> *restart*

FLECHA DE MADERA

PROBLEMA DINÁMICO: ARCO Y FLECHA

> $Ecuacion := -Hooke \cdot s(t) = Masa \cdot diff(s(t), t\$2)$

$$Ecuacion := -Hooke\, s(t) = Masa \left(\frac{d^2}{dt^2}\, s(t) \right) \quad \textbf{(1)}$$

> $Condiciones := s(0) = -\frac{4914}{10000}, D(s)(0) = 0;$

$$Condiciones := s(0) = -\frac{2457}{5000}, D(s)(0) = 0 \quad \textbf{(2)}$$

> $Gravedad := \frac{98}{10}; Hooke := \frac{(19)}{\left(\frac{5}{10}\right)}; Peso := \frac{(20)}{(1000)}; Masa := \frac{Peso}{Gravedad};$

$$Gravedad := \frac{49}{5}$$

$$Hooke := 38$$

$$Peso := \frac{1}{50}$$

$$Masa := \frac{1}{490} \quad \textbf{(3)}$$

> *Ecuacion*;

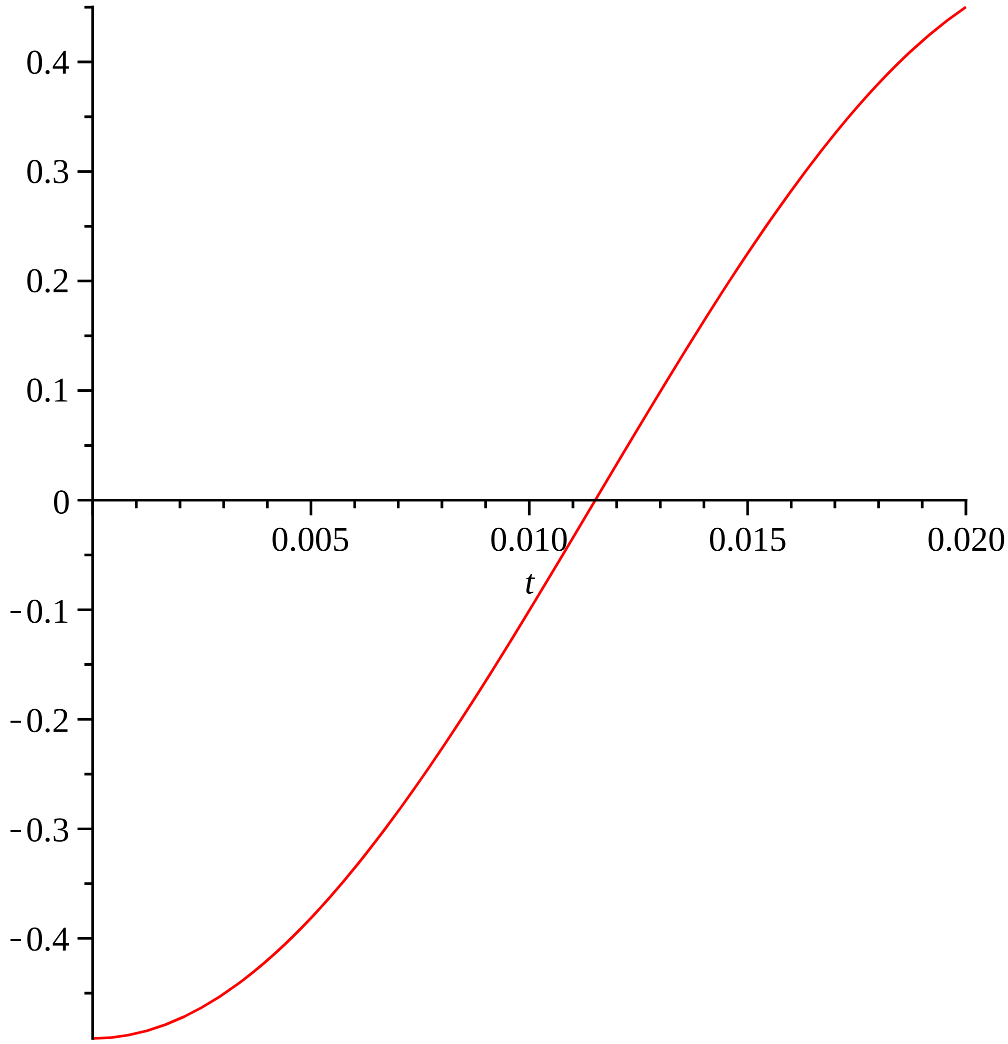
$$-38\, s(t) = \frac{1}{490} \frac{d^2}{dt^2}\, s(t) \quad \textbf{(4)}$$

