

Ex 2.3.1

$$\begin{array}{r}
 a) \quad x^3 - 8x^2 + 16x - 5 \\
 \underline{-x^3 + 5x^2} \\
 -3x^2 + 16x - 5 \\
 \underline{+3x^2 + 15x} \\
 x - 5 \\
 \underline{x - 5} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 x-5 \\
 \hline
 x^2-3x+1
 \end{array}$$

$$\Rightarrow \underline{x^3 - 8x^2 + 16x - 5 = (x-5)(x^2 - 3x + 1)}$$

$$\begin{array}{r}
 b) \quad x^5 - x^4 - 4x^3 + 2x^2 + 3x - 1 \\
 \underline{-x^5 + 2x^4 + x^3} \\
 -3x^4 - 3x^3 + 2x^2 + 3x - 1 \\
 \underline{+3x^4 + 6x^3 + 3x^2} \\
 3x^3 - x^2 + 3x - 1 \\
 \underline{-3x^3 + 6x^2 + 3x} \\
 -7x^2 + 6x - 1 \\
 \underline{+7x^2 + 14x + 7} \\
 20x - 8
 \end{array}$$

$$\begin{array}{r}
 x^2+2x-1 \\
 \hline
 x^3-3x^2+3x-7
 \end{array}$$

$$\Rightarrow \underline{x^5 - x^4 - 4x^3 + 2x^2 + 3x - 1 = (x^2 + 2x - 1)(x^3 - 3x^2 + 3x - 7) + 20x - 8}$$

$$\begin{array}{r}
 c) \quad x^4 - 3x^3 + x - 5 \\
 \underline{-x^4 + 3x^2} \\
 -3x^3 + 3x^2 + x - 5 \\
 \underline{+3x^3 + 9x} \\
 3x^2 - 8x - 5 \\
 \underline{-3x^2 + 9} \\
 -8x + 4
 \end{array}$$

$$\begin{array}{r}
 x^2-3 \\
 \hline
 x^2-3x+3
 \end{array}$$

$$\Rightarrow \underline{x^4 - 3x^3 + x - 5 = (x^2 - 3)(x^2 - 3x + 3) - 8x + 4}$$

$$\begin{array}{r}
 d) \quad 35x^3 + 47x^2 + 13x + 1 \quad | \quad 5x + 1 \\
 \underline{-35x^3 + 7x^2} \quad | \quad \underline{7x^2 + 8x + 1} \\
 40x^2 + 13x + 1 \quad | 8x + 1 \\
 \underline{-40x^2 + 8x} \quad | 13x + 1 \\
 5x + 1 \quad | 1 \\
 \underline{-5x + 1} \quad | 0 \\
 0 \quad |
 \end{array}$$

$$\Rightarrow \underline{35x^3 + 47x^2 + 13x + 1 = (5x + 1)(7x^2 + 8x + 1)}$$

$$\begin{array}{r}
 h) \quad x^5 - 3x^3 + 2x^2 + 5x \quad | \quad x + 2 \\
 \underline{-x^5 + 2x^4} \quad | \quad \underline{x^4 - 2x^3 + x^2 + 5} \\
 -2x^4 - 3x^3 + 2x^2 + 5x \quad | x^2 + 5 \\
 \underline{+ 2x^2 + 4x^3} \quad | 5x + 5 \\
 x^3 + 2x^2 + 5x \quad | 5 \\
 \underline{-x^3 + 2x^2} \quad | 5x \\
 5x \quad | 5x + 10 \\
 \underline{-5x + 10} \quad | 10 \\
 -10 \quad |
 \end{array}$$

$$\Rightarrow \underline{x^5 - 3x^3 + 2x^2 + 5x = (x + 2)(x^4 - 2x^3 + x^2 + 5) - 10}$$

avec schéma de Horner :

$$\begin{array}{r|rrrrrr}
 & 1 & 0 & -3 & 2 & 5 & 0 \\
 -2 & & -2 & 4 & -2 & 0 & -10 \\
 \hline
 & 1 & -2 & 1 & 0 & 5 & \parallel -10
 \end{array}$$

