**>** *restart*

Slope function

> $r(t-5) := (t-5) \cdot \text{Heaviside}(t-5)$

$$r(t-5) := (t-5) \, \text{Heaviside}(t-5) \tag{1}$$
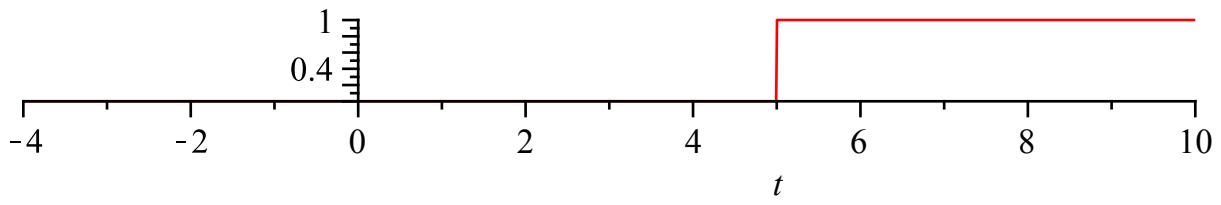
> $plot(r(t-5), t=-4..10, scaling=CONSTRAINED)$
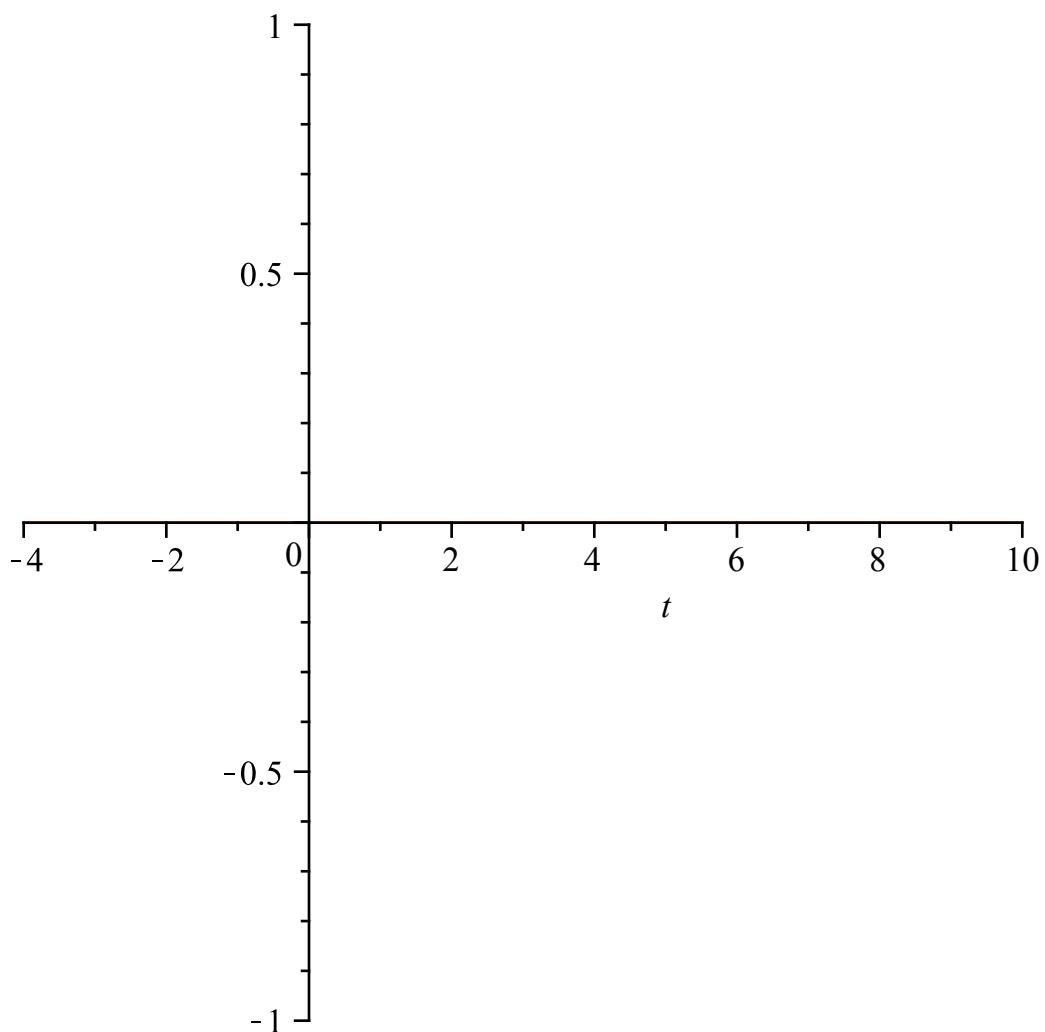
> $DerSlope := diff(r(t-5), t)$

