> `restart`

> $Int(\cos(4(t-\text{tau}))\cdot\sin(4\,\text{tau}), \text{tau}=0..t) = int(\cos(4(t-\text{tau}))\cdot\sin(4\,\text{tau}), \text{tau}=0..t)$

$$\int_0^t \cos(4t-4\tau)\,\sin(4\tau)\,d\tau = \frac{1}{2}\,\sin(4t)\,t \tag{1}$$

> $Int(\sin(4(t-\text{tau}))\cdot\cos(4\,\text{tau}), \text{tau}=0..t) = int(\sin(4(t-\text{tau}))\cdot\cos(4\,\text{tau}), \text{tau}=0..t)$

$$\int_0^t \sin(4t-4\tau)\,\cos(4\tau)\,d\tau = \frac{1}{2}\,\sin(4t)\,t \tag{2}$$

> `with(inttrans) :`

> $H(s) := \dfrac{s}{(s\cdot\cdot2 + 4\cdot\cdot2)\cdot\cdot2}$

$$H(s) := \frac{s}{\left(s^2 + 16\right)^2} \tag{3}$$

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

$$h(t) := \frac{1}{8}\,\sin(4t)\,t \tag{4}$$

> $laplace(\text{Dirac}(t-5), t, s)$

$$e^{-5s} \tag{5}$$

> $laplace(\text{Heaviside}(t-5), t, s)$

$$\frac{e^{-5s}}{s} \tag{6}$$

> $laplace((t-5)\cdot\text{Heaviside}(t-5), t, s)$

$$\frac{e^{-5s}}{s^2} \tag{7}$$

> `restart`

> $f(t) := 2\,\text{Heaviside}(t-1) + (t-1)\cdot\text{Heaviside}(t-1) - 2\cdot(t-3)\cdot\text{Heaviside}(t-3) + (t-5)\cdot\text{Heaviside}(t-5) - 4\cdot\text{Heaviside}(t-5) - (t-5)\cdot\text{Heaviside}(t-5) + 2\cdot(t-7)\cdot\text{Heaviside}(t-7) - (t-9)\cdot\text{Heaviside}(t-9) + 2\cdot\text{Heaviside}(t-9) : plot(f(t), t=0..15, y=-6..6)$
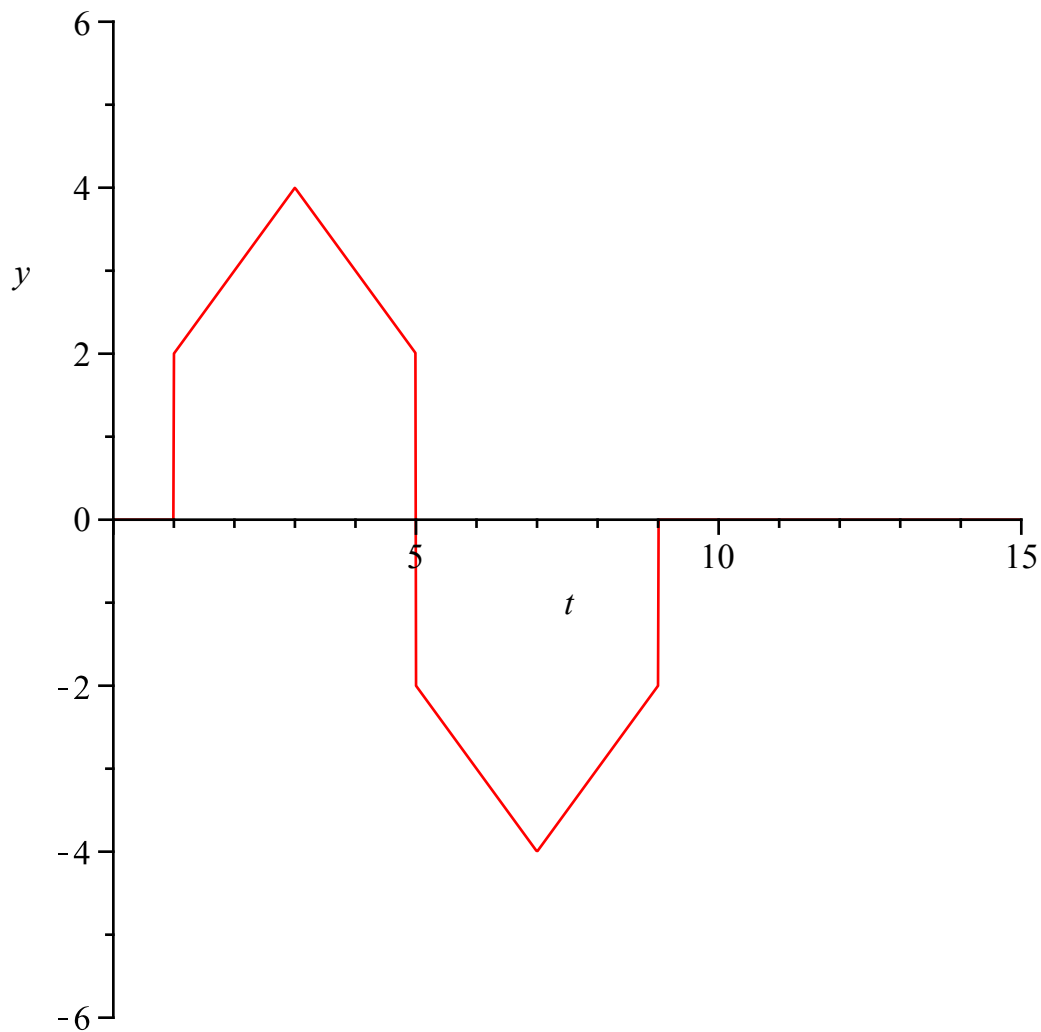
> $evalf(subs(t=2, f(t)))$

