```
> restart :
```

PROBLEMA DEL ARCO Y FLECHA CON LOS MÉTODOS DEL PROGRAMA DE ESTUDIOS

```
> gravedad := 981/100; Peso_flecha := 23/1000; Hooke := (1825/100)/(5/10);
```

$$gravedad := \frac{981}{100}$$

$$Peso_{flecha} := \frac{23}{1000}$$

$$Hooke := \frac{73}{2} \quad (1)$$

```
> Ecuacion := diff(s(t), t$2) + (Hooke·gravedad/Peso_flecha)·s(t) = 0;
```

$$Ecuacion := \frac{d^2}{dt^2} s(t) + \frac{358065}{23} s(t) = 0 \quad (2)$$

```
> EcuacionCaracteristica := m··2 + (Hooke·gravedad/Peso_flecha) = 0;
```

$$EcuacionCaracteristica := m^2 + \frac{358065}{23} = 0 \quad (3)$$

```
> Raiz := solve(EcuacionCaracteristica);
```

$$Raiz := \frac{3}{23} I\sqrt{915055}, -\frac{3}{23} I\sqrt{915055} \quad (4)$$

```
> Sol_1 := cos(Im(Raiz_1)·t); Sol_2 := sin(Im(Raiz_1)·t);
```

$$Sol_1 := \cos\left(\frac{3}{23}\sqrt{915055}\, t\right)$$

$$Sol_2 := \sin\left(\frac{3}{23}\sqrt{915055}\, t\right) \quad (5)$$

```
> SolucionGeneral := s(t) = C1·Sol_1 + C2·Sol_2;
```

$$SolucionGeneral := s(t) = C1 \cos\left(\frac{3}{23}\sqrt{915055}\, t\right) + C2 \sin\left(\frac{3}{23}\sqrt{915055}\, t\right) \quad (6)$$

```
> Condiciones := s(0) = -4964/10000, D(s)(0) = 0;
```

$$Condiciones := s(0) = -\frac{1241}{2500}, D(s)(0) = 0 \quad (7)$$

```
> sistema := subs(t = 0, rhs(SolucionGeneral) = -4964/10000), subs(t = 0,
    rhs(diff(SolucionGeneral, t)) = 0) : sistema_1; sistema_2;
```

$$C1 = -\frac{1241}{2500}$$

$$\frac{3}{23} C2 \sqrt{915055} = 0 \quad (8)$$

```
> SOL := solve({sistema}, {C1, C2});
```

$$SOL := \left\{ C1 = -\frac{1241}{2500},\ C2 = 0 \right\} \quad (9)$$

> $SolucionParticular := subs\left(C1 = rhs\left(SOL_1\right),\ C2 = rhs\left(SOL_2\right),\ SolucionGeneral\right);$

$$SolucionParticular := s(t) = -\frac{1241}{2500}\cos\left(\frac{3}{23}\sqrt{915055}\ t\right) \quad (10)$$

>

COMPROBACION

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

$$SolucionDinamica := s(t) = -\frac{1241}{2500}\cos\left(\frac{3}{23}\sqrt{915055}\ t\right) \quad (11)$$

CALCULAR TIEMPO Y VELOCIDAD IMPULSADA

> $tiempo_{impulso} := solve(rhs(SolucionParticular) = 0, t);\ evalf(\%, 4);$

$$tiempo_{impulso} := \frac{1}{238710}\pi\sqrt{915055}$$

$$0.01259 \quad (12)$$

> $VelocidadSalida := subs\left(t = tiempo_{impulso},\ rhs(diff(SolucionParticular, t))\right);\ evalf(\%, 4);$
> $evalf(\%\%, 4)\cdot 3.6;$

$$VelocidadSalida := \frac{3723}{57500}\sin\left(\frac{1}{2}\pi\right)\sqrt{915055}$$

$$61.94$$

$$222.984 \quad (13)$$

RESOLVER EL TIRO PARABÓLICO

> $EcuacionVertical := diff(y(t), t\$2) = -gravedad;$

$$EcuacionVertical := \frac{d^2}{dt^2}y(t) = -\frac{981}{100} \quad (14)$$

> $EcuacionVerticalHomogenea := lhs(EcuacionVertical) = 0;\ Q(t) := rhs(EcuacionVertical);$

