> $restart$

> $Ecuacion := diff(y(t), t\$2) = -\dfrac{98}{10}$

$$Ecuacion := \frac{d^2}{dt^2}\, y(t) = -\frac{49}{5} \tag{1}$$

> $Condiciones := y(0) = A, D(y)(0) = 0;$

$$Condiciones := y(0) = A, D(y)(0) = 0 \tag{2}$$

> $SolucionParticular := dsolve(\{Ecuacion, Condiciones\})$

$$SolucionParticular := y(t) = -\frac{49}{10}\, t^2 + A \tag{3}$$

> $TiempoDos := solve(rhs(SolucionParticular) = 0, t); evalf(\%, 4)$

$$TiempoDos := \frac{1}{7}\, \sqrt{10}\, \sqrt{A}, -\frac{1}{7}\, \sqrt{10}\, \sqrt{A}$$

$$0.4518\, \sqrt{A}, -0.4518\, \sqrt{A} \tag{4}$$

> $TiempoDosBis := subs(A = 2, TiempoDos_1); evalf(\%, 4)$

$$TiempoDosBis := \frac{1}{7}\, \sqrt{10}\, \sqrt{2}$$

$$0.6389 \tag{5}$$

> $VelocidadDos := subs(A = 2, t = TiempoDosBis, rhs(diff(SolucionParticular, t))); evalf(\%, 4) \cdot 3.6$

$$VelocidadDos := -\frac{7}{5}\, \sqrt{10}\, \sqrt{2}$$
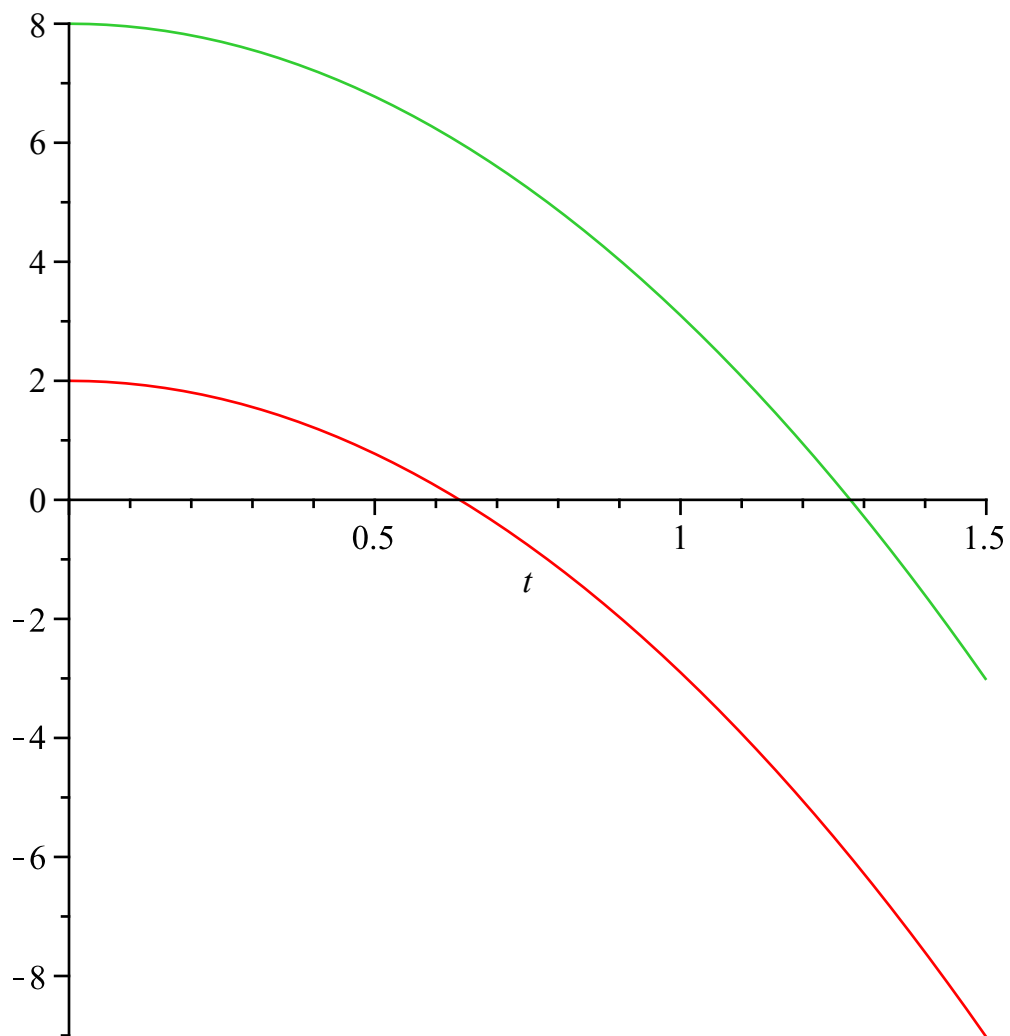
$$-22.5324 \tag{6}$$

