P56 #107

1. $f(x) = 17 - 3x$ polynomial function

zeros: $17 - 3x = 0$

$3x = 17$

$x = \frac{17}{3}$ → zeros $\left(\frac{17}{3}\right)$

3. $h(x) = 9$ → polynomial function

zeros: $h(x) = 0 \rightarrow 9 = 0 \rightarrow$ not possible

so no zeros

5. $m(x) = \frac{x^2 - 3x - 4}{x^2 + 1}$ → not a polynomial function

→ quadratic expression in the denominator

zeros: $m(x) = 0$

$\frac{x^2 - 3x - 4}{x^2 + 1} = 0$ → a fraction = 0 if the numerator is zero

0 ÷ any # = 0!

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

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

$x = 4, \quad x = -1$

7. $p(x) = x^3 - 9x$ → polynomial function

zeros: $p(x) = 0 \rightarrow x^3 - 9x = 0$

Factor x: $x(x^2 - 9) = 0$

$x(x + 3)(x - 3) = 0$

$x = 0, \quad x = -3, \quad x = 3$

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(15) $h(x) = 2x^2 - 5x + 6$

$h(-1)$

	2	−5	6
−1		−2	7
	2	−7	13

$h(-1) = 13$

$h(2i)$

	2	−5	6
$2i$		$4i$	$-10i + 8i^2 = -10i - 8$
	2	$-5+4i$	$-2-10i$

$h(2i) = -2 - 10i$

$h(1+i)$

	2	−5	6
$1+i$		$2+2i$	$-5-i$
	2	$-3+2i$	$1-i$

$h(1+i) = 1 - i$

$(-3+2i)(1+i)$

$-3 - 3i + 2i + 2i^2$

$-3 - i \quad -2 \rightarrow -5 - i$

$h(3a)$

	2	−5	6
$3a$		$6a$	$-15a + 18a^2$
	2	$-5+6a$	$18a^2 - 15a + 6$

(17) $f(x) = x^3 - 9x$

a) $f\left(-\frac{\sqrt{2}}{3}\right) =$

	1	0	$-9 = -\frac{81}{9}$	0
$-\frac{\sqrt{2}}{3}$		$-\frac{\sqrt{2}}{3}$	$\frac{2}{9}$	$\frac{7a\sqrt{2}}{27}$
	1	$-\frac{\sqrt{2}}{3}$	$-\frac{79}{9}$	$\frac{79\sqrt{2}}{27}$

$\frac{79\sqrt{2}}{27}$

(b) $f(i\sqrt{3})$

	1	0	−9	0
$i\sqrt{3}$		$i\sqrt{3}$	$3i^2 = -3$	$-12i\sqrt{3}$
	1	$i\sqrt{3}$	−12	$-12i\sqrt{3}$

(c) $f\left(\frac{x}{3}\right)$

	1	0	$-9 = -\frac{81}{9}$	0
$\frac{x}{3}$		$\frac{x}{3}$	$\frac{x^2}{9}$	$\frac{x^3 - 81x}{27}$
	1	$\frac{x}{3}$	$\frac{x^2 - 81}{9}$	

$\frac{x^3 - 81x}{27} = \frac{x^3}{27} - 3x$

p56
17d

$f(x-3)$ $x-3$

	1	0	-9	0
		$x-3$	x^2-6x+9	x^3-9x^2+18x ←
1		$x-3$	x^2-6x	x^3-9x^2+18x

$(x^2-6x)(x-3) = x^3-3x^2-6x^2+18x$

$= x^3-9x^2+18x$

23 $f(x) = 3x^3+kx-2$

4 is a zero so $f(4)=0$

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

$= 3(64)+4k-2$

$= 192+4k-2 \rightarrow 0 = 190+4k$

$4k = -190$

page 61 $k = -190 = -47.5$

1.a $(x^5-2x^3+x^2-4) \div (x-1)$

$1x^5+0x^4-2x^3+1x^2+0x-4$

$x-1=0$
$x=1$

	$1x^5$	0	-2	0	-4
1		1	1	-1	0	0

Q: $1x^4+1x^3-1x^2+0x+0$ remainder -4

3 b. $(1x^3-3x^2+0x+5) \div (x+2)$

	$1x^3$	-3	0	5
-2		-2	10	-20

Q: $1x^2-5x+10$ remainder -15

5. $(1x^4-2x^3+5x+2) \div (x+1)$

	$1x^{④}$	-2	$0x^2$	5	2
-1		-1	3	-3	-2

Q $1x^3-3x^2+3x+2$ remainder 0

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7 $(1x^5 + x^3 + x) \div (x-3)$

	$1x^5$	$0x^4$	1	$0x^2$	1	0
3		3	9	30	90	273

Q: $1x^4 + 3x^3 + 10x^2 + 30x + 91$ Remainder 273

9 Must use long division → divisor not linear

Q: $3x^2 - 8x + 21$

$x^2+2x \;|\; 3x^4 - 2x^3 + 5x^2 + x + 1$

$-3x^4 + 6x^3$

$-8x^3 + 5x^2$

$+8x^3 - 16x^2$

$21x^2 + x$

$-21x^2 + 42x$

$-41x + 1$ remainder

11. $f(x) = x^{100} - 4x^{99} + 3$

$f(1) = 1^{100} - 4(1)^{99} + 3 = 1 - 4 + 3 = 0 \rightarrow (x-1)$ is a factor of $f(x)$

$f(-1) = (-1)^{100} - 4(-1)^{99} + 3 = 1 + 4 + 3 = 8 \neq 0 \rightarrow (x+1)$ is not a factor of $f(x)$

13b $P(x) = x^3 - 5x^2 + 3x + 9$

$(x+3)$

	1	−5	3	9	
−3		−3	24	−81	
	1	−8	27	−72	

$P(-3) \neq 0$ so $(x+3)$ is not a factor

ⓒ $(x-3)$

	1	−5	3	9	
3		3	−6	−9	
	1	−2	−3	0	

$P(3) = 0$ so $(x-3)$ is a factor of $P(x)$

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17 $2x+1 \overline{)\,P(x)}$ $\quad x^2-x+4$

R3

$P(x) = (x^2-x+4)(2x+1)+3$

$= 2x^3+x^2-2x^2-x+8x+4+3$

$= 2x^3-x^2+7x+7$

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	$2x^3$	-5	-4	3
3		6	3	-3
	$2x^2+1x$	-1		$\boxed{0}$

$2x^2+x-1$

$2x \quad -1$

$x \quad +1$

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

$\frac{1}{2}$; -1

21.

	$2x^4$	-9	2	9	-4
-1		-2	11	-13	4
	$2x^3$	-11	13	-4	$\boxed{0}$
1		2	-9	4	
	$2x^2$	$-9x$	$+4$	$\boxed{0}$	

$2x^2-9x+4$

$2x \quad -1$

$x \quad -4$

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

$\frac{1}{2}$ $\quad$ 4

23

	$1x^4$	3	-3	3	-4
-4		-4	4	-4	4
	$1x^3$	-1	1	-1	$\boxed{0}$
1		1	0	1	
	$1x^2+0x$	$+1$		$\boxed{0}$	

$x^2+1=0$

$x^2=-1$

$x=\pm\sqrt{-1}$

$x=\pm i$