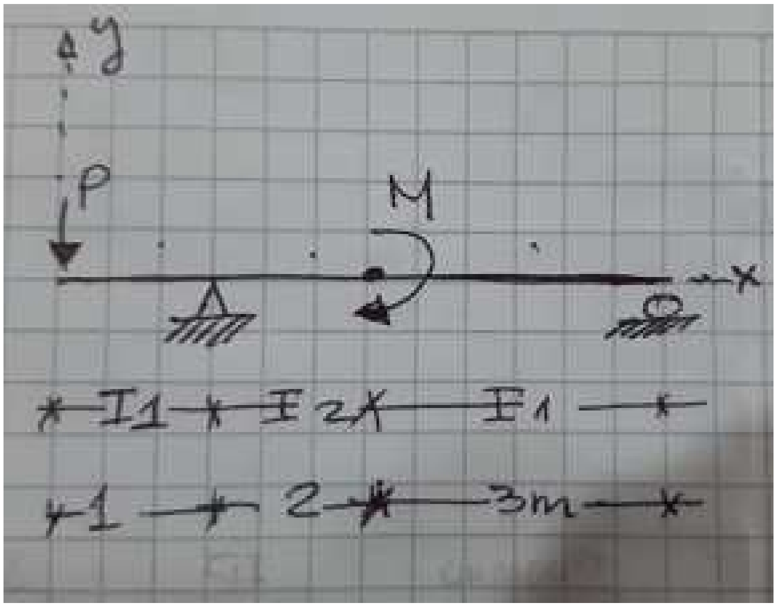
Determinar las funciones que representan la **curva elástica** por flexión pura de la viga de la figura (utilizar el método de la Carga Unitaria Ficticia):




#1: [CaseMode := Sensitive, InputMode := Word]

#2: $\left[P := 5,\ M := 2,\ E := 2\cdot 10^{7},\ I1 := 1.9\cdot 10^{-4},\ I2 := 2.2\cdot 10^{-4}\right]$

Equilibrio estático:

#3: [R1 :=, R2 :=]

#4: $\begin{bmatrix} R1 + R2 - P = 0 \\ R2\cdot 5 - M + P\cdot 1 = 0 \end{bmatrix}$

#5: $\left[R1 := \frac{28}{5},\ R2 := -\frac{3}{5}\right]$

#6: $[R1 = 5.6 \wedge R2 = -0.6]$

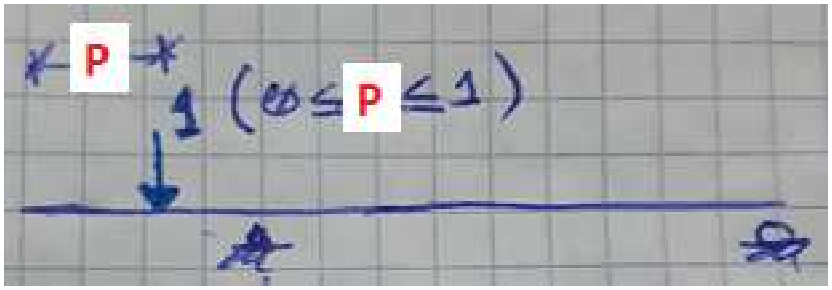
Momentos flectores: MF1(0≤x≤1),MF2(1≤x≤3),MF3(3≤x≤6)

#7: [MF1(x) :=, MF2(x) :=, MF3(x) :=]

#8: $\begin{bmatrix} MF1(x) := -P\cdot x \\ MF2(x) := -P\cdot x + R1\cdot (x - 1) \\ MF3(x) := -P\cdot x + R1\cdot (x - 1) + M \end{bmatrix}$

#9: $$\left[\begin{array}{c} MF1(x) := -5\cdot x \\ MF2(x) := 0.6\cdot x - 5.6 \\ MF3(x) := 0.6\cdot x - 3.6 \end{array}\right]$$

I) Aplicación de la carga unitaria ficticia entre $0\leq p\leq 1$:




Equilibrio estático:

#10: [r1I :=, r2I :=]

#11: $$\left[\begin{array}{c} r1I + r2I - 1 = 0 \\ r2I\cdot 5 + 1\cdot(1 - p) = 0 \end{array}\right]$$

#12: $$[r1I := 1.2 - 0.2\cdot p,\ r2I := 0.2\cdot p - 0.2]$$

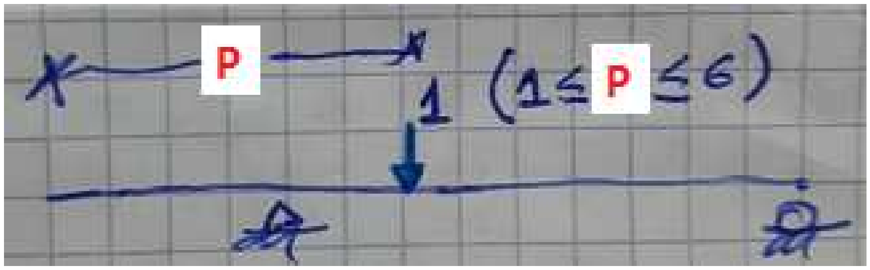
Momentos flectores de la viga con carga unitaria ficticia: $mf1(0\leq x\leq p)$,$mf2(p\leq x\leq 1)$,$mf3(1\leq x\leq 6)$