$$DerSlope := \text{Heaviside}(t-5) + (t-5) \, \text{Dirac}(t-5) \tag{2}$$

> $plot(DerSlope, t=-4..10, scaling=CONSTRAINED)$

> $DerStep := diff\left(\text{Heaviside}(t-5), t\right)$
$$DerStep := \text{Dirac}(t-5) \tag{3}$$
> $plot\left(DerStep, t = -4..10\right)$
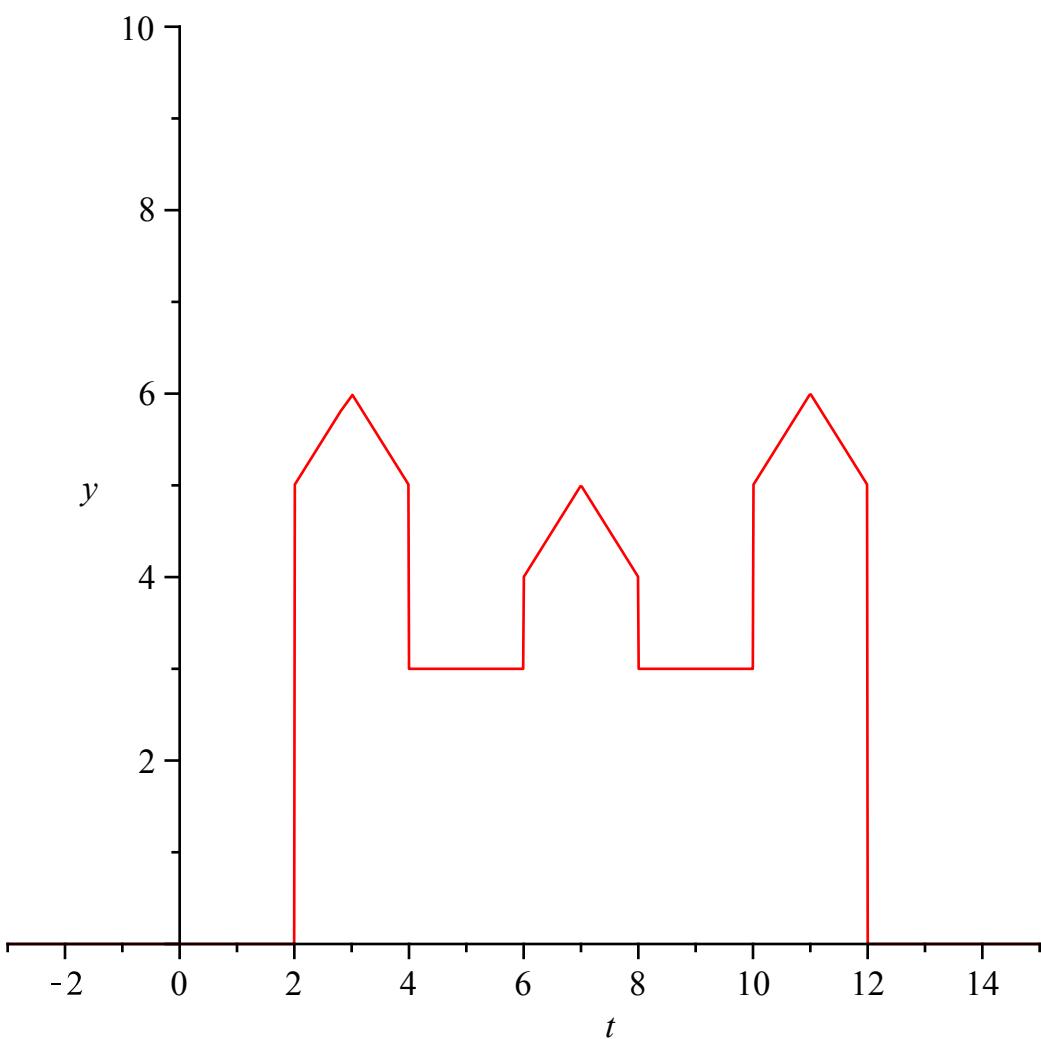
> $Areas := int(\mathrm{Dirac}(t-5), t = -infinity..infinity)$