Ex 2.3.2

$$\begin{array}{r}
 12x^4 + 47x^3 + 10x^2 \\
 -12x^4 + 32x^3 + 24x^2 \\
 \hline
 15x^3 + 34x^2 \\
 -15x^3 + 40x^2 + 30x \\
 \hline
 -6x^2 + 30x + 12 \\
 +6x^2 + 16x + 12 \\
 \hline
 46x
 \end{array}
 \quad +12 \left| \begin{array}{l} -3x^2 - 8x + 6 \\ -4x^2 - 5x + 2 \end{array} \right.$$

$$\underline{12x^4 + 47x^3 + 10x^2 + 12 = (-3x^2 - 8x + 6)(-4x^2 - 5x + 2) + 46x}$$

Ex 2.3.3

$$(x-5) \cdot p = x^3 - 3x^2 - 4x - 30$$

$$p = (x^3 - 3x^2 - 4x - 30) \div (x-5)$$

$$\begin{array}{r}
 x^3 - 3x^2 - 4x - 30 \\
 -x^2 + 5x^2 \\
 \hline
 2x^2 - 4x \\
 -2x^2 + 10x \\
 \hline
 6x - 30 \\
 -6x + 30 \\
 \hline
 0
 \end{array}
 \quad \left| \begin{array}{l} x-5 \\ x^2 + 2x + 6 \end{array} \right.$$

$$\Rightarrow x^3 - 3x^2 - 4x - 30 = (x-5)(x^2 + 2x + 6)$$

$$\Rightarrow \underline{p = x^2 + 2x + 6}$$

ou avec schéma de Horner :

$$\begin{array}{r|rrrr}
 & 1 & -3 & -4 & -30 \\
 5 & & 5 & 10 & 30 \\
 \hline
 & 1 & 2 & 6 & 0
 \end{array}$$

Ex 2.3.4

$$p = (2x^2 + 1)(5x^2 - 3x + 1) + 1 - x \quad (\text{égalité fondamentale})$$

$$= 10x^4 - 6x^3 + 2x^2 + 5x^2 - 3x + 1 + 1 - x$$

$$= \underline{10x^4 - 6x^3 + 7x^2 - 4x + 2}$$

Ex 2.3.8

avec théorème du reste

ou

avec Horner

$$\begin{aligned} \text{a) } r &= a(1) = 4 - 10 + 11 - 5 \\ &= \underline{0} \end{aligned}$$

$$\begin{array}{r|rrrr} & 4 & -10 & 11 & -5 \\ 1 & & 4 & -6 & 5 \\ \hline & 4 & -6 & 5 & | \underline{0} \end{array}$$

$$\begin{aligned} \text{b) } r &= a(-2) = 9 \cdot 16 - 8 - 4 - 2 + 2 \\ &= \underline{132} \end{aligned}$$

$$\begin{array}{r|rrrrr} & 9 & 1 & -1 & 1 & 2 \\ -2 & & -18 & 34 & -66 & 130 \\ \hline & 9 & -17 & 33 & -65 & | \underline{132} \end{array}$$

$$\text{c) } r = a(0) = \underline{-7}$$

ou

$$\begin{array}{r|rrrr} & 4 & -5 & 3 & -7 \\ 0 & & 0 & 0 & 0 \\ \hline & 4 & -5 & 3 & | \underline{-7} \end{array}$$

Ex 2.3.9

$$\text{a) } r = A(3) = 2 \cdot 27 - 9 + 15 - 1 = \underline{59}$$

$$\text{b) } r = A(-2) = 16 + 2 + 1 = \underline{19}$$

$$\text{c) } r = A(3) = 27 - 27 = \underline{0}$$

Ex 2.3.12

$$\text{a) } P(x) = 2x^3 - 14x + 12$$

candidats: $\pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 12$

$$P(1) = 2 - 14 + 12 = 0 \quad \Rightarrow \quad \underline{1 \text{ est un zéro}}$$

$$P(2) = 16 - 28 + 12 = 0 \quad \Rightarrow \quad \underline{2 \text{ est un zéro}}$$

$$P(3) = 54 - 42 + 12 \neq 0$$

$$P(-3) = -54 + 42 + 12 = 0 \quad \Rightarrow \quad \underline{-3 \text{ est un zéro}}$$