> $Solucion := dsolve(\{Ecuacion, Condiciones\}); evalf(\%, 4)$

$$Solucion := s(t) = -\frac{2457}{5000} \cos\left(14 \sqrt{95}\, t\right)$$

$$s(t) = -0.4914 \cos(136.5\, t) \quad \textbf{(5)}$$

> $plot(rhs(Solucion), t = 0 ..0.02)$



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

$$TiempoImpulso := \frac{1}{2660}\,\pi\sqrt{95}$$

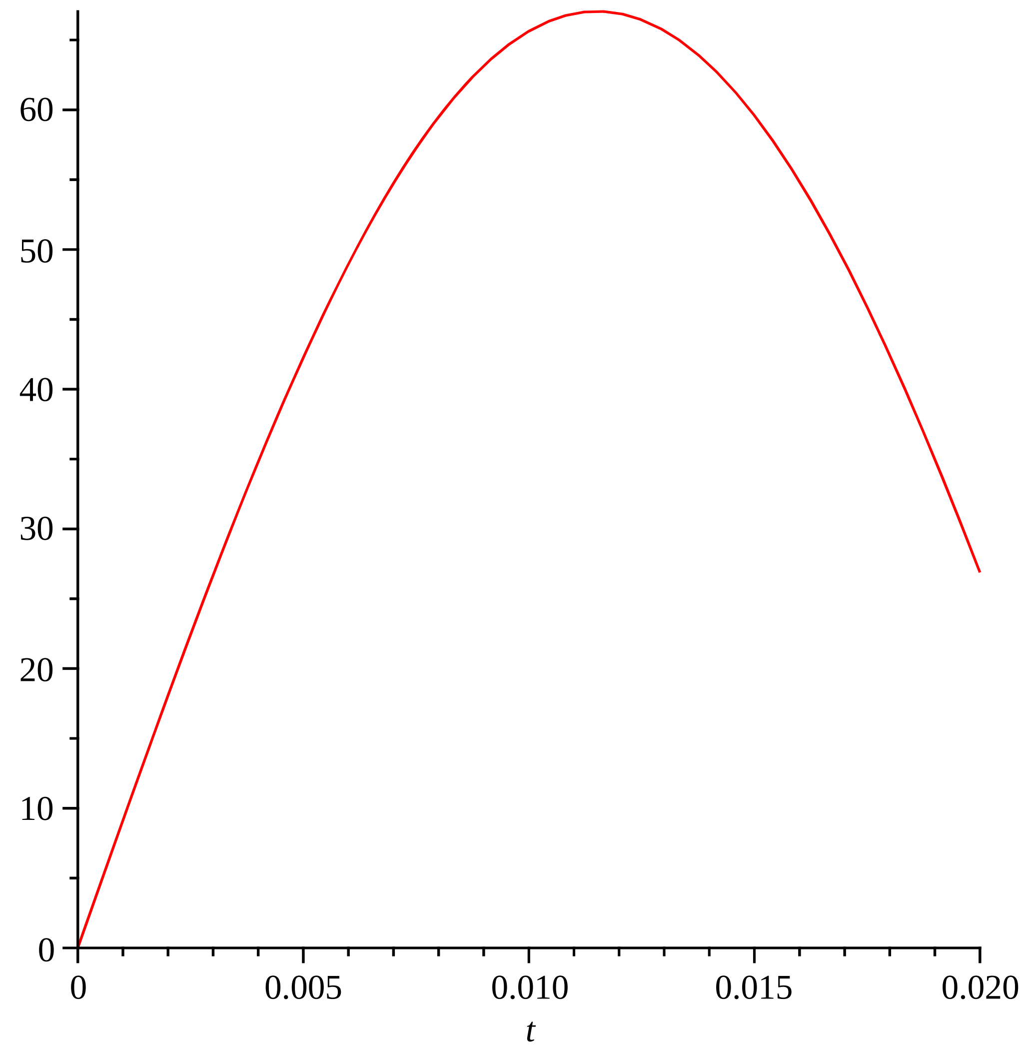
$$0.01151 \tag{6}$$

> $DerivadaSolucion := diff(Solucion, t); evalf(\%, 4)$

$$DerivadaSolucion := \frac{d}{dt}\,s(t) = \frac{17199}{2500}\,\sin\left(14\sqrt{95}\,t\right)\sqrt{95}$$

$$\frac{d}{dt}\,s(t) = 67.06\,\sin(136.5\,t) \tag{7}$$

> $plot(rhs(DerivadaSolucion), t = 0 ..0.02)$



> $VelocidadInicial := subs(t = TiempoImpulso, rhs(DerivadaSolucion)); evalf(\%, 4);$
> $\frac{evalf(\%, 4) \cdot 3600}{1000};$

$$VelocidadInicial := \frac{17199}{2500} \sin\left(\frac{1}{2}\pi\right)\sqrt{95}$$

$$67.06$$

$$241.4160000 \tag{8}$$

>

PROBLEMA CINEMÁTICO: TIRO PARABÓLICO

> $EcuacionVertical := diff(y(t), t\$2) = -Gravedad; evalf(\%, 4)$

$$EcuacionVertical := \frac{d^2}{dt^2} y(t) = -\frac{49}{5}$$

$$\frac{d^2}{dt^2} y(t) = -9.800 \tag{9}$$

> $EcuacionHorizontal := diff(x(t), t) = VelocidadInicial \cdot \cos\left(\frac{Pi}{4}\right); evalf(\%, 4)$

$$EcuacionHorizontal := \frac{d}{dt} x(t) = \frac{17199}{5000}\sqrt{95}\sqrt{2}$$

$$\frac{d}{dt}\, x(t) = 47.40 \qquad \textbf{(10)}$$

> $CondicionesVerticales := y(0) = 2, D(y)(0) = VelocidadInicial \cdot \sin\left(\frac{Pi}{4}\right);$

$$CondicionesVerticales := y(0) = 2, D(y)(0) = \frac{17199}{5000}\sqrt{95}\sqrt{2} \qquad \textbf{(11)}$$

> $CondicionesHorizontales := x(0) = 5;$

$$CondicionesHorizontales := x(0) = 5 \qquad \textbf{(12)}$$

> $SolucionVertical := dsolve(\{EcuacionVertical, CondicionesVerticales\}); evalf(\%, 4)$

$$SolucionVertical := y(t) = -\frac{49}{10}t^2 + \frac{17199}{5000}\sqrt{95}\sqrt{2}\, t + 2$$

$$y(t) = -4.900\, t^2 + 47.40\, t + 2. \qquad \textbf{(13)}$$

> $SolucionHorizontal := dsolve(\{EcuacionHorizontal, CondicionesHorizontales\}); evalf(\%, 4)$

$$SolucionHorizontal := x(t) = \frac{17199}{5000}\sqrt{190}\, t + 5$$

$$x(t) = 47.40\, t + 5. \qquad \textbf{(14)}$$

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

$$TiempoVuelo := \frac{351}{1000}\sqrt{95}\sqrt{2} - \frac{1}{7000}\sqrt{1167001310}, \frac{351}{1000}\sqrt{95}\sqrt{2} + \frac{1}{7000}\sqrt{1167001310}$$

$$-0.044, 9.718 \qquad \textbf{(15)}$$

> $evalf(TiempoVuelo_2, 4)$

$$9.718 \qquad \textbf{(16)}$$

> $DistanciaMaxima := subs(t = TiempoVuelo_2, rhs(SolucionHorizontal)); evalf(\%, 4)$