$$Areas := 1$$ **(4)**

> $restart$

> $Castle := 5 \cdot \mathrm{Heaviside}(t-2) + (t-2) \cdot \mathrm{Heaviside}(t-2) - 2 \cdot (t-3) \cdot \mathrm{Heaviside}(t-3) + (t-4) \cdot \mathrm{Heaviside}(t-4) - 2 \cdot \mathrm{Heaviside}(t-4) + \mathrm{Heaviside}(t-6) + (t-6) \cdot \mathrm{Heaviside}(t-6) - 2 \cdot (t-7) \cdot \mathrm{Heaviside}(t-7) + (t-8) \cdot \mathrm{Heaviside}(t-8) - \mathrm{Heaviside}(t-8) + 2 \cdot \mathrm{Heaviside}(t-10) + (t-10) \cdot \mathrm{Heaviside}(t-10) - 2 \cdot (t-11) \cdot \mathrm{Heaviside}(t-11) + (t-12) \cdot \mathrm{Heaviside}(t-12) - 5 \cdot \mathrm{Heaviside}(t-12) : plot(Castle, t = -3..15, y = 0..10)$

```
> with(inttrans) :
> CASTLE := laplace(Castle, t, s)
```

$$CASTLE := \frac{e^{-2s} + e^{-12s} - 2\,e^{-11s} + e^{-10s} + e^{-8s} - 2\,e^{-7s} + e^{-6s} + e^{-4s} - 2\,e^{-3s}}{s^2} \qquad \textbf{(5)}$$
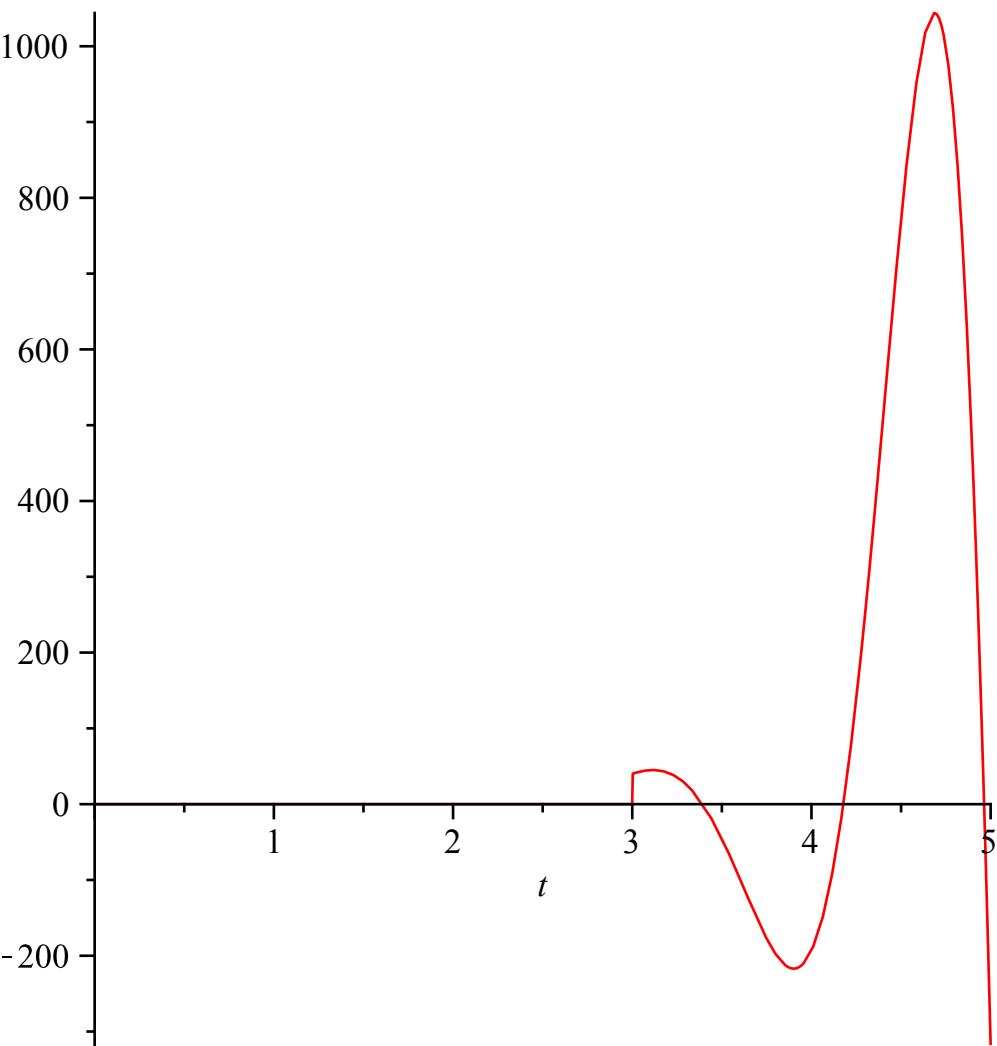
$$+ \frac{5\,e^{-2s} - 5\,e^{-12s} + 2\,e^{-10s} - e^{-8s} + e^{-6s} - 2\,e^{-4s}}{s}$$

```
> restart
> Q := 40·Heaviside(t − 3)·exp(2·( t − 3))·cos(4·( t − 3))
```