b) $P(x) = x^4 - 6x^3 + x - 6$ candidats: $\pm 1, \pm 2, \pm 3, \pm 6$

$$P(1) = 1 - 6 + 1 - 6 \neq 0$$

$$P(-1) = 1 + 6 - 1 - 6 = 0 \Rightarrow \underline{-1 \text{ est un zéro}}$$

$$P(2) = 16 - 48 + 2 - 6 \neq 0$$

$$P(-2) = 16 + 48 - 2 - 6 \neq 0$$

$$P(3) = 81 - 162 + 3 - 6 \neq 0$$

$$P(-3) \neq 0$$

$$P(6) = 1296 - 1296 + 6 - 6 = 0 \Rightarrow \underline{6 \text{ est un zéro}}$$

$$P(-6) \neq 0$$

Variante : $x^4 - 6x^3 + x - 6 \stackrel{GR}{=} x^3(x-6) + (x-6) = (x-6)(x^3+1) = 0$
 $= (x-6)(x+1)(x^2-x+1)$
 zéros : $\downarrow \quad \downarrow \quad \underbrace{\Delta < 0}$
 $6 \text{ et } -1$

Ex 2.3.16

$$p(x) = 2x^3 - 8x^2 + 8x \stackrel{HEE}{=} 2x(x^2 - 4x + 4) \stackrel{PR}{=} 2x(x-2)^2$$

Ex 2.3.18

a) $p(x) = x^4 + 2x^3 - 5x^2 - 6x$

$$\stackrel{HEE}{=} x(x^3 + 2x^2 - 5x - 6) \quad \text{candidats: } \pm 1, \pm 2, \pm 3, \pm 6$$

$$p(1) = 1 + 2 - 5 - 6 \neq 0$$

$$p(-1) = -1 + 2 + 5 - 6 = 0 \checkmark$$

	1	2	-5	-6
-1		-1	-1	6
	1	1	-6	0

$$\stackrel{DIV}{\Rightarrow} p(x) = x(x+1)(x^2+x-6)$$

$$\stackrel{SP}{=} \underline{x(x+1)(x+3)(x-2)}$$

$$b) \quad x^5 + 3x^4 - 16x - 48$$

$$\stackrel{GR}{=} x^4(x+3) - 16(x+3)$$

$$= (x+3)(x^4 - 16)$$

$$\stackrel{PR}{=} (x+3)(x^2+4)(x^2-4)$$

$$\stackrel{PR}{=} \underline{(x+3)(x^2+4)(x+2)(x-2)}$$

$$c) \quad 6x^4 - 5x^3 - 23x^2 + 20x - 4 \quad \text{candidats: } \pm 1, \pm 2; \pm 4$$

$$p(1) = 6 - 5 - 23 + 20 - 4 \neq 0$$

$$p(-1) = 6 + 5 - 23 - 20 - 4 \neq 0$$

$$p(2) = 6 \cdot 16 - 5 \cdot 8 - 23 \cdot 4 + 20 \cdot 2 - 4 = 0 \quad \checkmark$$

	6	-5	-23	20	-4
2		12	14	-18	4
	6	7	-9	2	0
-2		-12	10	-2	
	6	-5	1	0	

$$\Rightarrow p(x) = (x-2)(\underbrace{6x^3 + 7x^2 - 9x + 2}_{q(x)})$$

candidats: $\pm 1, \pm 2$
Non car déjà essayé

$$q(2) = 6 \cdot 8 + 7 \cdot 4 - 9 \cdot 2 + 2 \neq 0$$

$$q(-2) = -6 \cdot 8 + 7 \cdot 4 + 9 \cdot 2 + 2 = 0$$

$$\Rightarrow p(x) = (x-2)(x+2)(6x^2 - 5x + 1)$$

$$\Delta = 25 - 4 \cdot 6 = 1$$

$$x_{1,2} = \frac{5 \pm 1}{12} = \begin{cases} 1/2 \\ 1/3 \end{cases}$$

$$\Rightarrow 6(x - \frac{1}{2})(x - \frac{1}{3}) = (2x-1)(3x-1)$$

$$\Rightarrow \underline{p(x) = (x-2)(x+2)(2x-1)(3x-1)}$$

EX 2.3.19

$$\begin{array}{r|rrrrr}
 \text{a)} & 1 & 1 & 1 & 1 & 1 \\
 1 & & 1 & 2 & 3 & 4 \\
 \hline
 & 1 & 2 & 3 & 4 & 5
 \end{array}$$

