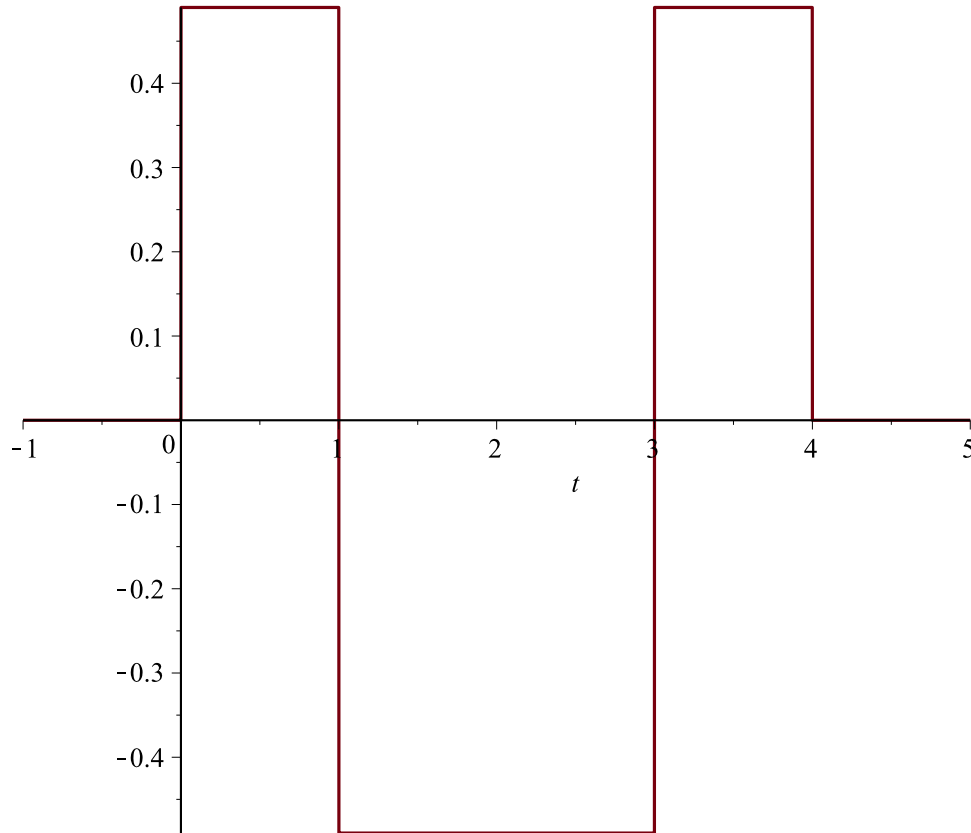> *restart*

> $S := \dfrac{49}{100} \cdot \text{Heaviside}(t) - \dfrac{2 \cdot 49}{100} \cdot \text{Heaviside}(t-a) + \dfrac{2 \cdot 49}{100} \cdot \text{Heaviside}(t-3 \cdot a) - \dfrac{49}{100}$
  $\cdot \text{Heaviside}(t - 4 \cdot a); plot(subs(a = 1, S), t = -1 .. 5)$

$S := \dfrac{49}{100} \text{Heaviside}(t) - \dfrac{49}{50} \text{Heaviside}(t-a) + \dfrac{49}{50} \text{Heaviside}(t-3\,a) - \dfrac{49}{100} \text{Heaviside}(t$
  $- 4\,a)$

> $Ecua := diff(y(t), t\$3) = S$

$Ecua := \dfrac{d^3}{dt^3} y(t) = \dfrac{49}{100} \text{Heaviside}(t) - \dfrac{49}{50} \text{Heaviside}(t-a) + \dfrac{49}{50} \text{Heaviside}(t-3\,a)$ **(1)**