$$Q := 40\,\text{Heaviside}(t - 3)\,e^{2t-6}\cos(4t - 12) \qquad \textbf{(6)}$$

```
> plot(Q, t = 0 ..5)
```

> $Equa := diff(y(t), t\$2) + diff(y(t), t) + y(t) = Q$

$$Equa := \frac{d^2}{dt^2}\,y(t) + \frac{d}{dt}\,y(t) + y(t) = 40\,\text{Heaviside}(t-3)\,e^{2t-6}\cos(4t-12)$$ **(7)**

> $InitCond := y(0) = 7, D(y)(0) = \text{-}4$

$$InitCond := y(0) = 7, D(y)(0) = -4$$ **(8)**
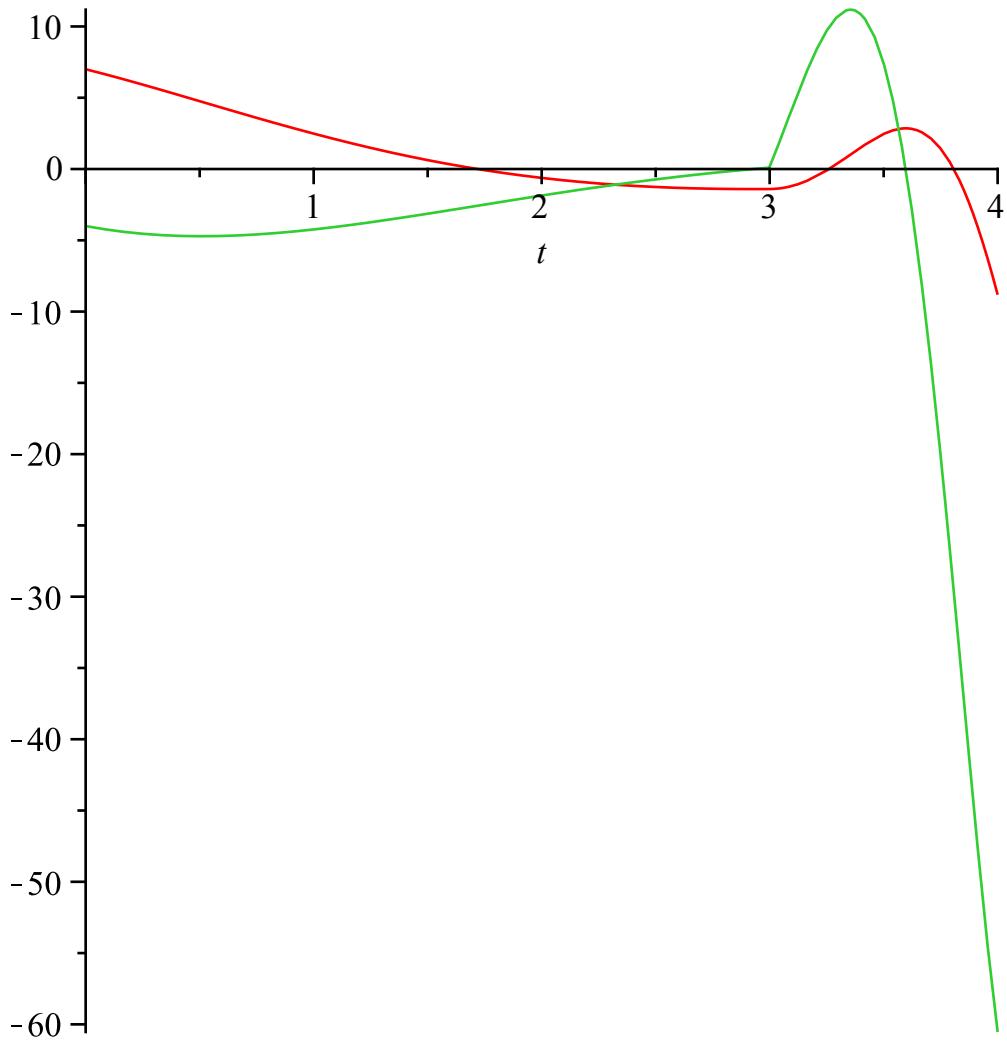
> $with(inttrans):$

> $LapTransEqua := subs(InitCond, laplace(Equa, t, s))$

$$LapTransEqua := s^2\,laplace(y(t), t, s) - 3 - 7s + s\,laplace(y(t), t, s) + laplace(y(t), t, s)$$ **(9)**

$$= \frac{40\,e^{-3s}\,(s-2)}{(s-2-4\,\mathrm{I})\,(s-2+4\,\mathrm{I})}$$

> $LapTransSol := simplify(isolate(LapTransEqua, laplace(y(t), t, s)))$

