

Practice 6-1

1)  $4x^2 + 4x + 1$

quadratic  
trinomial

2)  $3x^2 - 4x + 20$

quadratic  
trinomial

3)

4th degree  
binomial  
 $-4x^3 + x^2 + 3x$

4)  $x^8 - 10x^4 + 25$

8th degree  
trinomial

5)  $2m^2$

quadratic  
monomial

cubic  
trinomial

7)

yr	0	10	20	30	40	50
	22.71	29.03	81.73	123.82	321.10	550.50

yr.	60	63
	844.60	922.10

$y = .0009x^3 + .2230x^2 - 3.147x + 29.054$   
 $x = 70$

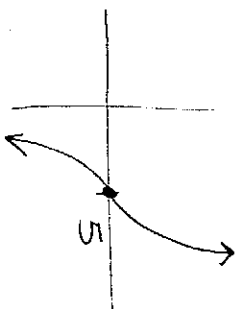
$y = 1210.164$

Practice 6-2

1)  $y = (x-5)^3$

$x = 5$ , mult of 3

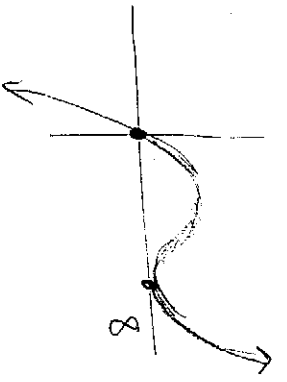
EB:  $\swarrow, \nearrow$



2)  $y = x(x-8)^2$

$x = 0, x = 8$  (mult of 2)