$$EcuacionVerticalHomogenea := \frac{d^2}{dt^2}y(t) = 0$$

$$Q(t) := -\frac{981}{100} \quad (15)$$

> $EcuacionVerticalCaracteristica := m\cdot\cdot 2 = 0;$

$$EcuacionVerticalCaracteristica := m^2 = 0 \quad (16)$$

> $RaizVertical := solve(EcuacionVerticalCaracteristica);$

$$RaizVertical := 0,\ 0 \quad (17)$$

> $SolVert_1 := t\cdot\exp\left(RaizVertical_1\cdot t\right);\ SolVert_2 := \exp\left(RaizVertical_2\cdot t\right);$

$$SolVert_1 := t$$

$$SolVert_2 := 1 \quad (18)$$

> $SolucionVerticalHomogenea := y(t) = C3\cdot SolVert_1 + C4\cdot SolVert_2;$

$$SolucionVerticalHomogenea := y(t) = C3\ t + C4 \quad (19)$$

> $SolucionVerticalNoHomogenea := y(t) = A(t)\cdot SolVert_1 + B(t)\cdot SolVert_2;$

$$SolucionVerticalNoHomogenea := y(t) = A(t)\ t + B(t) \quad (20)$$

```
> with(linalg):
> AA := wronskian([SolVert[1], SolVert[2]], t); BB := array([0, Q(t)]);
```

$$AA := \begin{bmatrix} t & 1 \\ 1 & 0 \end{bmatrix}$$

$$BB := \begin{bmatrix} 0 \\ -\frac{981}{100} \end{bmatrix} \quad (21)$$

```
> SOLvertical := linsolve(AA, BB);
```

$$SOLvertical := \begin{bmatrix} -\frac{981}{100} & \frac{981}{100}\, t \end{bmatrix} \quad (22)$$

```
> Aprima := SOLvertical[1]; Bprima := SOLvertical[2];
```

$$Aprima := -\frac{981}{100}$$

$$Bprima := \frac{981}{100}\, t \quad (23)$$

```
> A(t) := int(Aprima, t) + C3; B(t) := int(Bprima, t) + C4;
```

$$A(t) := -\frac{981}{100}\, t + C3$$

$$B(t) := \frac{981}{200}\, t^2 + C4 \quad (24)$$

```
> SolucionVerticalNoHomogenea;
```

$$y(t) = \left(-\frac{981}{100}\, t + C3\right) t + \frac{981}{200}\, t^2 + C4 \quad (25)$$

```
> SolucionVerticalGeneral := simplify(SolucionVerticalNoHomogenea);
```

$$SolucionVerticalGeneral := y(t) = -\frac{981}{200}\, t^2 + C3\, t + C4 \quad (26)$$

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

$$CondicionesVerticales := y(0) = 2,\ D(y)(0) = \frac{3723}{115000}\sqrt{915055}\,\sqrt{2} \quad (27)$$

```
> sistemaVertical := subs(t = 0, rhs(SolucionVerticalGeneral) = 2), subs(t = 0,
    rhs(diff(SolucionVerticalGeneral, t)) = VelocidadSalida·sin(Pi/4)) : sistemaVertical[1];
    sistemaVertical[2];
```

$$C4 = 2$$

$$C3 = \frac{3723}{115000}\sqrt{915055}\,\sqrt{2} \quad (28)$$

```
> SolucionVerticalParticular := subs(C3 = rhs(sistemaVertical[2]), C4 = rhs(sistemaVertical[1]),
    SolucionVerticalGeneral); evalf(%, 4);
```

$$SolucionVerticalParticular := y(t) = -\frac{981}{200}\, t^2 + \frac{3723}{115000}\sqrt{915055}\,\sqrt{2}\, t + 2$$

(29)

$$y(t) = -4.905\,t^2 + 43.80\,t + 2. \quad \textbf{(29)}$$

COMPROBACIÓN 2

> $SolucionFinalVertical := dsolve(\{EcuacionVertical, CondicionesVerticales\});$

$$SolucionFinalVertical := y(t) = -\frac{981}{200}\,t^2 + \frac{3723}{115000}\sqrt{915055}\,\sqrt{2}\,t + 2 \quad \textbf{(30)}$$

