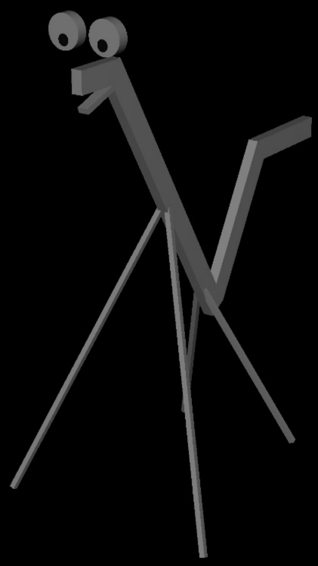
$x^2 - x^3 = 11$

$x = ?$ (avec réponses dans R et C)

résultats attendus:

- $x = -1,93570$
- $x = 1,46785 + 1,87831 \cdot i$
- $x = 1,46785 - 1,87831 \cdot i$



---------- Q U E S T I O N ----------

$x^2 - x^3 = 11$

x = ? (avec réponses dans R et C)

---------- R É P O N S E ----------

$x^2 - x^3 = 11$

$x^3 - x^2 + 11 = 0$

----- se débarrasser de x^2 -----

$x = k - b/3a$

$x = k - (-1)/(3\cdot 1)$

$x = k + 1/3$

si $x = k + 1/3$ alors $x^3 - x^2 + 11 = 0$ devient:

$(k + 1/3)^3 - (k + 1/3)^2 + 11 = 0$

$(k^3 + 3\cdot k^2\cdot(1/3) + 3\cdot k\cdot(1/3)^2 + (1/3)^3) - (k^2 + 2\cdot k\cdot(1/3) + (1/3)^2) + 11 = 0$

$(k^3 + k^2 + k/3 + 1/27) - (k^2 + (2k)/3 + 1/9) + 11 = 0$

$k^3 + k^2 + k/3 + 1/27 - k^2 - (2k)/3 - 1/9 + 11 = 0$

$k^3 + k^2 - k^2 + k/3 - (2k)/3 + 1/27 - 1/9 + 11 = 0$

$k^3 - k/3 + 1/27 - 3/27 + 297/27 = 0$

$k^3 - k/3 + 295/27 = 0$

----- méthode Cardano/Tartaglia -----

$k^3 - k/3 + 295/27 = 0$ est basé sur le modèle $k^3 + pk + q = 0$, avec:

$p = -1/3$

$q = 295/27$

recall: $k = [-q/2 + \sqrt{q^2/4 + p^3/27}]^{(1/3)} + [-q/2 - \sqrt{q^2/4 + p^3/27}]^{(1/3)}$

$$k = \left[-\frac{295/27}{2} + \sqrt{\frac{(295/27)^2}{4} + \frac{(-1/3)^3}{27}}\right]^{1/3} +$$

$$\left[-\frac{295/27}{2} - \sqrt{\frac{(295/27)^2}{4} + \frac{(-1/3)^3}{27}}\right]^{1/3}$$

$$k = -2{,}26904$$

$$x = k + 1/3 = -2{,}26904 + 1/3 = -1{,}93570$$

$$\boxed{x = -1{,}93570}$$

----- dans C -----

$$x^2 - x^3 = 11$$

$$\begin{cases} L1: x^3 - x^2 + 11 = 0 \\ L2: x + 1{,}93570 \end{cases}$$

$$L1/L2: (x^3 - x^2 + 0 \cdot x + 11)/(x + 1{,}93570) = x^2 - 2{,}93570 \cdot x + 5{,}68263$$

$$x^2 - 2{,}93570 \cdot x + 5{,}68263 = 0$$

$$\Delta = (-2{,}93570)^2 - 4 \cdot 1 \cdot 5{,}68263 = -14{,}11218$$

$$\sqrt{\Delta} = \sqrt{(-14{,}11218)} = \pm i\sqrt{14{,}11218}$$

- $\sqrt{\Delta} = +i\sqrt{14{,}11218}$: $x = (-(-2{,}93570) + i\sqrt{14{,}11218})/2 \cdot 1$

  $= (2{,}93570 + i\sqrt{14{,}11218})/2 = 1{,}46785 + 1{,}87831 \cdot i$

- $\sqrt{\Delta} = -i\sqrt{14{,}11218}$: $x = (-(-2{,}93570) - i\sqrt{14{,}11218})/2 \cdot 1$

  $= (2{,}93570 - i\sqrt{14{,}11218})/2 = 1{,}46785 - 1{,}87831 \cdot i$

$$\boxed{x = 1{,}46785 + 1{,}87831 \cdot i}$$

$$\boxed{x = 1{,}46785 - 1{,}87831 \cdot i}$$

la division euclidienne de L1 / L2 est présentée dans la page suivante

division euclidienne (L1/L2):

```
x³ -         x² +       0·x + 11 | x + 1,93570
                                 +-------------------------
x³ + 1,93570·x²                  | x² - 2,93570·x + 5,68263
---------------                  |
    -2,93570·x² + 0x             |
                                 |
    -2,93570·x² - 5,68263·x      |
    -----------------------      |
                  5,68263·x + 11 |
                                 |
                  5,68263·x + 11 |
                  -------------- |
                               0 |
```