> $TiempoOcho := subs(A = 8, TiempoDos_1); evalf(\%, 4)$

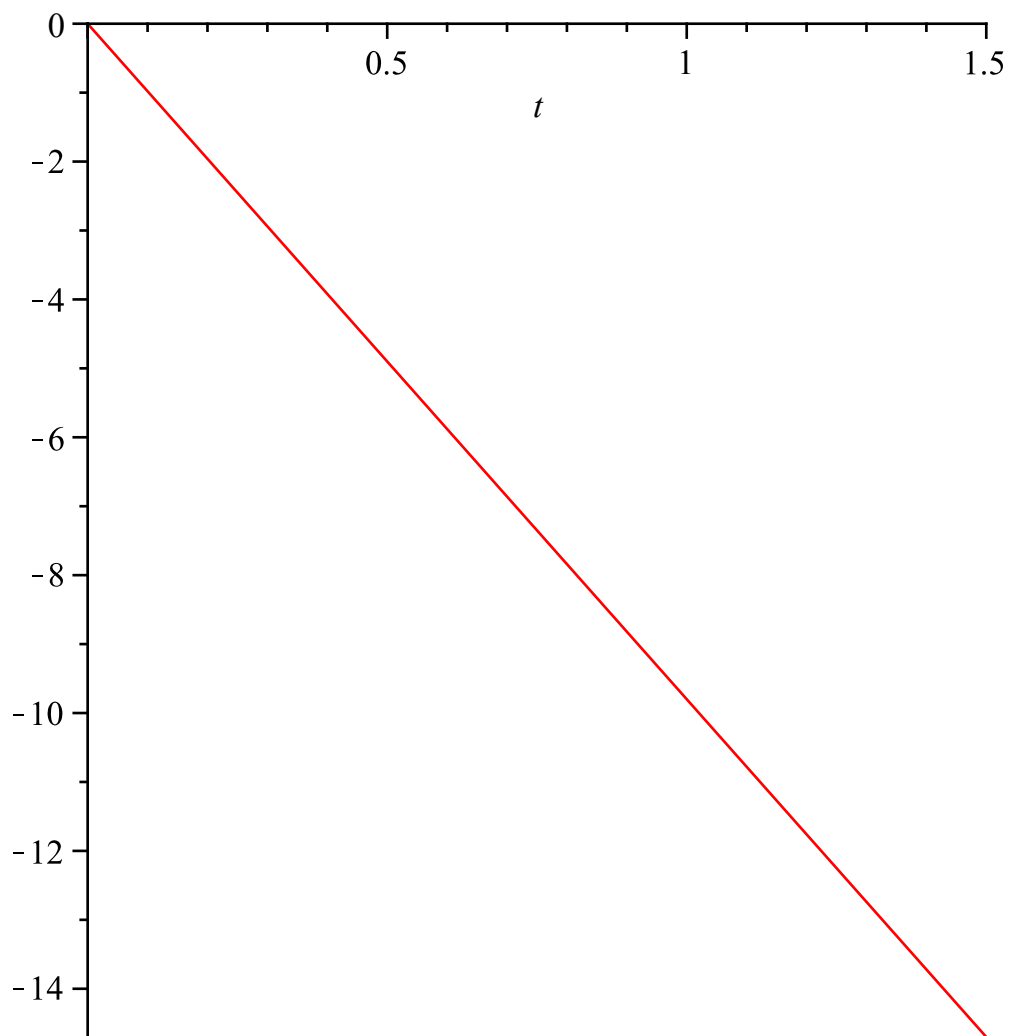$$TiempoOcho := \frac{1}{7}\, \sqrt{10}\, \sqrt{8}$$

$$1.278 \tag{7}$$

> $VelocidadOcho := subs(A = 8, t = TiempoOcho, rhs(diff(SolucionParticular, t))); evalf(\%, 4) \cdot 3.6$