$$DistanciaMaxima := \frac{17199}{5000}\sqrt{190}\left(\frac{351}{1000}\sqrt{95}\sqrt{2} + \frac{1}{7000}\sqrt{1167001310}\right) + 5$$

$$465.6 \qquad \textbf{(17)}$$

> $TiempoAlturaMaxima := solve(rhs(diff(SolucionVertical, t)) = 0, t); evalf(\%, 4)$

$$TiempoAlturaMaxima := \frac{351}{1000}\sqrt{95}\sqrt{2}$$

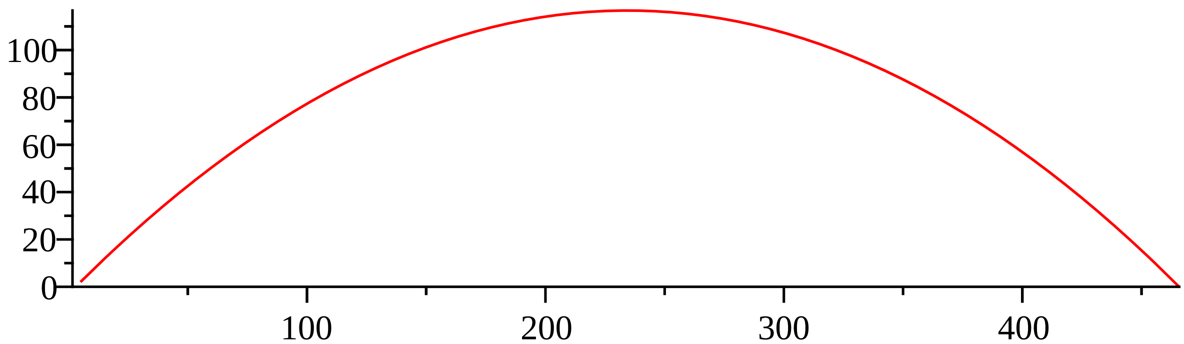
$$4.837 \qquad \textbf{(18)}$$

> $AlturaMaxima := subs(t = TiempoAlturaMaxima, rhs(SolucionVertical)); evalf(\%, 4)$

$$AlturaMaxima := \frac{116700131}{1000000}$$

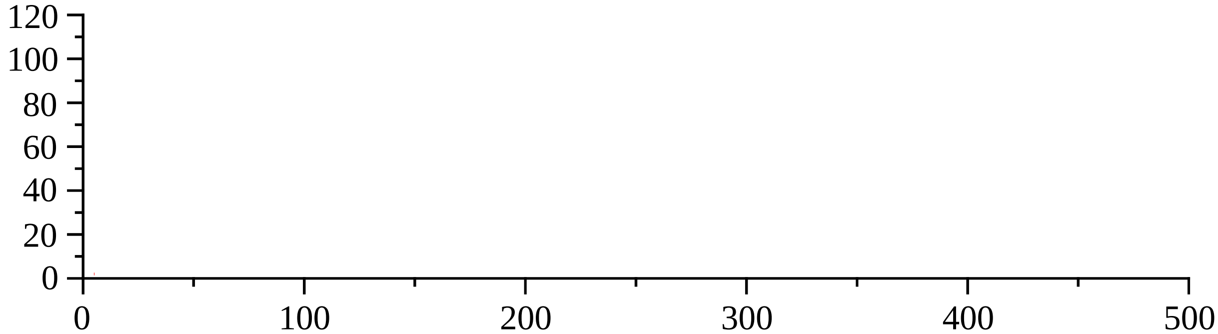
$$116.7 \qquad \textbf{(19)}$$

> $plot([rhs(SolucionHorizontal), rhs(SolucionVertical), t = 0 ..TiempoVuelo_2], scaling = CONSTRAINED)$



> $with(plots):$

> $animatecurve\left(\left[rhs(SolucionHorizontal), rhs(SolucionVertical), t = 0 ..TiempoVuelo_{2}\right], scaling = CONSTRAINED, view = [0 ..500, 0 ..120], frames = 100\right)$



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> *restart*

FLECHA DE ALUMNIO LIGERO

PROBLEMA DINÁMICO: ARCO Y FLECHA

> $Ecuacion := -Hooke \cdot s(t) = Masa \cdot diff(s(t), t\$2)$

$$Ecuacion := -Hooke\, s(t) = Masa \left(\frac{d^2}{dt^2}\, s(t) \right) \quad \textbf{(20)}$$

> $Condiciones := s(0) = -\frac{4914}{10000}, D(s)(0) = 0;$

$$Condiciones := s(0) = -\frac{2457}{5000}, D(s)(0) = 0 \quad \textbf{(21)}$$

> $Gravedad := \frac{98}{10}; Hooke := \frac{(19)}{\left(\frac{5}{10}\right)}; Peso := \frac{(22)}{(1000)}; Masa := \frac{Peso}{Gravedad};$

$$Gravedad := \frac{49}{5}$$

$$Hooke := 38$$

$$Peso := \frac{11}{500}$$

$$Masa := \frac{11}{4900} \tag{22}$$

> *Ecuacion*;