EB  $\swarrow \nearrow$



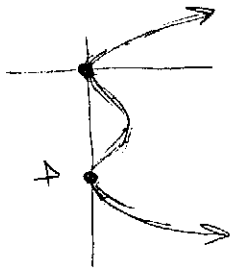
3)  $f(x) = x^4 - 8x^3 + 16x^2$

$x^2(x^2 - 8x + 16)$

$x^2(x-4)(x-4)$

$x = 0$ , mult 2  
 $x = 4$ , mult 2

EB  $\swarrow, \nearrow$

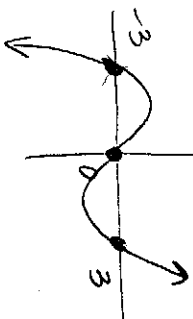


$$4) f(x) = 9x(x^2 - 9)$$

$$x = 0, \quad x^2 - 9 = 0$$

$$x = \pm 3$$

EB  $\downarrow, \nearrow$



$$5) y = (x+1)(x-3)(x-4)$$

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

$$= x^3 - 2x^2 - 3x - 4x^2 + 8x + 12$$

$$= x^3 - 6x^2 + 5x + 12$$

$$6) y = (x-1)(x-1)(x-2)$$

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

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

$$= x^3 - 4x^2 + 5x - 2$$

$$7) y = x(x+3)(x-5)$$

$$= x^2(x^2 - 2x - 15)$$

$$= x^4 - 2x^3 - 15x^2$$

$$8) y = (x+2)^3$$

$$= (x^2 + 4x + 4)(x+2)$$

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

$$= x^3 + 6x^2 + 12x + 8$$

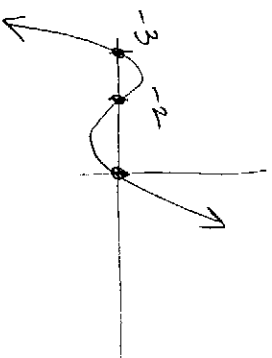
$$9) y = 2x^3 + 10x^2 + 12x$$

$$2x(x^2 + 5x + 6) = 0$$

$$2x(x+3)(x+2) = 0$$

$$x = 0, -3, -2$$

EB  $\downarrow \nearrow$



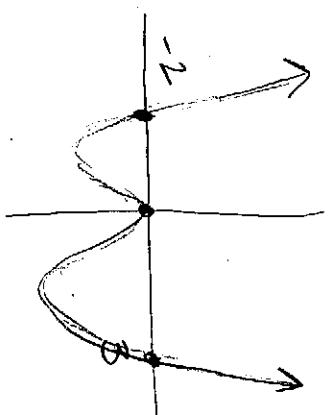
$$10) \quad y = x^4 - x^3 - 6x^2$$

$$x^2(x^2 - x - 6) = 0$$

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

$$x = 0, 3, -2, \quad \text{EB} \uparrow \quad \nearrow$$

mult of 2



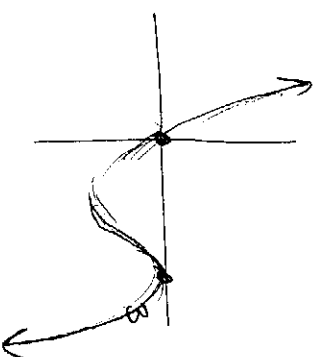
$$11) \quad y = -3x^3 + 18x^2 - 27x$$

$$-3x(x^2 - 6x + 9) = 0$$

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

$$x = 0, \underline{3}, \underline{3}$$

mult of 2, EB  $\downarrow$



$$12) \quad x = -1, 0, 1 \quad 13) \quad x = -2, -2, 2$$

$$x(x+1)(x-1)$$

$$y = (x+2)(x+2)(x-2)$$

$$x(x^2 - 1)$$

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

$$y = x^3 - x$$

$$-(x^3 + 2x^2 - 4x - 8)$$

$$14) \quad x = -7, 5, 5$$

$$(x+7)(x-5)(x-5)$$

$$(x^2 + 2x - 35)(x-5)$$

$$x^3 + 2x^2 - 35x - 5x^2 - 10x + 175$$

$$y = x^3 - 3x^2 - 45x + 175$$

Practice 6-3

1)  $\begin{array}{r} -4 \overline{) 3 \quad -10 \quad -24} \\ \underline{-4 \phantom{0} \phantom{0}} \\ -6 \phantom{0} \phantom{0} \\ \underline{-6 \phantom{0}} \\ 24 \end{array} \rightarrow -4 \text{ is a factor.}$

2)  $\begin{array}{r} 3 \overline{) 3 \quad -10 \quad -24} \\ \underline{3 \phantom{0} \phantom{0}} \\ -10 \phantom{0} \\ \underline{-9 \phantom{0}} \\ -1 \phantom{0} \\ \underline{-3 \phantom{0}} \\ 2 \end{array} \rightarrow 3 \text{ is a factor.}$

3)  $\begin{array}{r} 2x+11 \overline{) 2x^2+x-7} \\ \underline{-(2x^2-10x)} \\ 11x-7 \\ \underline{-(11x-55)} \\ 48 \end{array} \quad \boxed{2x+11, R 48}$

4)  $\begin{array}{r} x^2+6x+3 \overline{) x^3+5x^2-3x-1} \\ \underline{-(x^3-x^2)} \\ 6x^2-3x \\ \underline{-(6x^2-6x)} \\ 3x-1 \\ \underline{-(3x-3)} \\ 2 \end{array} \quad \boxed{x^2+6x+3, R 2}$

5)  $\begin{array}{r} 3x^2-7x+7 \overline{) x+2} \\ \underline{-(3x^3+6x^2)} \\ -7x^2-7x \\ \underline{-(-7x^2-14x)} \\ 7x+6 \\ \underline{-(7x+14)} \\ -8 \end{array} \quad \boxed{3x^2-7x+7, R -8}$

6)  $\begin{array}{r} 5 \overline{) 1 \quad -8 \quad 17 \quad -10} \\ \underline{5 \phantom{0} \phantom{0} \phantom{0}} \\ -3 \phantom{0} \phantom{0} \phantom{0} \\ \underline{-3 \phantom{0} \phantom{0}} \\ 2 \end{array} \quad \boxed{x^2-3x+2}$

$$\begin{array}{r} 7) \underline{-2} \phantom{0} | 1 \phantom{0} 5 \phantom{0} -1 \phantom{0} -9 \\ \phantom{0} \downarrow \phantom{0} \phantom{0} -2 \phantom{0} -6 \phantom{0} \phantom{0} \phantom{0} 14 \\ \phantom{0} \phantom{0} 1 \phantom{0} 3 \phantom{0} -7 \phantom{0} \phantom{0} \phantom{0} \phantom{0} \boxed{5} \end{array}$$

