,s}{s^2 + 2\,s + 2}$$

(7)

```
> f := invlaplace(F, s, t)
```

$$f := \text{Heaviside}(t - 2)\,e^{-t + 2}\,(\cos(t - 2) - \sin(t - 2))$$

(8)

```
> g := exp(a·t)·cos(b·t)
```

$$g := e^{a\,t}\cos(b\,t)$$

(9)

```
> G := laplace(g, t, s)
```

(10)

$$G := \frac{s-a}{(s-a)^2 + b^2} \tag{10}$$

> $h := \exp(a \cdot t) \cdot \sin(b \cdot t)$

$$h := e^{at} \sin(b\,t) \tag{11}$$

> $H := laplace(h, t, s)$

$$H := \frac{b}{(s-a)^2 + b^2} \tag{12}$$

> $restart$

> $Ecuacion := diff(y(t), t\$2) - 9 \cdot diff(y(t), t) + 20 \cdot y(t) = 2 \cdot \exp(3 \cdot t) \cdot \cos(4 \cdot t)$

$$Ecuacion := \frac{d^2}{dt^2} y(t) - 9 \left(\frac{d}{dt} y(t) \right) + 20\,y(t) = 2\,e^{3t} \cos(4\,t) \tag{13}$$

> $Cond := y(0) = 5, \mathrm{D}(y)(0) = -2$

$$Cond := y(0) = 5, \mathrm{D}(y)(0) = -2 \tag{14}$$

> $with(inttrans):$

> $EcuaTL := subs(Cond, laplace(Ecuacion, t, s))$

$$EcuaTL := s^2\,laplace(y(t), t, s) + 47 - 5\,s - 9\,s\,laplace(y(t), t, s) + 20\,laplace(y(t), t, s)$$
$$= \frac{2\,(s-3)}{(s-3)^2 + 16} \tag{15}$$

> $SolTL := isolate(EcuaTL, laplace(y(t), t, s))$

$$SolTL := laplace(y(t), t, s) = \frac{\dfrac{2\,(s-3)}{(s-3)^2 + 16} + 5\,s - 47}{s^2 - 9\,s + 20} \tag{16}$$

> $SolPart := invlaplace(SolTL, s, t)$

$$SolPart := y(t) = \frac{457}{17}\,e^{4t} - \frac{109}{5}\,e^{5t} - \frac{1}{85}\,e^{3t}\,(7 \cos(4\,t) + 6 \sin(4\,t)) \tag{17}$$

> $plot([rhs(SolPart), rhs(diff(SolPart, t))], t = 0..0.3, y = -50..10)$