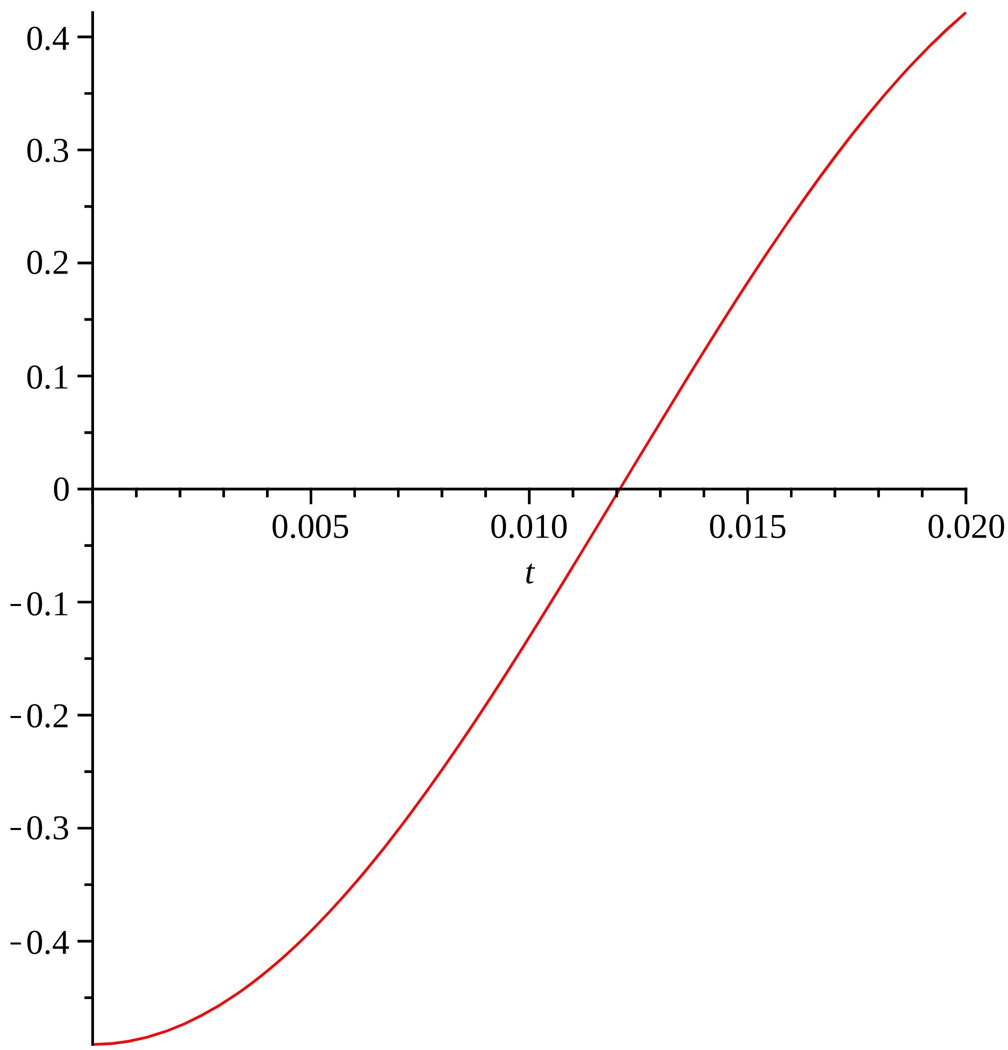
$$-38\, s(t) = \frac{11}{4900} \frac{d^2}{dt^2} s(t) \tag{23}$$

> *Solucion* := *dsolve*({*Ecuacion*, *Condiciones*}); *evalf* (%, 4)

$$Solucion := s(t) = -\frac{2457}{5000} \cos\left(\frac{70}{11} \sqrt{418}\, t\right)$$

$$s(t) = -0.4914 \cos(130.1\, t) \tag{24}$$

> *plot*(*rhs*(*Solucion*), *t* = 0 ..0.02)



> *TiempoImpulso* := *solve*(*rhs*(*Solucion*) = 0, *t*); *evalf* (%, 4)