#13: [mf1I(x) :=, mf2I(x) :=, mf3I(x) :=]

#14: $$\left[\begin{array}{c} mf1I(x) := 0 \\ mf2I(x) := -1\cdot(x - p) \\ mf3I(x) := -1\cdot(x - p) + r1I\cdot(x - 1) \end{array}\right]$$

#15: $$\left[\begin{array}{c} mf1I(x) := 0 \\ mf2I(x) := p - x \\ mf3I(x) := x\cdot(0.2 - 0.2\cdot p) + 1.2\cdot p - 1.2 \end{array}\right]$$

II) Aplicación de la carga unitaria ficticia entre 1<=p<=6:




Equilibrio estático:

#16: $[r1II :=, r2II :=]$

#17: $$\begin{bmatrix} r1II + r2II - 1 = 0 \\ r2II \cdot 5 - 1 \cdot (p - 1) = 0 \end{bmatrix}$$

#18: $[r1II := 1.2 - 0.2 \cdot p, r2II := 0.2 \cdot p - 0.2]$

Momentos flectores de la viga con carga unitaria ficticia: $mf1(0 \le x \le 1)$,$mf2(1 \le x \le p)$,$mf3(p \le x \le 6)$

#19: $[mf1II(x) :=, mf2II(x) :=, mf3II(x) :=]$

#20: $$\begin{bmatrix} mf1II(x) := 0 \\ mf2II(x) := r1II \cdot (x - 1) \\ mf3II(x) := r1II \cdot (x - 1) - 1 \cdot (x - p) \end{bmatrix}$$

#21: $$\begin{bmatrix} mf1II(x) := 0 \\ mf2II(x) := 0.2 \cdot x \cdot (6 - p) + 0.2 \cdot (p - 6) \\ mf3II(x) := 0.2 \cdot x \cdot (1 - p) + 1.2 \cdot (p - 1) \end{bmatrix}$$

Cálculo de las funciones de deflexión: $\Delta1(0 \le p \le 1)$, $\Delta(1 \le p \le 3)$, $\Delta(3 \le p \le 6)$

#22: $[\Delta1(p) :=, \Delta2(p) :=, \Delta3(p) :=]$

#23: $$\begin{bmatrix} \Delta1(p) := \frac{1}{E} \cdot \left( \frac{1}{I1} \cdot \int_0^p MF1(x) \cdot mf1I(x)\, dx + \frac{1}{I1} \cdot \int_p^1 MF1(x) \cdot mf2I(x)\, dx + \right. \\ \Delta2(p) := \frac{1}{E} \cdot \left( \frac{1}{I1} \cdot \int_0^1 MF1(x) \cdot mf1II(x)\, dx + \frac{1}{I2} \cdot \int_1^p MF2(x) \cdot mf2II(x)\, dx + \right. \\ \Delta3(p) := \frac{1}{E} \cdot \left( \frac{1}{I1} \cdot \int_0^1 MF1(x) \cdot mf1II(x)\, dx + \frac{1}{I2} \cdot \int_1^3 MF2(x) \cdot mf2II(x)\, dx + \right. \end{bmatrix}$$

$$\left.\frac{1}{I2}\cdot\int_1^3 MF2(x)\cdot mf3I(x)\,dx + \frac{1}{I1}\cdot\int_3^6 MF3(x)\cdot mf3I(x)\,dx\right)\ \Big]$$

$$\left.\frac{1}{I2}\cdot\int_p^3 MF2(x)\cdot mf3II(x)\,dx + \frac{1}{I1}\cdot\int_3^6 MF3(x)\cdot mf3II(x)\,dx\right)$$