$$3. \tag{8}$$

> $evalf(subs(t=7, f(t)))$

$$-4. \tag{9}$$

> $with(inttrans):$
> $laplace(f(t), t, s)$

$$\frac{e^{-s} - e^{-9s} + 2\,e^{-7s} - 2\,e^{-3s}}{s^2} + \frac{2\,(e^{-s} + e^{-9s} - 2\,e^{-5s})}{s} \tag{10}$$

> $f(t)$

$2\,\mathrm{Heaviside}(t-1) + (t-1)\,\mathrm{Heaviside}(t-1) - 2\,(t-3)\,\mathrm{Heaviside}(t-3) - 4\,\mathrm{Heaviside}(t-5) + 2\,(t-7)\,\mathrm{Heaviside}(t-7) - (t-9)\,\mathrm{Heaviside}(t-9) + 2\,\mathrm{Heaviside}(t-9)$ $\tag{11}$

> $restart$

> $Equation := diff(y(t), t\$2) + 3\,diff(y(t), t) + 3\,y(t) = 4 \cdot \exp(3\,t) + 4\,t \cdot\cdot 2$

$$Equation := \frac{d^2}{dt^2}\,y(t) + 3\left(\frac{d}{dt}\,y(t)\right) + 3\,y(t) = 4\,e^{3t} + 4\,t^2 \tag{12}$$

> $InitialCondition := y(0) = 2, D(y)(0) = -2$

$$InitialCondition := y(0) = 2, D(y)(0) = -2 \tag{13}$$

```
> with(inttrans) :
> LaplaceTransformEquation := subs(InitialCondition, laplace(Equation, t, s))
```

$$LaplaceTransformEquation := s^2 \, laplace(y(t), t, s) - 4 - 2\,s + 3\,s\,laplace(y(t), t, s) \qquad \textbf{(14)}$$
$$+ 3\,laplace(y(t), t, s) = \frac{4}{s-3} + \frac{8}{s^3}$$

```
> LaplaceTransformSolution := simplify(isolate(LaplaceTransformEquation, laplace(y(t), t, s)))
```

$$LaplaceTransformSolution := laplace(y(t), t, s) = \frac{2\left(-4\,s^3 + 4\,s - 12 - s^4 + s^5\right)}{(s-3)\,s^3\,(s^2 + 3\,s + 3)} \qquad \textbf{(15)}$$

```
> ParticularSolution := simplify(invlaplace(LaplaceTransformSolution, s, t))
```

$$ParticularSolution := y(t) = \frac{16}{9} + \frac{4}{21}\,e^{3t} - \frac{8}{3}\,t + \frac{4}{3}\,t^2 + \frac{2}{63}\,e^{-\frac{3}{2}t}\cos\left(\frac{1}{2}\sqrt{3}\,t\right) \qquad \textbf{(16)}$$
$$+ \frac{2}{21}\,e^{-\frac{3}{2}t}\sqrt{3}\,\sin\left(\frac{1}{2}\sqrt{3}\,t\right)$$

```
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```