  $- \dfrac{49}{100} \text{Heaviside}(t - 4\,a)$

> $CondIni := y(0) = 0, D(y)(0) = 0, D(D(y))(0) = 0$

$\qquad\qquad CondIni := y(0) = 0, D(y)(0) = 0, D^{(2)}(y)(0) = 0$ **(2)**

> $with(inttrans):$

> $EcuaTransLap := subs(CondIni, laplace(Ecua, t, s))$

$EcuaTransLap := s^3\, laplace(y(t), t, s) = \dfrac{49}{100\,s} - \dfrac{49}{50}\, laplace(\text{Heaviside}(t-a), t, s)$ **(3)**

$$+ \frac{49}{50} \, laplace(\text{Heaviside}(t-3\,a), t, s) - \frac{49}{100} \, laplace(\text{Heaviside}(t-4\,a), t, s)$$

> $SolTransLap := isolate(EcuaTransLap, laplace(y(t), t, s))$

$$SolTransLap := laplace(y(t), t, s) = \frac{1}{s^3}\left(\frac{49}{100\,s} - \frac{49}{50} \, laplace(\text{Heaviside}(t-a), t, s) \right. \tag{4}$$

$$\left. + \frac{49}{50} \, laplace(\text{Heaviside}(t-3\,a), t, s) - \frac{49}{100} \, laplace(\text{Heaviside}(t-4\,a), t, s) \right)$$

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

$$SolPart := y(t) = \frac{49}{600}\,t^3 - \frac{49}{50} \, \text{Heaviside}(-a)\,a^3 - \frac{49}{600} \, \text{Heaviside}(t-4\,a)\,(t-4\,a)^3 \tag{5}$$

$$+ \frac{49}{300} \, \text{Heaviside}(t-3\,a)\,(t-3\,a)^3 - \frac{49}{300} \, \text{Heaviside}(t-a)\,(t-a)^3$$

> $SolucionReal := subs(t=4 \cdot a, rhs(SolPart)) = 225)$

$$SolucionReal := \frac{392}{75}\,a^3 - \frac{49}{50} \, \text{Heaviside}(-a)\,a^3 + \frac{49}{300} \, \text{Heaviside}(a)\,a^3 \tag{6}$$

$$- \frac{441}{100} \, \text{Heaviside}(3\,a)\,a^3 = 225$$

> $Para := solve(subs(\text{Heaviside}(a)=1, \text{Heaviside}(3 \cdot a)=0, \text{Heaviside}(-a)=0, SolucionReal),$
> $a); evalf(\%, 5)$

$$Para := \frac{5}{7}\,630^{1/3},\ -\frac{5}{14}\,630^{1/3} + \frac{5}{14}\,I\sqrt{3}\,630^{1/3},\ -\frac{5}{14}\,630^{1/3} - \frac{5}{14}\,I\sqrt{3}\,630^{1/3}$$