$$TiempoImpulso := \frac{1}{5320} \pi \sqrt{418}$$

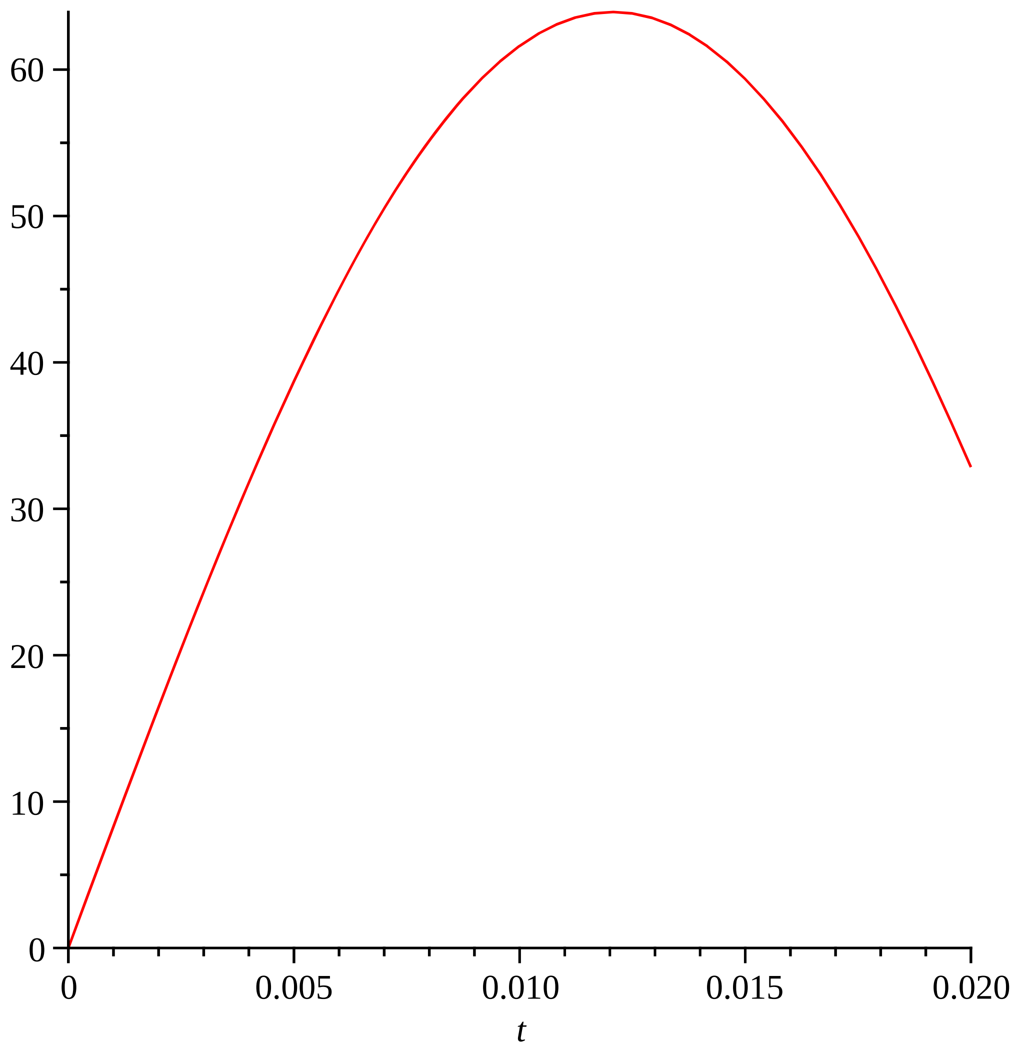
$$0.01208 \tag{25}$$

> $DerivadaSolucion := diff(Solucion, t);\ evalf(\%, 4)$

$$DerivadaSolucion := \frac{d}{dt}\, s(t) = \frac{17199}{5500} \sin\left(\frac{70}{11}\sqrt{418}\, t\right)\sqrt{418}$$

$$\frac{d}{dt}\, s(t) = 63.95 \sin(130.1\, t) \tag{26}$$

> $plot(rhs(DerivadaSolucion), t = 0 ..0.02)$



> $VelocidadInicial := subs(t = TiempoImpulso, rhs(DerivadaSolucion));\ evalf(\%, 4);\ \frac{evalf(\%, 4) \cdot 3600}{1000};$

$$VelocidadInicial := \frac{17199}{5500} \sin\left(\frac{1}{2}\pi\right)\sqrt{418}$$

$$63.95$$

$$230.2200000 \tag{27}$$

>

PROBLEMA CINEMÁTICO: TIRO PARABÓLICO

> $EcuacionVertical := diff(y(t), t\$2) = -Gravedad;\ evalf(\%, 4)$

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

$$\frac{d^2}{dt^2} y(t) = -9.800 \tag{28}$$

> $EcuacionHorizontal := diff(x(t), t) = VelocidadInicial \cdot \cos\left(\frac{Pi}{4}\right); evalf(\%, 4)$

$$EcuacionHorizontal := \frac{d}{dt} x(t) = \frac{17199}{11000} \sqrt{418} \sqrt{2}$$

$$\frac{d}{dt} x(t) = 45.23 \tag{29}$$

> $CondicionesVerticales := y(0) = 2, D(y)(0) = VelocidadInicial \cdot \sin\left(\frac{Pi}{4}\right);$

$$CondicionesVerticales := y(0) = 2, D(y)(0) = \frac{17199}{11000} \sqrt{418} \sqrt{2} \tag{30}$$

> $CondicionesHorizontales := x(0) = 5;$

$$CondicionesHorizontales := x(0) = 5 \tag{31}$$

> $SolucionVertical := dsolve(\{EcuacionVertical, CondicionesVerticales\}); evalf(\%, 4)$

$$SolucionVertical := y(t) = -\frac{49}{10} t^2 + \frac{17199}{11000} \sqrt{418} \sqrt{2}\, t + 2$$

$$y(t) = -4.900\, t^2 + 45.23\, t + 2. \tag{32}$$

> $SolucionHorizontal := dsolve(\{EcuacionHorizontal, CondicionesHorizontales\}); evalf(\%, 4)$

$$SolucionHorizontal := x(t) = \frac{17199}{5500} \sqrt{209}\, t + 5$$

$$x(t) = 45.22\, t + 5. \tag{33}$$

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

$$TiempoVuelo := \frac{351}{1100} \sqrt{209} - \frac{1}{7700} \sqrt{1285901441}, \frac{351}{1100} \sqrt{209} + \frac{1}{7700} \sqrt{1285901441}$$

$$-0.044, 9.272 \tag{34}$$

> $evalf(TiempoVuelo_2, 4)$

$$9.272 \tag{35}$$

> $DistanciaMaxima := subs(t = TiempoVuelo_2, rhs(SolucionHorizontal)); evalf(\%, 4)$

$$DistanciaMaxima := \frac{17199}{5500} \sqrt{209} \left(\frac{351}{1100} \sqrt{209} + \frac{1}{7700} \sqrt{1285901441}\right) + 5$$

$$424.3 \tag{36}$$

> $TiempoAlturaMaxima := solve(rhs(diff(SolucionVertical, t)) = 0, t); evalf(\%, 4)$

$$TiempoAlturaMaxima := \frac{351}{2200} \sqrt{418} \sqrt{2}$$

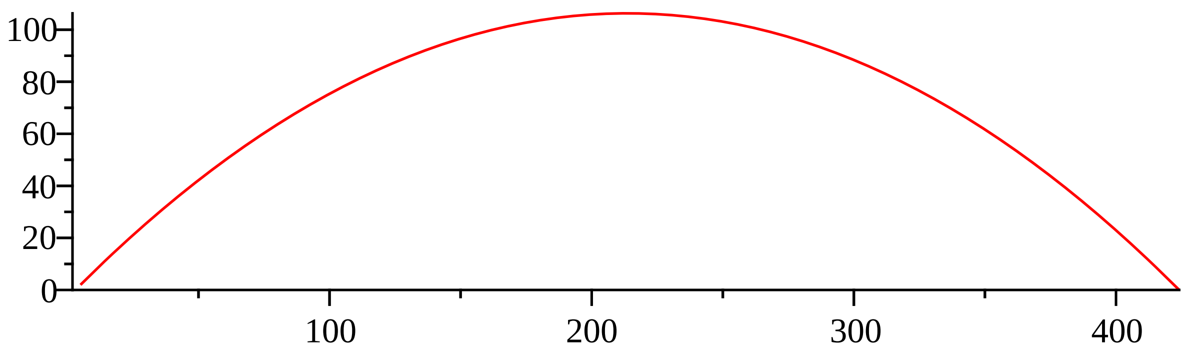
$$4.613 \tag{37}$$

> $AlturaMaxima := subs(t = TiempoAlturaMaxima, rhs(SolucionVertical)); evalf(\%, 4)$