$$\boxed{x^2 + 3x - 7, R5}$$

$$\begin{array}{r} 8) \underline{2} \phantom{0} | 3 \phantom{0} -4 \phantom{0} -5 \phantom{0} 1 \\ \phantom{0} \downarrow \phantom{0} \phantom{0} 6 \phantom{0} 4 \phantom{0} -2 \\ \phantom{0} \phantom{0} 3 \phantom{0} 2 \phantom{0} -1 \phantom{0} \phantom{0} \phantom{0} \phantom{0} \boxed{-1} \end{array}$$

$$\boxed{P(2) = -1}$$

$$\begin{array}{r} 9) \underline{-3} | 1 \phantom{0} 6 \phantom{0} 10 \phantom{0} 3 \\ \phantom{0} \downarrow \phantom{0} -3 \phantom{0} -9 \phantom{0} -3 \\ \phantom{0} \phantom{0} 1 \phantom{0} 3 \phantom{0} 1 \phantom{0} \phantom{0} \phantom{0} \boxed{0} \end{array}$$

$$\boxed{P(-3) = 0}$$

$$\begin{array}{r} 10) \underline{-5} | 1 \phantom{0} 3 \phantom{0} -13 \phantom{0} -15 \\ \phantom{0} \downarrow \phantom{0} -5 \phantom{0} 10 \phantom{0} 15 \\ \phantom{0} \phantom{0} 1 \phantom{0} -2 \phantom{0} -3 \phantom{0} \phantom{0} \phantom{0} \phantom{0} 0 \end{array}$$

$$(x+5)(x^2 - 2x - 3)$$

$$(x+5)(x-3)(x+1)$$

$$\begin{array}{r} 11) \underline{2} | 1 \phantom{0} -3 \phantom{0} -10 \phantom{0} 24 \\ \phantom{0} \downarrow \phantom{0} 2 \phantom{0} -2 \phantom{0} -24 \\ \phantom{0} \phantom{0} 1 \phantom{0} -1 \phantom{0} -12 \phantom{0} \phantom{0} \phantom{0} \phantom{0} 0 \end{array}$$

$$(x-2)(x^2 - x - 12)$$

$$(x-2)(x-4)(x+3)$$

$$\begin{array}{r} 12) \underline{-\frac{4}{3}} | 6 \phantom{0} 2 \phantom{0} -11 \phantom{0} 12 \\ \phantom{0} \downarrow \phantom{0} -8 \phantom{0} 8 \phantom{0} 4 \\ \phantom{0} \phantom{0} 6 \phantom{0} -6 \phantom{0} -3 \phantom{0} \phantom{0} 16 \end{array}$$

$$\boxed{6x^2 - 6x - 3, R16}$$

$$\begin{array}{r} 13) \underline{1} | 1 \phantom{0} 2 \phantom{0} 0 \phantom{0} 1 \phantom{0} -3 \\ \phantom{0} \downarrow \phantom{0} 1 \phantom{0} 3 \phantom{0} 3 \phantom{0} 4 \\ \phantom{0} \phantom{0} 1 \phantom{0} 3 \phantom{0} 3 \phantom{0} 4 \phantom{0} \phantom{0} 1 \end{array}$$

$$\boxed{x^3 + 3x^2 + 3x + 4, R1}$$

$$\begin{array}{r} 14) \underline{2} | 1 \phantom{0} 0 \phantom{0} -3 \phantom{0} 0 \phantom{0} -10 \\ \phantom{0} \downarrow \phantom{0} 2 \phantom{0} 4 \phantom{0} 2 \phantom{0} 4 \\ \phantom{0} \phantom{0} 1 \phantom{0} 2 \phantom{0} 1 \phantom{0} \phantom{0} \phantom{0} 2 \phantom{0} -6 \end{array}$$

$$\boxed{x^3 + 2x^2 + x + 2, R-6}$$

$$15) \begin{array}{r} 8 \mid 1 \quad -16 \quad 79 \quad -120 \\ \downarrow \quad 8 \quad -64 \quad 120 \\ 1 \quad -8 \quad 15 \quad 0 \end{array}$$