$$6.1233,\ -3.0616 + 5.3032\,I,\ -3.0616 - 5.3032\,I \tag{7}$$

> $evalf(Para[1], 5); evalf(Para[2], 5); evalf(Para[3], 5)$

$$6.1233$$
$$-3.0616 + 5.3032\,I$$
$$-3.0616 - 5.3032\,I \tag{8}$$

> $TiempoFinalRecorrido := Para[1] \cdot 4 : evalf(\%, 5)$
$$24.493 \tag{9}$$

> $SolucionFinal := subs(a = Para[1], SolPart) : plot(rhs(SolucionFinal), t=0$
> $..TiempoFinalRecorrido)$
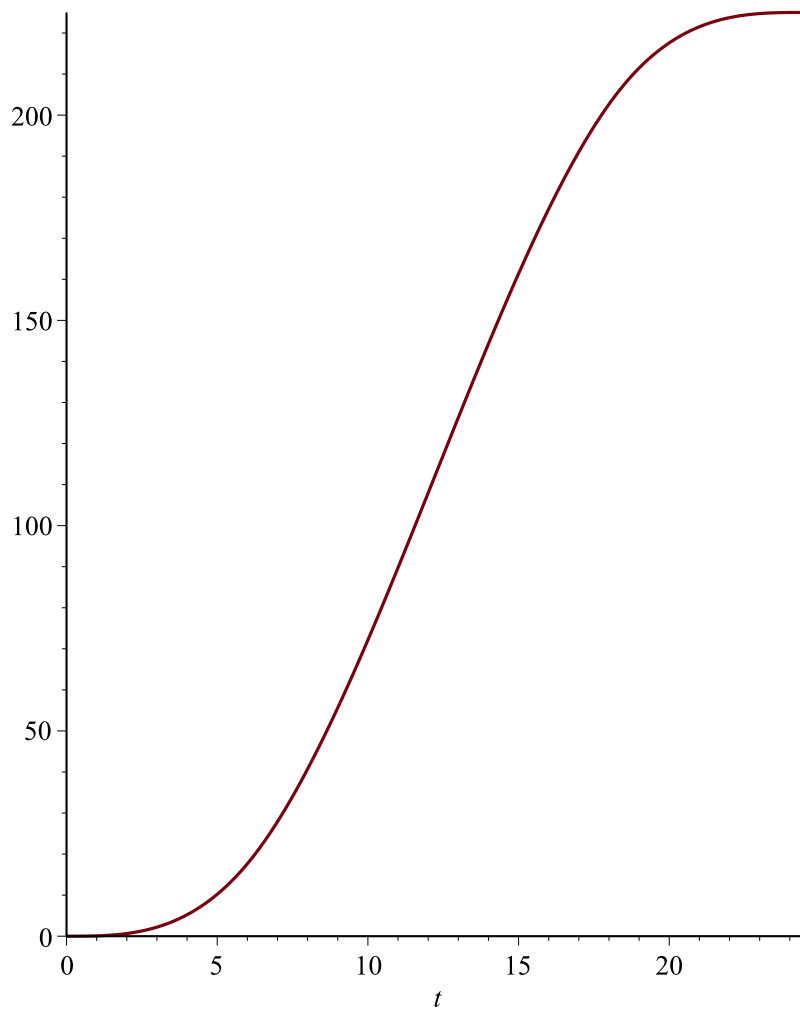
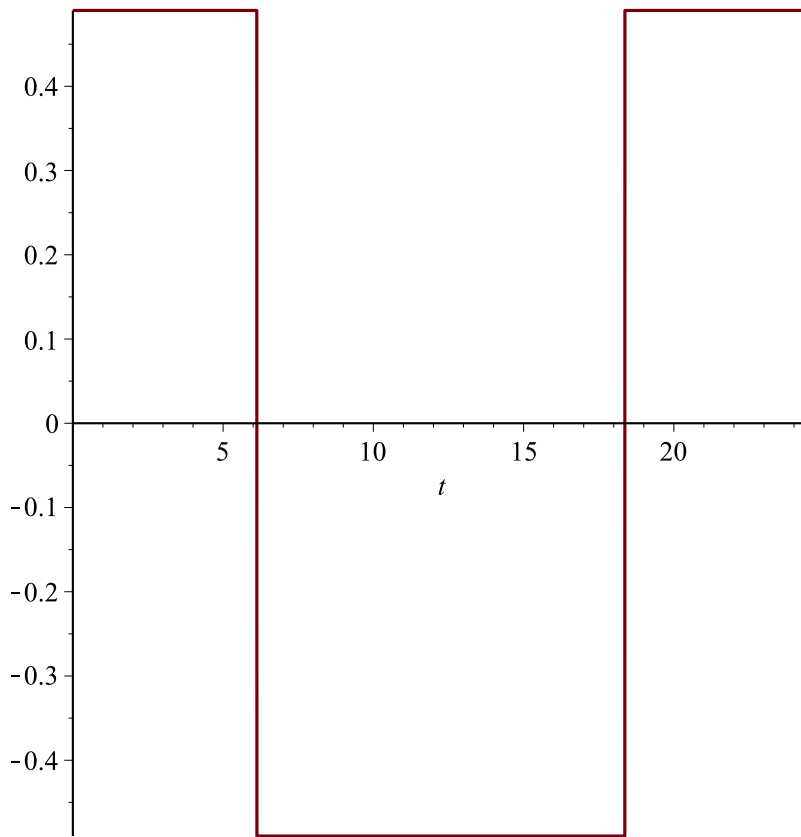$\text{>}\ plot(rhs(diff(SolucionFinal, t)), t = 0 .. TiempoFinalRecorrido)$
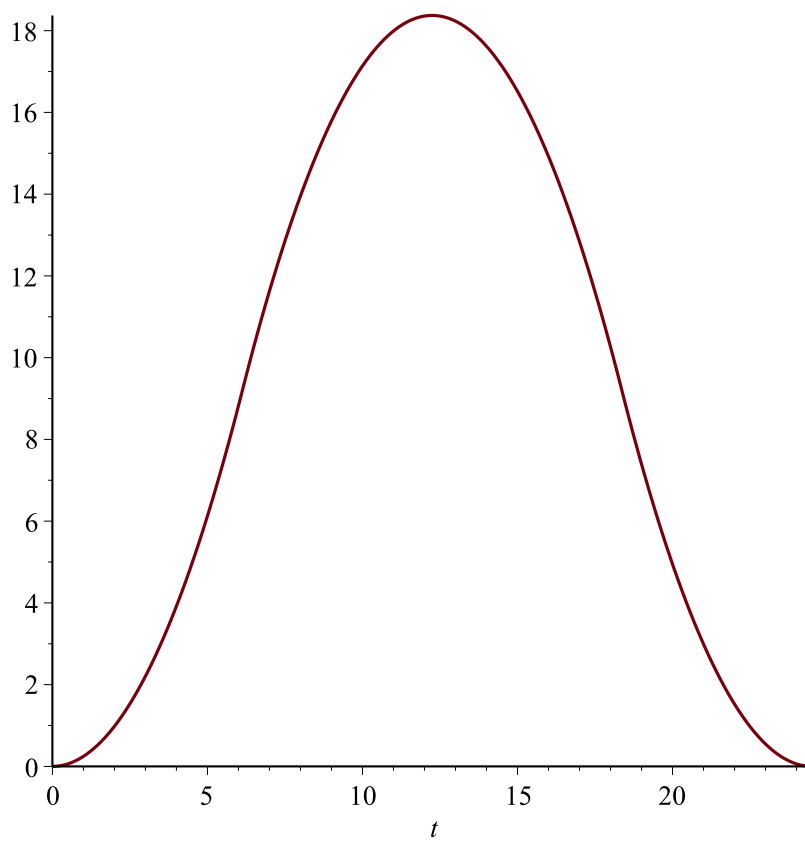
> $plot(rhs(diff(SolucionFinal, t\$2)), t = 0 .. TiempoFinalRecorrido)$
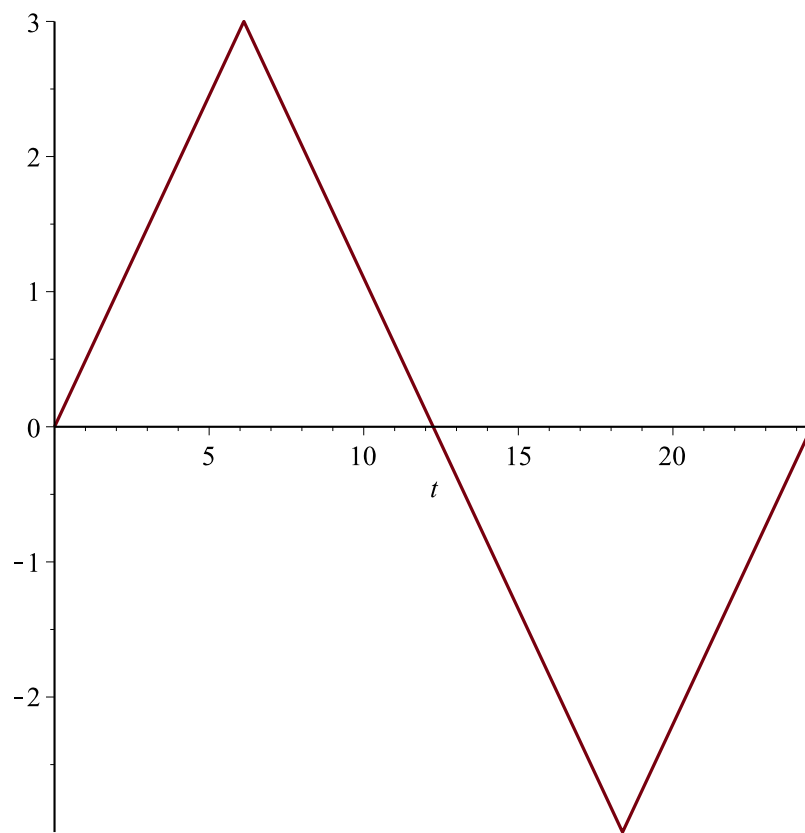
$$> plot(rhs(diff(SolucionFinal, t\$3)), t = 0 .. TiempoFinalRecorrido)$$

