Sec 1.6.1

Solving higher-order polynomial equations by factoring

-equation must = 0
- be written in descending order
-factor
-set factors = 0 and solve resulting equations

Solve- $3x^4 = 27x^2$

$3x^4 - 27x^2 = 0$

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

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

$3x^2 = 0 \quad x+3=0 \quad x-3=0$

$x^2 = 0$

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

$\{-3, 0, 3\}$

Do NOT divide through by variables! Solutions are "lost". Also, the variable could equal zero...can't divide by zero.

Four terms?
Factor by
GROUPING

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

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

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

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

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

$x+1=0 \quad x+2=0 \quad x-2=0$

$x=-1 \quad x=-2 \quad x=2$

$\{-2, -1, 2\}$

$3x^4 - 24x = 0$

won't ever factor; imag solns

$3x(x^3 - 8) = 0$

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

$3x = 0 \quad x - 2 = 0$

$x = 0 \quad x = 2$

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

$$= \frac{-2 \pm \sqrt{-12}}{2}$$

$$= \frac{-2 \pm \sqrt{-1 \cdot 4 \cdot 3}}{2}$$

$$= \frac{-2 \pm 2i\sqrt{3}}{2}$$

$$\boxed{= -1 \pm \sqrt{3}i}$$

4 solutions
2 real
2 imaginary

Suggested Practice
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Solutions

1. $-4, 0, 4$
2. $\pm 2, 0$
3. $-2, -\frac{2}{3}, 2$
4. $\pm \frac{3}{2}, 3$
5. $\pm \frac{1}{2}, \frac{3}{2}$
6. $\pm \frac{1}{3}, -1$
7. $-2, \pm \frac{1}{2}$
8. $\pm \frac{2}{3}, 2$
9. $0, 2, -1 \pm i\sqrt{3}$ ←
10. $0, 3, -\frac{3}{2} \pm i\frac{3\sqrt{3}}{2}$ ←

$$2x^4 = 16x$$

$$2x^4 - 16x = 0$$

$$2x(x^3 - 8) = 0$$

$$2x = 0 \qquad x^3 - 8 = 0$$

$$x = 0 \qquad x^3 = 8$$

$$x = 2$$

$$x^3 - 8$$

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

$$\vdots$$

$$x^3 - 8$$

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

$x = 2$

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

$$= \frac{-2 \pm \sqrt{-12}}{2} \quad -1 \cdot 4 \cdot 3$$

$$= \frac{-2 \pm 2i\sqrt{3}}{2}$$

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

$$3x^4 - 81x = 0$$

$$3x(x^3 - 27) = 0$$

$x = 0$

$$(x - 3)(x^2 + 3x + 9)$$

$x = 3$

$$x = \frac{-3 \pm \sqrt{9 - 4(9)}}{2}$$

$$= \frac{-3 \pm \sqrt{-27}}{2}$$

$\sqrt{-1} \cdot 9 \cdot 3$

$$\frac{-3 \pm 3i\sqrt{3}}{2}$$

$$= \frac{-3}{2} \pm \frac{3}{2}i\sqrt{3}$$