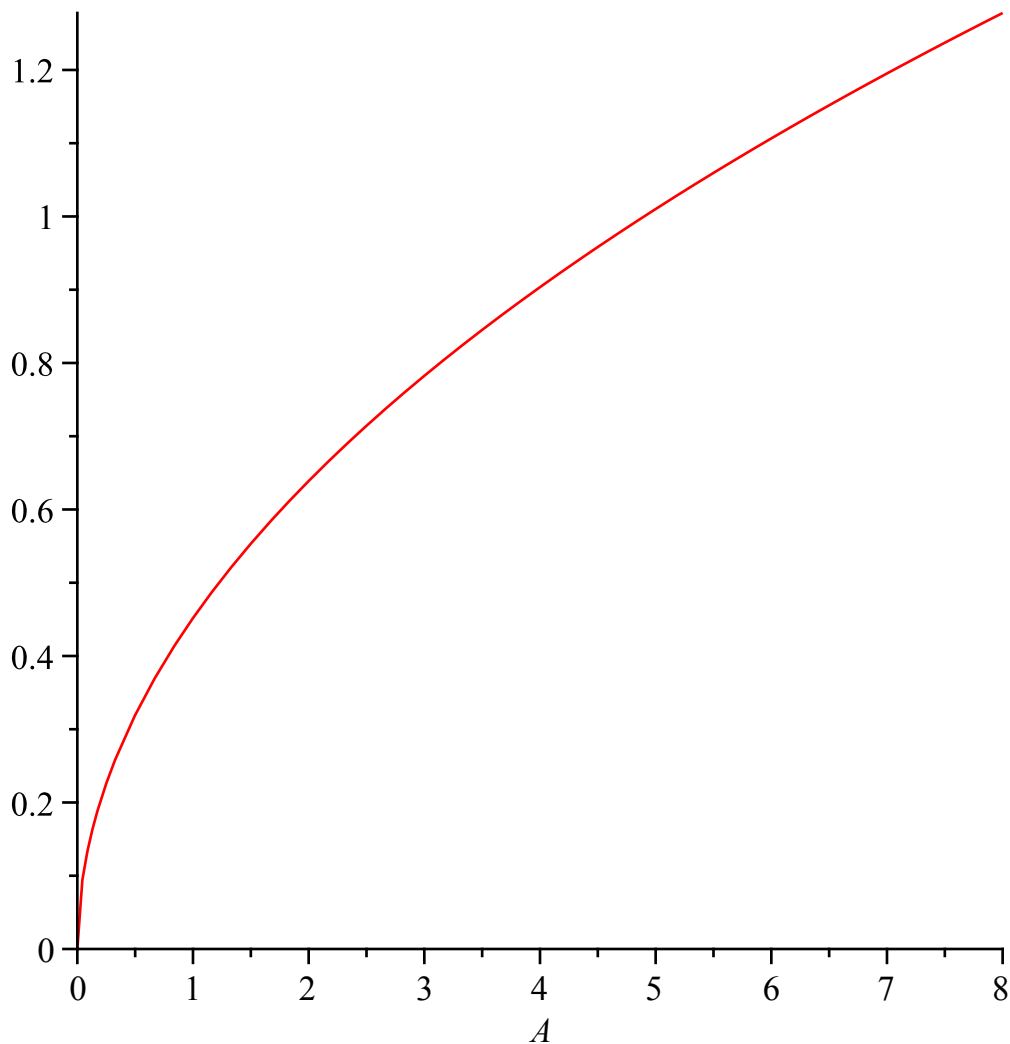$$VelocidadOcho := -\frac{7}{5}\, \sqrt{10}\, \sqrt{8}$$

$$-45.072 \tag{8}$$

> $plot([subs(A = 2, rhs(SolucionParticular)), subs(A = 8, rhs(SolucionParticular))], t = 0..1.5)$