> *restart*

> $Ecua := diff(z(x, y), x\$2) + 3 \cdot diff(z(x, y), x, y) + 2 \cdot diff(z(x, y), y\$2) = 0$

$$Ecua := \frac{\partial^2}{\partial x^2} z(x, y) + 3 \left(\frac{\partial^2}{\partial y \, \partial x} z(x, y) \right) + 2 \left(\frac{\partial^2}{\partial y^2} z(x, y) \right) = 0 \tag{10}$$

> $EcuaDos := simplify(eval(subs(z(x, y) = F(y + m \cdot x), Ecua)))$

$$EcuaDos := \mathrm{D}^{(2)}(F)(m\,x + y)\, m^2 + 3\, \mathrm{D}^{(2)}(F)(m\,x + y)\, m + 2\, \mathrm{D}^{(2)}(F)(m\,x + y) = 0 \tag{11}$$

> $EcuaCarac := m^2 + 3 \cdot m + 2 = 0$

$$EcuaCarac := m^2 + 3\,m + 2 = 0 \tag{12}$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := -1, \, -2 \tag{13}$$

> $SolGral := z(x, y) = \_F1(-x + y) + \_F2(-2 \cdot x + y)$

$$SolGral := z(x, y) = \_F1(-x + y) + \_F2(-2\,x + y) \tag{14}$$

> $Comp := eval(subs(z(x, y) = rhs(SolGral), Ecua))$

$$Comp := 0 = 0 \tag{15}$$

> $SolPart := z(x, y) = \cos(y - x) + 5 \cdot \sin(y - 2 \cdot x)$

$$SolPart := z(x, y) = \cos(x - y) - 5 \sin(2\,x - y) \tag{16}$$

> $DerSolPartX := diff(rhs(SolPart), x)$

$$\tag{17}$$

$$DerSolPartX := -\sin(x-y) - 10\cos(2x-y) \tag{17}$$

> $DerSolPartY := diff(rhs(SolPart), y)$
$$DerSolPartY := \sin(x-y) + 5\cos(2x-y) \tag{18}$$

> $DerSolPartXX := diff(rhs(SolPart), x\$2)$
$$DerSolPartXX := -\cos(x-y) + 20\sin(2x-y) \tag{19}$$

> $DerSolPartYY := diff(rhs(SolPart), y\$2)$
$$DerSolPartYY := -\cos(x-y) + 5\sin(2x-y) \tag{20}$$

> $DerSolPartXY := diff(rhs(SolPart), x, y)$
$$DerSolPartXY := \cos(x-y) - 10\sin(2x-y) \tag{21}$$

> $CompDos := eval(subs(z(x,y) = rhs(SolPart), Ecua))$
$$CompDos := 0 = 0 \tag{22}$$