$$LapTransSol := laplace(y(t), t, s) = -\frac{40\,e^{-3s}\,s - 80\,e^{-3s} - 25\,s^2 + 128\,s + 60 + 7\,s^3}{(-s+2+4\,\mathrm{I})\,(s-2+4\,\mathrm{I})\,(s^2+s+1)}$$ **(10)**

> $PartSolution := simplify(invlaplace(LapTransSol, s, t))$

$$PartSolution := y(t) = \frac{360}{481}\,\text{Heaviside}(t-3)\,e^{-\frac{1}{2}t + \frac{3}{2}}\cos\left(\frac{1}{2}\,\sqrt{3}\,(t-3)\right)$$ **(11)**

$$-\frac{4600}{1443}\,\mathrm{Heaviside}(t-3)\,e^{-\frac{1}{2}t+\frac{3}{2}}\sqrt{3}\,\sin\left(\frac{1}{2}\,\sqrt{3}\,(t-3)\right)+7\,e^{-\frac{1}{2}t}\cos\left(\frac{1}{2}\,\sqrt{3}\,t\right)$$

$$-\frac{1}{3}\,e^{-\frac{1}{2}t}\sqrt{3}\,\sin\left(\frac{1}{2}\,\sqrt{3}\,t\right)+\frac{800}{481}\,e^{2t-6}\sin(4t-12)\,\mathrm{Heaviside}(t-3)$$

$$-\frac{360}{481}\,\mathrm{Heaviside}(t-3)\,e^{2t-6}\cos(4t-12)$$

> `plot([rhs(PartSolution), rhs(diff(PartSolution, t))], t = 0 ..4)`

>