$$AlturaMaxima := \frac{116900131}{1100000}$$

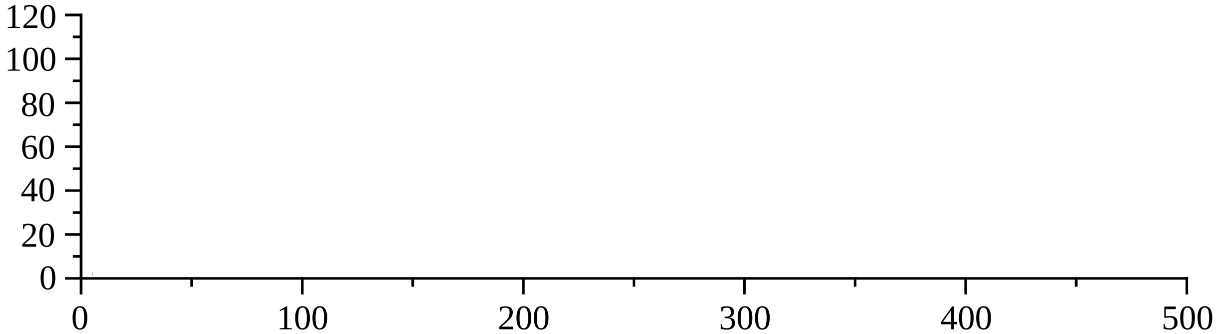
$$106.3 \tag{38}$$

> $plot([rhs(SolucionHorizontal), rhs(SolucionVertical), t = 0..TiempoVuelo_2], scaling = CONSTRAINED)$



> $with(plots):$

> $animatecurve\left(\left[rhs(SolucionHorizontal), rhs(SolucionVertical), t = 0 .. TiempoVuelo_2\right], scaling = CONSTRAINED, view = [0 .. 500, 0 .. 120], frames = 100\right)$



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> *restart*

FLECHA DE ALUMNIO PESADO

PROBLEMA DINÁMICO: ARCO Y FLECHA

> $Ecuacion := -Hooke \cdot s(t) = Masa \cdot diff\,(s(t), t\$2)$

$$Ecuacion := -Hooke\, s(t) = Masa \left(\frac{d^2}{dt^2}\, s(t) \right) \quad \textbf{(39)}$$

> $Condiciones := s(0) = -\frac{4914}{10000}, \mathrm{D}(s)(0) = 0;$

$$Condiciones := s(0) = -\frac{2457}{5000}, \mathrm{D}(s)(0) = 0 \quad \textbf{(40)}$$

> $Gravedad := \frac{98}{10}; Hooke := \frac{(19)}{\left(\frac{5}{10}\right)}; Peso := \frac{(30)}{(1000)}; Masa := \frac{Peso}{Gravedad};$

$$Gravedad := \frac{49}{5}$$

$$Hooke := 38$$

$$Peso := \frac{3}{100}$$

$$Masa := \frac{3}{980} \tag{41}$$

> *Ecuacion*;

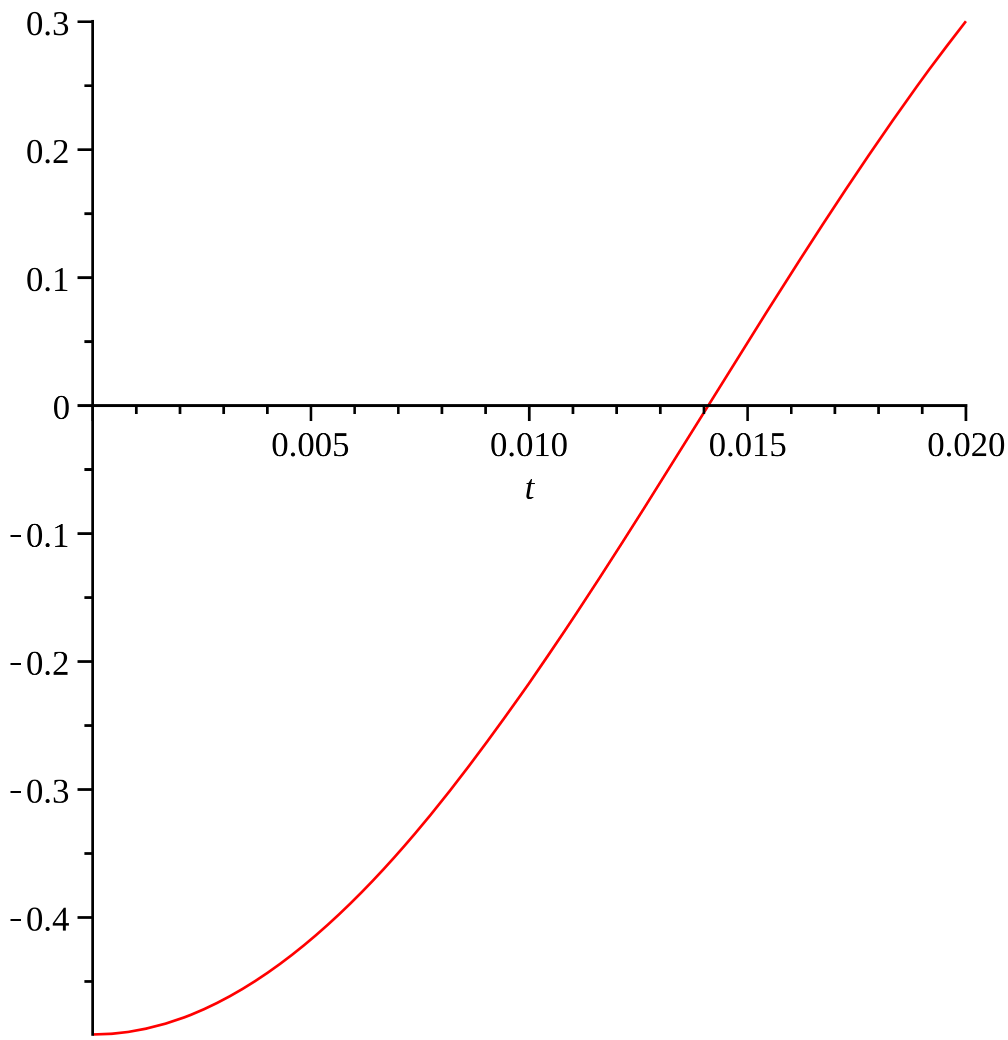
$$-38\, s(t) = \frac{3}{980} \frac{d^2}{dt^2} s(t) \tag{42}$$