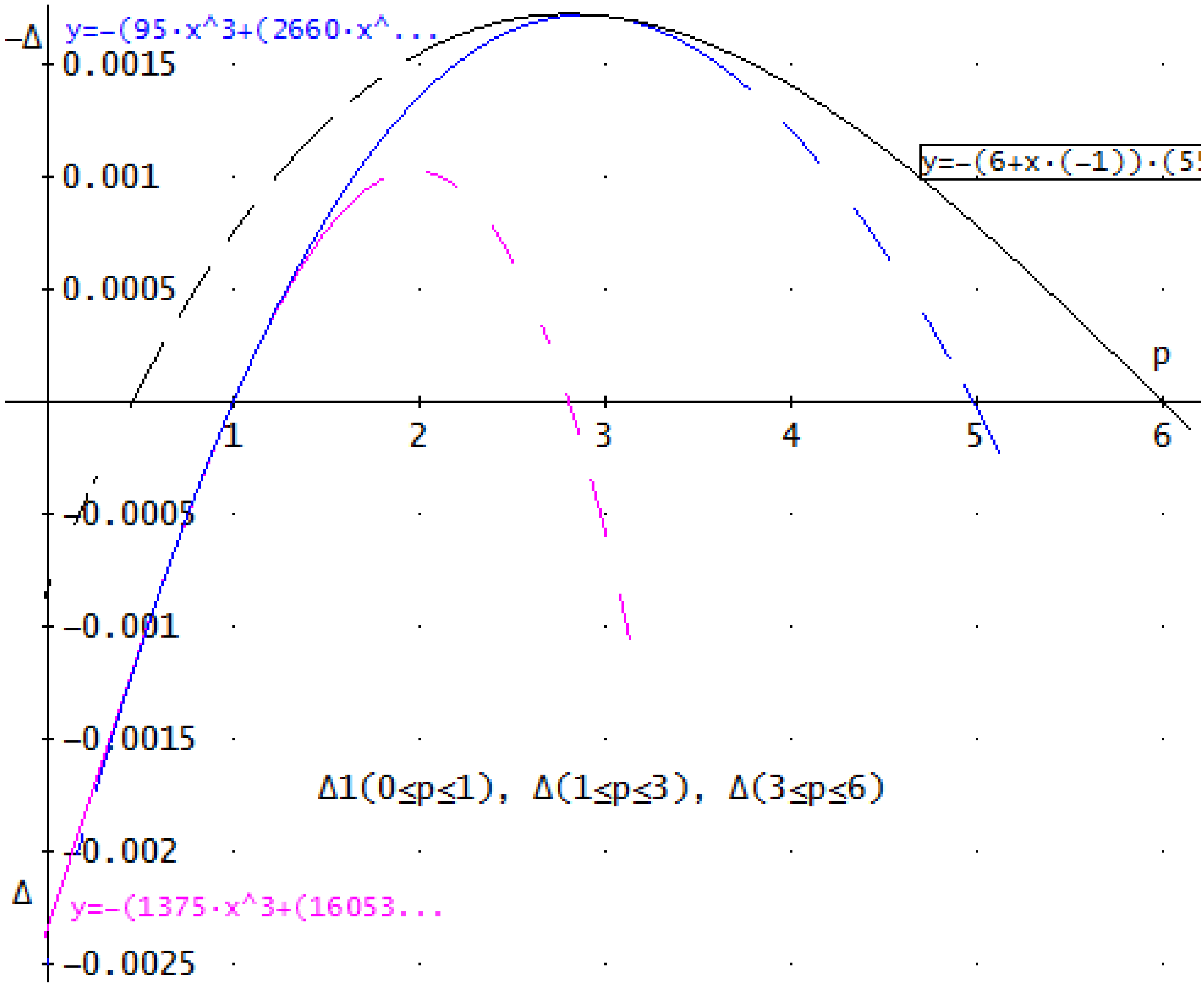
$$\left.\frac{1}{I1}\cdot\int_3^p MF3(x)\cdot mf2II(x)\,dx + \frac{1}{I1}\cdot\int_p^6 MF3(x)\cdot mf3II(x)\,dx\right)\ \Big]$$

#24:

$$\left[\begin{array}{c} \Delta1(p) := \dfrac{1375\cdot p^3 - 16053\cdot p + 14678}{6270000} \\ \Delta2(p) := -\dfrac{95\cdot p^3 - 2660\cdot p^2 + 12987\cdot p - 10422}{4180000} \\ \Delta3(p) := \dfrac{(6 - p)\cdot(55\cdot p^2 - 660\cdot p + 291)}{2090000} \end{array}\right]$$

#25:

$$\left[\begin{array}{c} \Delta1(p) := 0.0002192982456\cdot(p^3 - 3\cdot p + 2) \\ \Delta2(p) := -4.545454545\cdot10^{-6}\cdot(5\cdot p^3 - 140\cdot p^2 + 621\cdot p - 486) \\ \Delta3(p) := 5.263157894\cdot10^{-6}\cdot(6 - p)\cdot(5\cdot p^2 - 60\cdot p + 99) \end{array}\right]$$




La deflexión máxima positiva (hacia abajo) se prresenta en el voladizo, en Δ1(0) y la deflexión máxima negativa (hacia arriga) se prresenta en un punto cercano a p=3m, sin especificar apriori la Δ2 y Δ3:

#26: $$\Delta 1(0) = 0.002340988835$$

#27: $$\frac{d}{dp} \Delta 2(p) = 0$$

Puntos de deflexión máxima para la función Δ2(1≤p≤3):

#28: $$\frac{d}{dp} \Delta 2(p) = 0$$

#29: $$p = 2.887971429$$

#30: $$\Delta 2(2.887971429) = -0.001719358998$$

Puntos de deflexión máxima para la función Δ3(3≤p≤6):

#31: $\frac{d}{dp}\,\Delta 3(p) = 0$

#32: $p\cdot(p - 12) = -25.76363636$

#33: $p = 2.800568231 \vee p = 9.199431768$

#34: $\Delta 3(3) = -0.001713875598$

El punto de deflexión máxima negativa (hacia arriba) está en 2.88m con 1.719 mm