> $plot(rhs(diff(SolucionParticular, t)), t = 0..1.5)$

> $plot(\mathit{TiempoDos}_1, A = 0 ..8)$

A

```
> restart
```

```
> SolucionGeneral := y(x) = C_1·exp(-2 x) + C_2·x·exp(-2 x)
```

$$SolucionGeneral := y(x) = C_1\, e^{-2x} + C_2\, x\, e^{-2x} \qquad (9)$$

```
> Sistema := diff(SolucionGeneral, x), diff(SolucionGeneral, x$2) : Sistema_1; Sistema_2
```

$$\frac{d}{dx}\, y(x) = -2\, C_1\, e^{-2x} + C_2\, e^{-2x} - 2\, C_2\, x\, e^{-2x}$$

$$\frac{d^2}{dx^2}\, y(x) = 4\, C_1\, e^{-2x} - 4\, C_2\, e^{-2x} + 4\, C_2\, x\, e^{-2x} \qquad (10)$$

```
> Parametro := solve( {Sistema}, {C_1, C_2} ) : Parametro_1; Parametro_2
```

$$C_1 = \frac{1}{4}\, \frac{-\left(\dfrac{d^2}{dx^2}\, y(x)\right) - 4\left(\dfrac{d}{dx}\, y(x)\right) + 2\, x\left(\dfrac{d^2}{dx^2}\, y(x)\right) + 4\, x\left(\dfrac{d}{dx}\, y(x)\right)}{e^{-2x}}$$

$$C_2 = -\frac{1}{2}\, \frac{\dfrac{d^2}{dx^2}\, y(x) + 2\left(\dfrac{d}{dx}\, y(x)\right)}{e^{-2x}} \qquad (11)$$

> $EcuacionInicial := simplify\big(subs\big(C_1 = rhs(Parametro_1), C_2 = rhs(Parametro_2),$
   $SolucionGeneral\big)\big)$

$$EcuacionInicial := y(x) = -\frac{1}{4}\,\frac{d^2}{dx^2}\,y(x) - \left(\frac{d}{dx}\,y(x)\right) \tag{12}$$

> $EcuacionFinal := lhs(EcuacionInicial)\cdot 4 - rhs(EcuacionInicial)\cdot 4 = 0$

$$EcuacionFinal := 4\,y(x) + \frac{d^2}{dx^2}\,y(x) + 4\left(\frac{d}{dx}\,y(x)\right) = 0 \tag{13}$$

> $SolucionGeneral; Sistema_1; Sistema_2$

$$y(x) = C_1\,e^{-2x} + C_2\,x\,e^{-2x}$$

$$\frac{d}{dx}\,y(x) = -2\,C_1\,e^{-2x} + C_2\,e^{-2x} - 2\,C_2\,x\,e^{-2x}$$

$$\frac{d^2}{dx^2}\,y(x) = 4\,C_1\,e^{-2x} - 4\,C_2\,e^{-2x} + 4\,C_2\,x\,e^{-2x} \tag{14}$$

> $restart$

> $SolucionGeneral := y(t) = C_1\cdot\exp(3\,t) + C_2\cdot\exp(3\,t)\cdot\cos(2\,t) + C_3\cdot\exp(3\,t)\cdot\sin(2\,t)$

$$SolucionGeneral := y(t) = C_1\,e^{3t} + C_2\,e^{3t}\cos(2\,t) + C_3\,e^{3t}\sin(2\,t) \tag{15}$$