$$\Rightarrow \underline{q(x) = x^3 + 2x^2 + 3x + 4} \text{ et } \underline{r = 5}$$

$$\begin{array}{r|rrrrrr}
 \text{b)} & 1 & 0 & 0 & 0 & 0 & 1 \\
 -1 & & -1 & 1 & -1 & 1 & -1 \\
 \hline
 & 1 & -1 & 1 & -1 & 1 & 0
 \end{array}$$

$$\Rightarrow \underline{q(x) = x^4 - x^3 + x^2 - x + 1} \text{ et } \underline{r = 0}$$

$$\begin{array}{r|rrrrrr}
 \text{c)} & 3 & -8 & 7 & 1 & -5 & 6 \\
 -2 & & -6 & 28 & -70 & 138 & -266 \\
 \hline
 & 3 & -14 & 35 & -69 & 133 & -260
 \end{array}$$

$$\Rightarrow \underline{q(x) = 3x^4 - 14x^3 + 35x^2 - 69x + 133} \text{ et } \underline{r = -260}$$

Ex 2.3.20

$$p(x) = x^6 - 6x^5 + 15x^4 - 20x^3 + 15x^2 - 6x + 1$$

$$r = p(1) = 1 - 6 + 15 - 20 + 15 - 6 + 1 = 0 \quad \checkmark \quad \Rightarrow \text{divisible par } x-1$$

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Ex 2.3.21

$$\begin{array}{r}
 d) \quad 6x^4 + 4x^3 - 7x^2 \\
 \underline{-6x^4} \qquad \qquad \qquad +9x^2 \\
 \qquad 4x^3 + 2x^2 \\
 \underline{-4x^3} \qquad \qquad \qquad +6x \\
 \qquad \qquad 2x^2 + 6x \\
 \underline{-2x^2} \qquad \qquad \qquad +3 \\
 \qquad \qquad \qquad 6x + 3
 \end{array}
 \quad \left| \begin{array}{r}
 2x^2 - 3 \\
 \hline
 3x^2 + 2x + 1
 \end{array} \right.$$

$$\Rightarrow \underline{6x^4 + 4x^3 - 7x^2 = (2x^2 - 3)(3x^2 + 2x + 1) + 6x + 3}$$

$$\begin{array}{r}
 e) \quad 14x^4 - 27x^3 + 21x^2 - 3x - 2 \\
 \underline{-14x^4 + 21x^3 + 14x^2} \\
 \qquad -6x^3 + 7x^2 - 3x \\
 \underline{+6x^3 + 9x^2 + 6x} \\
 \qquad \qquad -2x^2 + 3x - 2 \\
 \underline{-2x^2 + 3x - 2} \\
 \qquad \qquad \qquad 0
 \end{array}
 \quad \left| \begin{array}{r}
 2x^2 - 3x + 2 \\
 \hline
 7x^2 - 3x - 1
 \end{array} \right.$$

$$\Rightarrow \underline{14x^4 - 27x^3 + 21x^2 - 3x - 2 = (2x^2 - 3x + 2)(7x^2 - 3x - 1)}$$

Ex 2.3.22

$$p(x) = 2x^3 + 3x^2 - 11x - 6$$

candidates: $\pm 1, \pm 2, \pm 3, \pm 6$

	2	3	-11	-6
-3		-6	9	6
	2	-3	-2	0

$$p(-1) \neq 0, \quad p(-2) \neq 0, \quad p(-3) = 0 \checkmark$$

$$\Rightarrow p(x) = (x+3)(2x^2 - 3x - 2) = (x+3)2(x + \frac{1}{2})(x-2) = \underline{(x+3)(2x+1)(x-2)}$$

$$\Delta = 25$$
$$x_{1,2} = \frac{3 \pm 5}{4} = \left\langle \begin{matrix} -1/2 \\ 2 \end{matrix} \right.$$