> *Solucion* := *dsolve*({*Ecuacion*, *Condiciones*}); *evalf* (%, 4)

$$Solucion := s(t) = -\frac{2457}{5000} \cos\left(\frac{14}{3} \sqrt{570}\, t\right)$$

$$s(t) = -0.4914 \cos(111.4\, t) \tag{43}$$

> *plot*(*rhs*(*Solucion*), *t* = 0 ..0.02)



> *TiempoImpulso* := *solve*(*rhs*(*Solucion*) = 0, *t*); *evalf* (%, 4)

$$TiempoImpulso := \frac{1}{5320} \pi \sqrt{570}$$

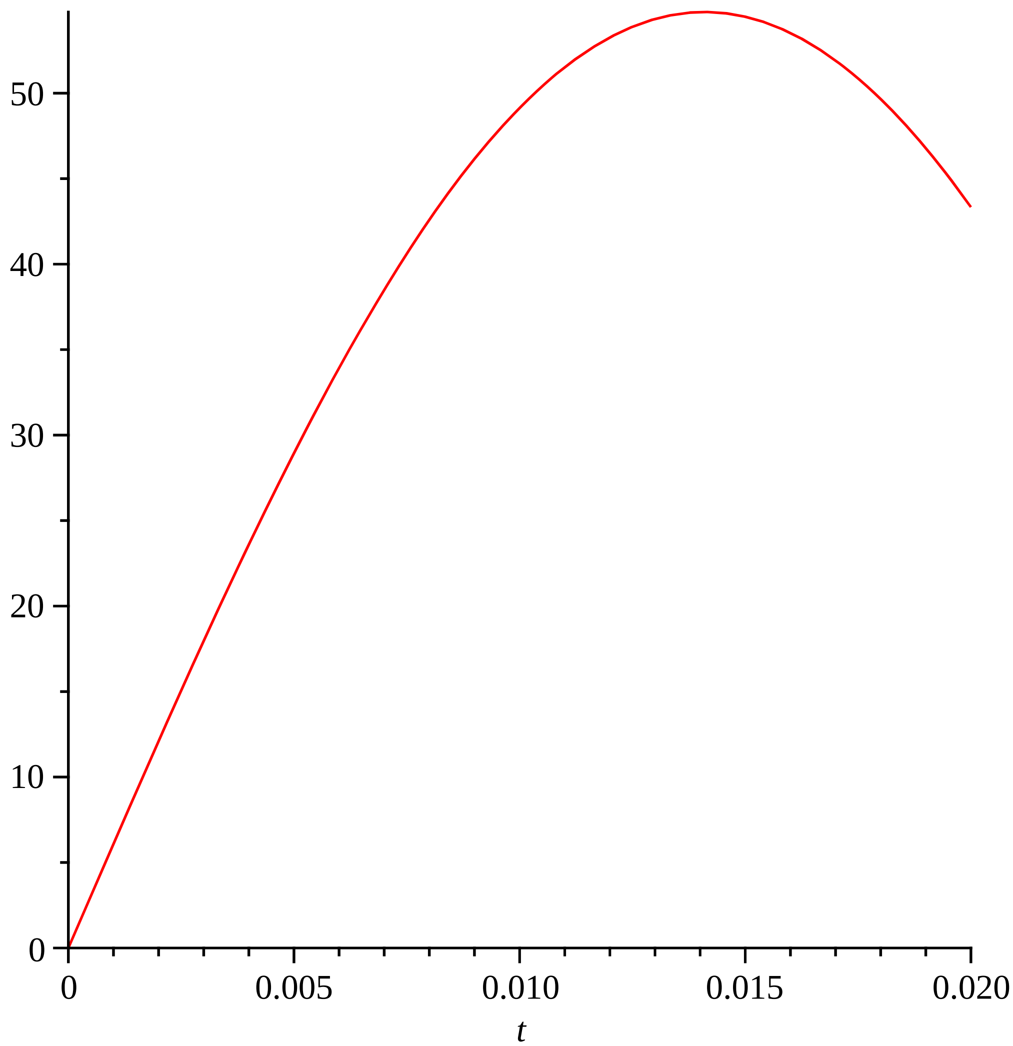
$$0.01410 \tag{44}$$

> $DerivadaSolucion := diff(Solucion, t);\ evalf(\%, 4)$

$$DerivadaSolucion := \frac{d}{dt}\, s(t) = \frac{5733}{2500} \sin\left(\frac{14}{3} \sqrt{570}\, t\right) \sqrt{570}$$

$$\frac{d}{dt}\, s(t) = 54.73 \sin(111.4\, t) \quad \textbf{(45)}$$

> $plot(rhs(DerivadaSolucion), t = 0 ..0.02)$



> $VelocidadInicial := subs(t = TiempoImpulso, rhs(DerivadaSolucion));\ evalf(\%, 4);\ \frac{evalf(\%, 4) \cdot 3600}{1000};$

$$VelocidadInicial := \frac{5733}{2500} \sin\left(\frac{1}{2}\pi\right) \sqrt{570}$$

$$54.73$$

$$197.0280000 \quad \textbf{(46)}$$

>

PROBLEMA CINEMÁTICO: TIRO PARABÓLICO

> $EcuacionVertical := diff(y(t), t\$2) = -Gravedad;\ evalf(\%, 4)$

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

$$\frac{d^2}{dt^2}\, y(t) = -9.800 \tag{47}$$

> *EcuacionHorizontal* := *diff*(*x*(*t*), *t*) = *VelocidadInicial*·cos(Pi/4); *evalf*(%, 4)

$$EcuacionHorizontal := \frac{d}{dt}\, x(t) = \frac{5733}{5000}\sqrt{570}\,\sqrt{2}$$

$$\frac{d}{dt}\, x(t) = 38.71 \tag{48}$$

> *CondicionesVerticales* := *y*(0) = 2, D(*y*)(0) = *VelocidadInicial*·sin(Pi/4);

$$CondicionesVerticales := y(0) = 2,\ D(y)(0) = \frac{5733}{5000}\sqrt{570}\,\sqrt{2} \tag{49}$$