> $Sistema := diff(SolucionGeneral, t), diff(SolucionGeneral, t\$2), diff(SolucionGeneral, t$
   $\$3) : Sistema_1; Sistema_2; Sistema_3$

$$\frac{d}{dt}\,y(t) = 3\,C_1\,e^{3t} + 3\,C_2\,e^{3t}\cos(2\,t) - 2\,C_2\,e^{3t}\sin(2\,t) + 3\,C_3\,e^{3t}\sin(2\,t) + 2\,C_3\,e^{3t}\cos(2\,t)$$

$$\frac{d^2}{dt^2}\,y(t) = 9\,C_1\,e^{3t} + 5\,C_2\,e^{3t}\cos(2\,t) - 12\,C_2\,e^{3t}\sin(2\,t) + 5\,C_3\,e^{3t}\sin(2\,t)$$
$$+ 12\,C_3\,e^{3t}\cos(2\,t)$$

$$\frac{d^3}{dt^3}\,y(t) = 27\,C_1\,e^{3t} - 9\,C_2\,e^{3t}\cos(2\,t) - 46\,C_2\,e^{3t}\sin(2\,t) - 9\,C_3\,e^{3t}\sin(2\,t) \tag{16}$$
$$+ 46\,C_3\,e^{3t}\cos(2\,t)$$

> $Parametro := solve\big(\{Sistema\}, \{C_1, C_2, C_3\}\big) : Parametro_1; Parametro_2; Parametro_3$

$$C_1 = \frac{1}{12}\,\frac{\dfrac{d^3}{dt^3}\,y(t) - 6\left(\dfrac{d^2}{dt^2}\,y(t)\right) + 13\left(\dfrac{d}{dt}\,y(t)\right)}{e^{3t}}$$

$$C_2 = -\frac{1}{52}\,\frac{1}{e^{3t}\left(\cos(2\,t)^2 + \sin(2\,t)^2\right)}\left(-14\cos(2\,t)\left(\frac{d^2}{dt^2}\,y(t)\right) + 15\cos(2\,t)\left(\frac{d}{dt}\,y(t)\right)\right.$$

$$+ 3\left(\frac{d^3}{dt^3}\,y(t)\right)\cos(2\,t) - 2\left(\frac{d^3}{dt^3}\,y(t)\right)\sin(2\,t) + 18\sin(2\,t)\left(\frac{d^2}{dt^2}\,y(t)\right)$$

$$\left.- 36\sin(2\,t)\left(\frac{d}{dt}\,y(t)\right)\right)$$

$$\tag{17}$$

$$C_3 = -\frac{1}{52} \frac{1}{e^{3t}\left(\cos(2\,t)^2 + \sin(2\,t)^2\right)} \left(-18\cos(2\,t)\left(\frac{d^2}{dt^2}\,y(t)\right) + 36\cos(2\,t)\left(\frac{d}{dt}\,y(t)\right) \right. \tag{17}$$

$$\left. -14\sin(2\,t)\left(\frac{d^2}{dt^2}\,y(t)\right) + 15\sin(2\,t)\left(\frac{d}{dt}\,y(t)\right) + 3\left(\frac{d^3}{dt^3}\,y(t)\right)\sin(2\,t) \right.$$

$$\left. +2\left(\frac{d^3}{dt^3}\,y(t)\right)\cos(2\,t) \right)$$

> $EcuacionInicial := simplify\left(subs\left(C_1 = rhs\left(Parametro_1\right), C_2 = rhs\left(Parametro_2\right), C_3 \right.\right.$
> $\left.\left. = rhs\left(Parametro_3\right), SolucionGeneral\right)\right)$

$$EcuacionInicial := y(t) = \frac{1}{39}\frac{d^3}{dt^3}\,y(t) - \frac{3}{13}\frac{d^2}{dt^2}\,y(t) + \frac{31}{39}\frac{d}{dt}\,y(t) \tag{18}$$

> $EcuacionFinal := rhs(EcuacionInicial)\cdot 39 - lhs(EcuacionInicial)\cdot 39 = 0$

$$EcuacionFinal := \frac{d^3}{dt^3}\,y(t) - 9\left(\frac{d^2}{dt^2}\,y(t)\right) + 31\left(\frac{d}{dt}\,y(t)\right) - 39\,y(t) = 0 \tag{19}$$

> $SolucionGeneral$

$$y(t) = C_1\,e^{3t} + C_2\,e^{3t}\cos(2\,t) + C_3\,e^{3t}\sin(2\,t) \tag{20}$$

>
>
>