Ex 2.3.23

a) $p(x) = x^3 + 9x^2 + 11x - 21$

candidates: $\pm 1, \pm 3, \pm 7, \pm 21$

$$p(1) = 1 + 9 + 11 - 21 = 0 \checkmark$$

$$p(x) \stackrel{\text{Div}}{=} (x-1)(x^2 + 10x + 21)$$
$$\stackrel{\text{SP}}{=} \underline{(x-1)(x+3)(x+7)}$$

	1	9	11	-21
1		10	21	21
	1	10	21	0

b) $p(x) = x^4 + 2x^3 - 16x^2 - 2x + 15$

candidates: $\pm 1, \pm 3, \pm 5, \pm 15$

$$p(1) = 1 + 2 - 16 - 2 + 15 = 0 \checkmark$$

	1	2	-16	-2	15
1		1	3	-13	-15
	1	3	-13	-15	0
-1		-1	-2	15	
	1	2	-15	0	

$$\Rightarrow p(x) = (x-1) \underbrace{(x^3 + 3x^2 - 13x - 15)}_{q(x)}$$

candidates: $\pm 1, \pm 3, \pm 5, \pm 15$

$$q(1) = 1 + 3 - 13 - 15 \neq 0$$

$$q(-1) = -1 + 3 + 13 - 15 = 0 \checkmark$$

$$\Rightarrow p(x) \stackrel{\text{Div}}{=} (x-1)(x+1)(x^2 + 2x - 15)$$

$$\stackrel{\text{SP}}{=} \underline{(x-1)(x+1)(x+5)(x-3)}$$

c) idem ex 2.3.18 c)

$$d) p(x) = x^5 - 3x^4 - 21x^3 + 43x^2 + 96x - 180$$

candidates: $\pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, \pm 9, \pm 10, \pm 12, \pm 15,$
 $\pm 18, \pm 20, \pm 30, \pm 36, \pm 45, \pm 60, \pm 90, \pm 180$

$$p(1) = 1 - 3 - 21 + 43 + 96 - 180 \neq 0$$

$$p(-1) = -1 - 3 + 21 + 43 - 96 - 180 \neq 0$$

$$p(2) = \dots = 0 \checkmark$$

	1	-3	-21	43	96	-180
2		2	-2	-46	-6	180
	1	-1	-23	-3	90	0
-3		-3	12	33	-90	
	1	-4	-11	30	0	
5		5	5	-30		
	1	1	-6	0		

$$q(x) = x^4 - x^3 - 23x^2 - 3x + 90$$

$$q(2) = \dots \neq 0$$

$$q(3) = \dots \neq 0$$

$$q(-3) = \dots = 0 \checkmark$$

$$s(x) = x^3 - 4x^2 - 11x + 30$$

$$s(4) \dots \neq 0$$

$$s(-4) \dots \neq 0$$

$$s(5) = \dots = 0 \checkmark$$

$$\Rightarrow p(x) \stackrel{\text{Div}}{=} (x-2)(x+3)(x-5)(x^2+x-6)$$

$$\stackrel{\text{SP}}{=} (x-2)(x+3)(x-5)(x-2)(x+3) = \underline{(x-2)^2(x+3)^2(x-5)}$$

Ex 2.3.25

$$a) \quad \underline{x^3 + 2x^2} - \underline{x - 2} = 0$$

$$\text{GR} \quad x^2(x+2) - (x+2) = 0$$

$$(x+2)(x^2-1) = 0$$

$$\text{PR} \quad (x+2)(x+1)(x-1) = 0$$

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ -2 & -1 & 1 \end{array}$$

$$\Rightarrow \underline{S = \{-2; -1; 1\}}$$

$$b) \quad \underline{x^3 - 3x^2} - \underline{4x + 12} = 0$$

$$\text{GR} \quad x^2(x-3) - 4(x-3) = 0$$

$$(x-3)(x^2-4) = 0$$

$$\text{PR} \quad (x-3)(x+2)(x-2) = 0$$

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 3 & -2 & 2 \end{array}$$

$$\Rightarrow \underline{S = \{-2; 2; 3\}}$$

$$c) \quad 4x^5 - 12x^4 + 9x^3 = 0$$

$$\text{HEE} \quad x^3(4x^2 - 12x + 9) = 0$$

$$\text{PR} \quad x^3(2x-3)^2 = 0$$

$$\begin{array}{ccc} \downarrow & \downarrow & \\ 0 & 2x-3=0 & \\ & 2x=3 & \\ & x=3/2 & \end{array}$$