> $Ecua$
$$\frac{\partial^2}{\partial x^2} z(x,y) + 3\left(\frac{\partial^2}{\partial y\,\partial x} z(x,y)\right) + 2\left(\frac{\partial^2}{\partial y^2} z(x,y)\right) = 0 \tag{23}$$

> $EcuaSeparable := eval(subs(z(x,y) = F(x) + G(y), Ecua))$
$$EcuaSeparable := \frac{d^2}{dx^2} F(x) + 2\left(\frac{d^2}{dy^2} G(y)\right) = 0 \tag{24}$$

> $EcuaSeparada := lhs(EcuaSeparable) - \frac{d^2}{dx^2} F(x) = rhs(EcuaSeparable) - \frac{d^2}{dx^2} F(x)$
$$EcuaSeparada := 2\left(\frac{d^2}{dy^2} G(y)\right) = -\left(\frac{d^2}{dx^2} F(x)\right) \tag{25}$$

> $EcuaX := rhs(EcuaSeparada) = \text{alpha};\ EcuaY := lhs(EcuaSeparada) = \text{alpha}$
$$EcuaX := -\left(\frac{d^2}{dx^2} F(x)\right) = \alpha$$
$$EcuaY := 2\left(\frac{d^2}{dy^2} G(y)\right) = \alpha \tag{26}$$

> $SolXcero := dsolve(subs(\text{alpha}=0, EcuaX))$
$$SolXcero := F(x) = \_C1\,x + \_C2 \tag{27}$$

> $SolYcero := dsolve(subs(\text{alpha}=0, EcuaY))$
$$SolYcero := G(y) = \_C1\,y + \_C2 \tag{28}$$

> $SolGralCero := z(x,y) = rhs(SolXcero) \cdot subs(\_C1 = \_C3, \_C2 = \_C4, rhs(SolYcero))$
$$SolGralCero := z(x,y) = (\_C1\,x + \_C2)(\_C3\,y + \_C4) \tag{29}$$

> $SolXpos := dsolve\left(subs\left(\text{alpha}=\beta^2, EcuaX\right)\right)$
$$SolXpos := F(x) = -\frac{1}{2}\beta^2 x^2 + \_C1\,x + \_C2 \tag{30}$$

> $SolYpos := dsolve\left(subs\left(\text{alpha}=\beta^2, EcuaY\right)\right)$
$$SolYpos := G(y) = \frac{1}{4}\beta^2 y^2 + \_C1\,y + \_C2 \tag{31}$$

> $SolGralPos := z(x,y) = rhs(SolXpos) \cdot subs(\_C1 = \_C3, \_C2 = \_C4, rhs(SolYpos))$
$$SolGralPos := z(x,y) = \left(-\frac{1}{2}\beta^2 x^2 + \_C1\,x + \_C2\right)\left(\frac{1}{4}\beta^2 y^2 + \_C3\,y + \_C4\right) \tag{32}$$

> $SolXneg := dsolve\left(subs\left(\text{alpha} = -\beta^2, EcuaX\right)\right)$

$$SolXneg := F(x) = \frac{1}{2}\,\beta^2\,x^2 + \_C1\,x + \_C2 \tag{33}$$

> $SolYneg := dsolve\left(subs\left(\text{alpha} = -\beta^2, EcuaY\right)\right)$

$$SolYneg := G(y) = -\frac{1}{4}\,\beta^2\,y^2 + \_C1\,y + \_C2 \tag{34}$$

> $SolGralNeg := z(x,y) = rhs(SolXneg) \cdot subs(\_C1 = \_C3, \_C2 = \_C4, rhs(SolYneg))$

$$SolGralNeg := z(x,y) = \left(\frac{1}{2}\,\beta^2\,x^2 + \_C1\,x + \_C2\right)\left(-\frac{1}{4}\,\beta^2\,y^2 + \_C3\,y + \_C4\right) \tag{35}$$

>