$$(x-8)(x^2-8x+15)$$

$$(x-8)(x-5)(x-3)$$

Practice 6-4

$$1) (2x-3)(4x^2+6x+9) = 0$$

$$x = \frac{3}{2} \quad x = \frac{-6 \pm \sqrt{36-4(4)(9)}}{2(4)} = \frac{-6 \pm 6i\sqrt{3}}{8} = \frac{-3 \pm 3i\sqrt{3}}{4}$$

$$2) (x+4)(x^2-4x+16)$$

$$x = -4 \quad x = \frac{4 \pm \sqrt{16-4(1)(16)}}{2(1)} = \frac{4 \pm 4i\sqrt{3}}{2} = 2 \pm 2i\sqrt{3}$$

$$3) (x^2-4)(x^2-1) = 0$$

$$x = \pm 2 \quad x = \pm 1$$

$$4) (x^2-8)(x^2-2) = 0$$

$$x = \pm 2\sqrt{2} \quad x = \pm \sqrt{2}$$

$$5) (x^2-9)(x^2+9) = 0$$

$$x = \pm 3 \quad x = \pm 3i$$

$$6) x^2(x+4)+7(x+4) = 0$$

$$(x^2+7)(x+4) = 0$$

$$x = \pm i\sqrt{7} \quad x = -4$$

$$7) (-4, 76, 0)$$

$$(-1, 90, 0)$$

$$(1, 66, 0)$$

$$(-3, 52, 10, 378) \text{ Max}$$

$$(0, 19, -15, 19) \text{ Min}$$

$$8) (-0.37, 0)$$

$$(, 95, 0)$$

$$9) (-5, 0)$$

$$(-3, 23, 93, 19) \text{ Max}$$

$$(-0.37, 0) \text{ Min}$$

$$(1, 37, 0) \quad (, 57, -16, 60)$$

## Practice 6-5

1)  $2-3i$  and  $-\sqrt{7}$     2)  $3+\sqrt{2}$  and  $1-\sqrt{3}$

3)  $4i$  and  $6+i$     4)  $5+\sqrt{6}$  and  $-2-\sqrt{10}$

5)  $2x^4 - 9x^2 + 4$

$P: \pm 1, \pm 4, \pm 2$

$q: \pm 1, \pm 2$

~~$P/q = \pm 1, +\frac{1}{2}, +4, \pm 2$~~

$$\begin{array}{r} -2 \overline{) 2} \quad 0 \quad -9 \quad 0 \quad 4 \\ \underline{-2} \phantom{0} \phantom{-9} \phantom{0} \phantom{4} \\ 0 \phantom{-9} \phantom{0} \phantom{4} \end{array}$$

$$\begin{array}{r} \phantom{-2} \overline{) 2} \quad -4 \quad 8 \quad 2 \quad -4 \\ \underline{-2} \phantom{0} \phantom{8} \phantom{2} \phantom{-4} \\ 0 \phantom{8} \phantom{2} \phantom{-4} \end{array}$$

$x = -2$

$$\begin{array}{r} 2 \overline{) 2} \quad -4 \quad -1 \quad 2 \quad 0 \\ \underline{-2} \phantom{0} \phantom{-1} \phantom{2} \phantom{0} \\ 0 \phantom{-1} \phantom{2} \phantom{0} \end{array}$$

$x = 2$

$$\begin{array}{r} \phantom{2} \overline{) 2} \quad 0 \quad -1 \quad 0 \quad -2 \\ \underline{-2} \phantom{0} \phantom{-1} \phantom{0} \phantom{-2} \\ 0 \phantom{-1} \phantom{0} \phantom{-2} \end{array}$$

$x = \pm \sqrt{\frac{1}{2}}$

$2x^2 - 1 = 0$

6)  $x^3 - 5x^2 + 2x + 8 = 0$

$P/q = \pm 1, \pm 8, \pm 2, \pm 4$

$$\begin{array}{r} -1 \overline{) 1} \quad -5 \quad 2 \quad 8 \\ \underline{-1} \phantom{0} \phantom{2} \phantom{8} \\ 0 \phantom{2} \phantom{8} \end{array}$$