$$\Rightarrow \underline{S = \{0; \frac{3}{2}\}}$$

$$d) \quad 16x^3 - 16x^2 - 4x + 4 = 0$$

$$4(\underline{4x^3 - 4x^2} - \underline{x + 1}) = 0$$

$$4[4x^2(x-1) - (x-1)] = 0$$

$$4(x-1)(4x^2-1) = 0$$

$$4(x-1)(2x+1)(2x-1) = 0$$

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 1 & -\frac{1}{2} & \frac{1}{2} \end{array}$$

$$\Rightarrow \underline{S = \{-\frac{1}{2}; \frac{1}{2}; 1\}}$$

Ex 2.3.26

a) $x^4 + 2x^3 - 4x^2 - 5x - 6 = 0$

$$\begin{array}{r|rrrrr} & 1 & 2 & -4 & -5 & -6 \\ 2 & & 2 & 8 & 8 & 6 \\ \hline & 1 & 4 & 4 & 3 & 0 \end{array}$$

$\Rightarrow (x-2)(x^3 + 4x^2 + 4x + 3) = 0$

$$\begin{array}{r|rrrr} & 1 & 4 & 4 & 3 \\ -3 & & -3 & -3 & -3 \\ \hline & 1 & 1 & 1 & 0 \end{array}$$

$\Rightarrow (x-2)(x+3)(x^2+x+1) = 0$
 $\downarrow \quad \downarrow \quad \Delta = -3 < 0$
 $2 \quad -3$

b) $x^4 - 7x^3 + 18x^2 - 20x + 8 = 0$

$$\begin{array}{r|rrrrr} & 1 & -7 & 18 & -20 & 8 \\ 1 & & 1 & -6 & 12 & -8 \\ \hline & 1 & -6 & 12 & -8 & 0 \end{array}$$

$\Rightarrow (x-1)(x^3 - 6x^2 + 12x - 8) = 0$

$(x-1)(x-2)^3 = 0$
 $\downarrow \quad \downarrow$
 $1 \quad 2$

c) $35x^3 + 47x^2 + 13x + 1 = 0$

$$\begin{array}{r|rrrr} & 35 & 47 & 13 & 1 \\ -1 & & -35 & -12 & -1 \\ \hline & 35 & 12 & 1 & 0 \end{array}$$

$\Rightarrow (x+1)(35x^2 + 12x + 1) = 0$

candidates: $\pm 1, \pm 2, \pm 3, \pm 6$

$p(1) = 1 + 2 - 4 - 5 - 6 \neq 0$

$p(-1) = 1 - 2 - 4 + 5 - 6 \neq 0$

$p(2) = 16 + 16 - 16 - 10 - 6 = 0 \checkmark$

candidates: $\pm 1, \pm 3$

déjà essayé plus haut

$q(3) = 27 + 36 + 12 + 3 \neq 0$

$q(-3) = -27 + 36 - 12 + 3 = 0 \checkmark$

$\Rightarrow S = \{-3, 2\}$

candidates: $\pm 1, \pm 2, \pm 4, \pm 8$

$p(1) = 1 - 7 + 18 - 20 + 8 = 0 \checkmark$

$\Rightarrow S = \{1, 2\}$

candidates: ± 1

$p(-1) = -35 + 47 - 13 + 1 = 0 \checkmark$

$\Delta = 144 - 4 \cdot 35 \cdot 1 = 4$

$x_{1,2} = \frac{-12 \pm 2}{70} = \begin{cases} -1/7 \\ -1/5 \end{cases}$

$\Rightarrow S = \{-1, -1/5, -1/7\}$

$$d) \quad x^3 + 5x^2 - 8x - 48 = 0$$

1	5	-8	-48
3	3	24	48
1	8	16	0

$$\Rightarrow (x-3)(x^2 + 8x + 16) = 0$$

$$(x-3)(x+4)^2 = 0$$

\downarrow \downarrow
3 -4

candidates : $\pm 1, \pm 2, \pm 3, \pm 4, \dots$
 ± 48

$$p(3) = 0 \checkmark$$

$$\Rightarrow \underline{S = \{-4; 3\}}$$