CONTINUAR TIRO PARABÓLICO

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

$$EcuacionHorizontal := \frac{d}{dt}x(t) = \frac{3723}{115000}\sqrt{915055}\,\sqrt{2} \quad \textbf{(31)}$$

> $p(t) := 0; q(t) := rhs(EcuacionHorizontal);$

$$p(t) := 0$$

$$q(t) := \frac{3723}{115000}\sqrt{915055}\,\sqrt{2} \quad \textbf{(32)}$$

> $SolucionGeneralHorizontal := x(t) = C5 \cdot \exp(-int(p(t), t)) + \exp(-int(p(t), t)) \cdot int(\exp(int(p(t), t)) \cdot q(t), t)$

$$SolucionGeneralHorizontal := x(t) = C5 + \frac{3723}{115000}\sqrt{915055}\,\sqrt{2}\,t \quad \textbf{(33)}$$

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

$$CondicionesHorizontales := x(0) = 5 \quad \textbf{(34)}$$

> $parametro := subs(t = 0, rhs(SolucionGeneralHorizontal) = 5)$

$$parametro := C5 = 5 \quad \textbf{(35)}$$

> $SolucionParticularHorizontal := subs(C5 = rhs(parametro), SolucionGeneralHorizontal);$

$$SolucionParticularHorizontal := x(t) = 5 + \frac{3723}{115000}\sqrt{915055}\,\sqrt{2}\,t \quad \textbf{(36)}$$

>

COMPROBACION 3

> $SolucionFinalHorizontal := dsolve(\{EcuacionHorizontal, CondicionesHorizontales\});$

$$SolucionFinalHorizontal := x(t) = \frac{3723}{115000}\sqrt{1830110}\,t + 5 \quad \textbf{(37)}$$

>

CÁLCULO FINAL RESULTADOS

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

$$TiempoVuelo := \frac{1241}{376050}\sqrt{915055}\,\sqrt{2} - \frac{1}{376050}\sqrt{2876178638910},\ \frac{1241}{376050}\sqrt{915055}\,\sqrt{2} + \frac{1}{376050}\sqrt{2876178638910}$$

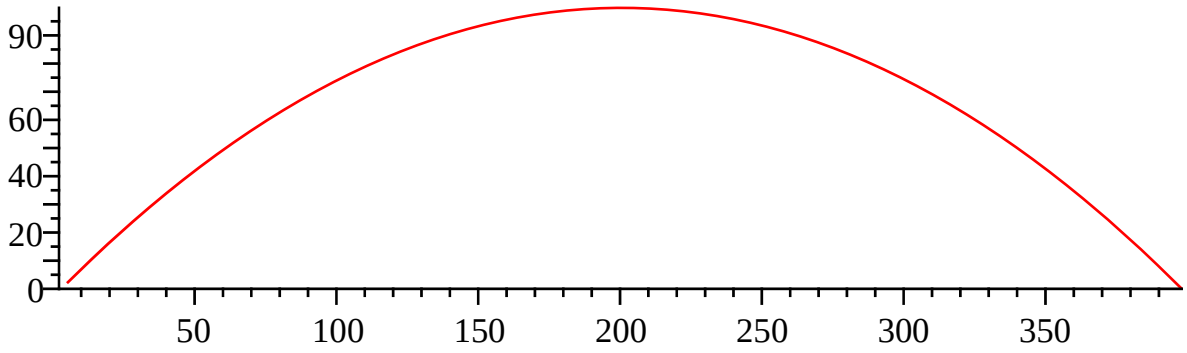
$$-0.045,\ 8.975 \quad \textbf{(38)}$$

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

$$DistanciaMaxima := 5 + \frac{3723}{115000}\sqrt{915055}\,\sqrt{2}\left(\frac{1241}{376050}\sqrt{915055}\,\sqrt{2} + \frac{1}{376050}\sqrt{2876178638910}\right)$$

398.0 **(39)**

```
> plot([rhs(SolucionParticularHorizontal), rhs(SolucionVerticalParticular), t = 0
    ..TiempoVuelo2], scaling = CONSTRAINED);
```




```
>
>
```