$x = -1$

$$\begin{array}{r} \phantom{-1} \overline{) 1} \quad -1 \quad 6 \quad -8 \\ \underline{-1} \phantom{0} \phantom{6} \phantom{-8} \\ 0 \phantom{6} \phantom{-8} \end{array}$$

$x = 2$

$$\begin{array}{r} 2 \overline{) 1} \quad -6 \quad 8 \quad 0 \\ \underline{-2} \phantom{0} \phantom{8} \phantom{0} \\ 0 \phantom{8} \phantom{0} \end{array}$$

$x = 4$

$$\begin{array}{r} \phantom{2} \overline{) 1} \quad -4 \quad 0 \\ \underline{-1} \phantom{0} \phantom{0} \\ 0 \end{array}$$

$x - 4 = 0$

7)  $2x^3 + 13x^2 + 17x - 12 = 0$

$P/q = \pm 1, \pm 12, \pm 2, \pm 6, \pm 4, \pm 3, \pm \frac{1}{2}, \pm \frac{3}{2}$

$$\begin{array}{r} -4 \overline{) 2} \quad 13 \quad 17 \quad -12 \\ \underline{-4} \phantom{0} \phantom{17} \phantom{-12} \\ 0 \phantom{17} \phantom{-12} \end{array}$$

$x = -4$

$$\begin{array}{r} -3 \overline{) 2} \quad 5 \quad -3 \quad 0 \\ \underline{-3} \phantom{0} \phantom{-3} \phantom{0} \\ 0 \phantom{-3} \phantom{0} \end{array}$$

$x = -3$

$$\begin{array}{r} \phantom{-3} \overline{) 2} \quad -1 \quad 0 \\ \underline{-2} \phantom{0} \phantom{0} \\ 0 \end{array}$$

$x = \frac{1}{2}$

$2x - 1 = 0$

$$8) \quad 6x^3 + 10x^2 + 5x = 0$$

$$x(6x^2 + 10x + 5) = 0$$

$x = 0$  (2 imaginary which are not rat'l roots)

$$9) \quad x = 5, x = -2i, x = 2i$$

$$(x-5)(x+2i)(x-2i)$$

$$(x-5)(x^2 - 4i^2)$$

$$(x-5)(x^2 + 4)$$

$$x^3 - 5x^2 + 4x - 20$$

$$10) \quad x = -7, x = i, x = -i$$

$$(x+7)(x-i)(x+i)$$

$$(x+7)(x^2 + 1)$$

$$x^3 + 7x^2 + x + 7$$

### Practice 6-6

$$1) -4x(x^2 - 25) = 0$$

$$x = 0, 5, -5$$

$$2) \quad x^3 + 3x^2 + 6x + 4$$

$$\begin{array}{r} \overline{1} \mid 1 \quad 3 \quad 6 \quad 4 \\ \downarrow -1 \quad -2 \quad -4 \\ 1 \quad 2 \quad 4 \quad 0 \checkmark \end{array}$$

$$x^2 + 2x + 4$$

$$x = -1, \frac{-2 \pm \sqrt{4 - 4(1)(4)}}{2}$$

$$x = 1, -1 \pm i\sqrt{3}$$

$$3) \quad \begin{array}{r} \overline{-2} \mid 1 \quad 6 \quad 13 \quad 12 \quad 4 \\ \downarrow -2 \quad -8 \quad -10 \quad -4 \\ 1 \quad 4 \quad 5 \quad 2 \quad 0 \checkmark \\ \overline{-1} \mid \quad \downarrow -1 \quad -3 \quad -2 \\ 1 \quad 3 \quad 2 \quad 0 \checkmark \end{array}$$

$$x^2 + 3x + 2$$

$$(x+2)(x+1)$$

$$x = -2, \text{ mult } 2$$

$$x = -1, \text{ mult } 2$$

$$4) \quad \overline{3} \mid 1 \quad -9 \quad 27 \quad -27$$

$$\begin{array}{r} \downarrow 3 \quad -18 \quad -27 \\ 1 \quad -6 \quad 9 \quad 0 \checkmark \end{array}$$

$$x^2 - 6x + 9$$

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

$$x = 3, \text{ mult } 3.$$