> *CondicionesHorizontales* := *x*(0) = 5;

$$CondicionesHorizontales := x(0) = 5 \tag{50}$$

> *SolucionVertical* := *dsolve*({*EcuacionVertical*, *CondicionesVerticales*}); *evalf*(%, 4)

$$SolucionVertical := y(t) = -\frac{49}{10}\, t^2 + \frac{5733}{5000}\sqrt{570}\,\sqrt{2}\, t + 2$$

$$y(t) = -4.900\, t^2 + 38.71\, t + 2. \tag{51}$$

> *SolucionHorizontal* := *dsolve*({*EcuacionHorizontal*, *CondicionesHorizontales*}); *evalf*(%, 4)

$$SolucionHorizontal := x(t) = \frac{5733}{2500}\sqrt{285}\, t + 5$$

$$x(t) = 38.71\, t + 5. \tag{52}$$

> *TiempoVuelo* := *solve*(*rhs*(*SolucionVertical*) = 0, *t*); *evalf*(%, 4)

$$TiempoVuelo := \frac{117}{500}\sqrt{285} - \frac{1}{3500}\sqrt{196166885},\ \frac{117}{500}\sqrt{285} + \frac{1}{3500}\sqrt{196166885}$$

$$-0.053,\ 7.953 \tag{53}$$

> *evalf*($TiempoVuelo_2$, 4);

$$7.953 \tag{54}$$

> *DistanciaMaxima* := *subs*(*t* = $TiempoVuelo_2$, *rhs*(*SolucionHorizontal*)); *evalf*(%, 4)

$$DistanciaMaxima := \frac{5733}{2500}\sqrt{285}\left(\frac{117}{500}\sqrt{285} + \frac{1}{3500}\sqrt{196166885}\right) + 5$$

$$312.7 \tag{55}$$

> *TiempoAlturaMaxima* := *solve*(*rhs*(*diff*(*SolucionVertical*, *t*)) = 0, *t*); *evalf*(%, 4)

$$TiempoAlturaMaxima := \frac{117}{1000}\sqrt{570}\,\sqrt{2}$$

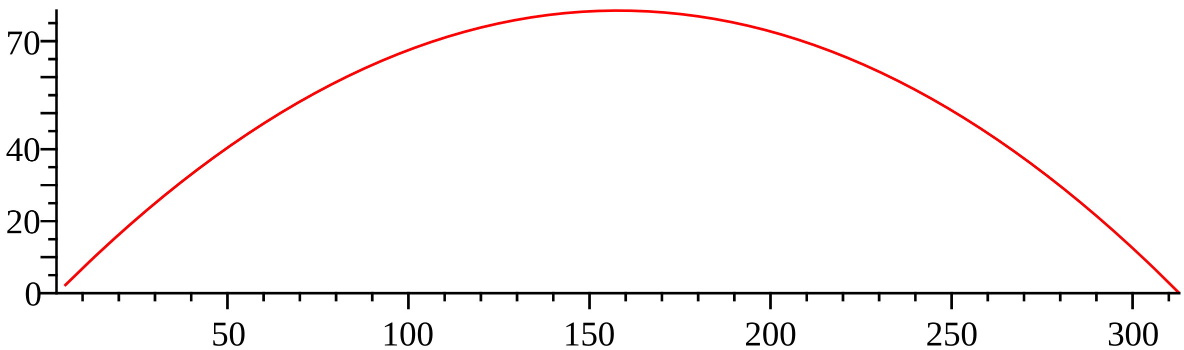
$$3.949 \tag{56}$$

> *AlturaMaxima* := *subs*(*t* = *TiempoAlturaMaxima*, *rhs*(*SolucionVertical*)); *evalf*(%, 4)

$$AlturaMaxima := \frac{39233377}{500000}$$

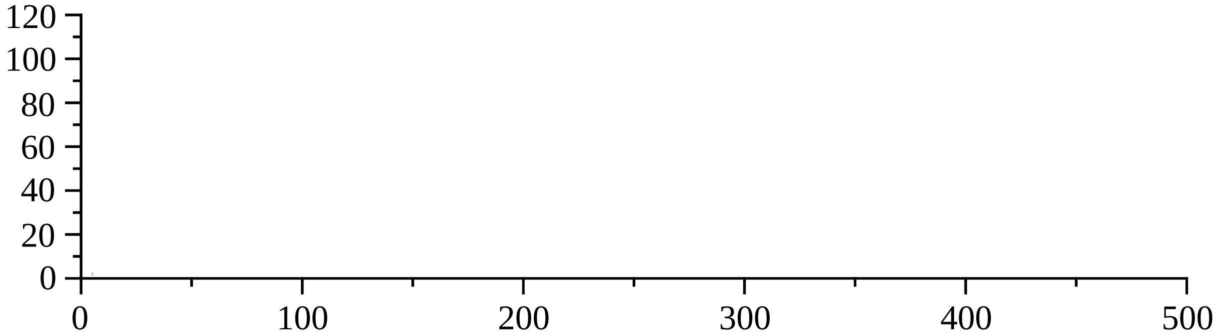
$$78.47 \tag{57}$$

> *plot*([*rhs*(*SolucionHorizontal*), *rhs*(*SolucionVertical*), *t* = 0 ..$TiempoVuelo_2$], *scaling* = *CONSTRAINED*)



> $with(plots):$

> $animatecurve\left(\left[rhs(SolucionHorizontal), rhs(SolucionVertical), t = 0 ..TiempoVuelo_2\right], scaling = CONSTRAINED, view = [0 ..500, 0 ..120], frames = 100\right)$



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