Warm up

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

Factor, if possible. If prime, write PRIME.

1. $9x^2 - 4y^2$

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

2. $81m^4 - 1$

$(9m^2+1)(9m^2-1)$

$(9m^2+1)(3m+1)(3m-1)$

3. $a^2b^8 - 9p^6q^2$ $a = ab^4$ $b = 3p^3q$

$(ab^4+3p^3q)(ab^4-3p^3q)$

4. $36x^2 + 81$

$9(4x^2+9)$

5. $(5m^3)^2 - (6n)^2$ $a = 5m^3$ $b = 6n$

$(5m^3+6n)(5m^3-6n)$

6. $(x + 3)^2 - y^2$

$a = x+3$ $b = y$

$(x+3+y)(x+3-y)$

Common Polynomial Identities:

Description	Identity
Difference of Two Squares	$a^2 - b^2 = (a+b)(a-b)$
~~Sum of Two Squares~~	$\cancel{a^2 + b^2 = (a+bi)(a-bi)}$
Perfect Square Trinomial	$a^2 + 2ab + b^2 = (a+b)^2$
Perfect Square Trinomial	$a^2 - 2ab + b^2 = (a-b)^2$
Binomial Cubed	$a^3 + 3a^2b + 3ab^2 + b^3 = (a+b)^3$
Binomial Cubed	$a^3 - 3a^2b + 3ab^2 - b^3 = (a-b)^3$
Difference of Two Cubes	$a^3 - b^3 = (a-b)(a^2+ab+b^2)$
Sum of Two Cubes	$a^3 + b^3 = (a+b)(a^2-ab+b^2)$

Factor the following polynomial expressions.

Always look for GCF 1st!

1. $3x(2x-1) + 4(2x-1) + 2x(2x-1)$ GCF: $2x-1$

$(2x-1)(3x+4+2x)$

$(2x-1)(5x+4)$

2. $a^2(a+3) - 9(a+3)$

$(a+3)(a^2-9) = (a+3)(a+3)(a-3)$

Dif of Squares

Factor the following polynomial expressions using the **grouping** technique. use when you have 4 terms

3. $(6m^3 + 8m^2)(+ 9m + 12) = 2m^2(3m+4) + 3(3m+4)$

$(3m+4)(2m^2+3)$

4. $(9a^3 - 6a^2)(- 6a + 4) = 3a^2(3a-2) - 2(3a-2)$

$(3a-2)(3a^2-2)$

5. $(3p^3 - 2p^2)(- 27p + 18) = p^2(3p-2) - 9(3p-2)$

$(p^2-9)(3p-2)$

$(p+3)(p-3)(3p-2)$

Sum and Difference of Cubes:

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

Same sign

Opposite sign

Always P

$1^3 = 1$
$2^3 = 8$
$3^3 = 27$
$4^3 = 64$
$5^3 = 125$
$6^3 = 216$
$7^3 = 343$
...

- Must be a binomial & both are perfect cubes.
- Take the cube root of each term to find a & b
- Signs: SOAP (Same Opposite Always Positive)

Examples of sums and differences of cubes:

1. $a^3 + 64$

$(a \;_S\; b)(a^2 \;_O\; ab \;_{AP}\; b^2)$

$a = \sqrt[3]{a^3} = a$

$b = \sqrt[3]{64} = 4$

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

Trinomial in cube formula is never factorable. To solve use quad. formula + you get 2 imag. sol.

2. $8x^3 - 125$

$a = \sqrt[3]{8x^3} = 2x$

$b = \sqrt[3]{125} = 5$

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

$ab = 2x(5)$

$(2x-5)(4x^2+10x+25)$

3. $27x^3 - y^3$ $a = 3x$ $b = y$

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

$b = \sqrt[3]{64y^6}$

4. $27x^3 + 64y^6$ $a = 3x$ $b = 4y^2$

$(3x + 4y^2)(9x^2 - 12xy^2 + 16y^4)$

What is the difference between these two problems?

$2y^3 + 4y^2 - 30y$

$2y(y^2 + 2y - 15)$

$2y(y+5)(y-3)$

$2y^3 + 4y^2 - 30y = 0$

$2y(y^2 + 2y - 15) = 0$

$2y(y+5)(y-3) = 0$

$2y = 0$ $y + 5 = 0$ $y - 3 = 0$

$y = 0$ $y = -5$ $y = 3$

*we can NEVER divide an equation through by a variable

Real roots = zeros = x-intercepts

If abc = 0, then either a=0 or b=0 or c=0.

If x + 3 is a factor, then x = -3 is a root.
If 6 is a root, then x-6 is a factor.

*imaginary roots are not seen as x-intercepts on our graphs

Find the roots of these equations.

roots: 6
degree

1. $4x^6 + 4x^5 - 24x^4 = 0$

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

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

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

$\frac{4x^4}{4}=\frac{0}{4}$ $\quad x=-3 \quad x=2$

$\sqrt[4]{x^4}=\sqrt[4]{0}$

$x=0$
multiplicity of 4
mult. 4

2. $x^4 + 25 = 26x^2$

Set = 0 1st

4 roots

$x^4 - 26x^2 + 25 = 0$

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

$(x+5)(x-5)(x+1)(x-1) = 0$

$x = -5$ $x = 5$ $x = -1$ $x = 1$

Sometimes factors appear most than once. This creates a multiple root. (multiplicity is the number of times x - r is a factor)

3. $3x^5 + 18x^4 + 27x^3 = 0$

degree 5 = 5 roots

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

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

$3x^3 = 0$ $x+3=0$ $x+3=0$

$x = 0$ multiplicity of 3

$x = -3$ mult. of 2

4. Solve $x^3 - 27 = 0$

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

$x - 3 = 0$

$x = 3$

$x^2 + 3x + 9 = 0$ Quad. Formula $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = 1$ $b = 3$ $c = 9$

$x = \frac{-3 \pm \sqrt{(3)^2 - 4(1)(9)}}{2(1)}$

$x = \frac{-3 \pm \sqrt{-27}}{2} = \frac{-3 \pm 3i\sqrt{3}}{2}$ $\sqrt{-9 \cdot 3}$

5. $8x^3 = 1$

$8x^3 - 1 = 0$

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

$2x - 1 = 0$

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

$a = 4$ $b = 2$ $c = 1$

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

$x = \frac{-2 \pm \sqrt{-12}}{8}$ $\sqrt{-1 \cdot 4 \cdot 3}$

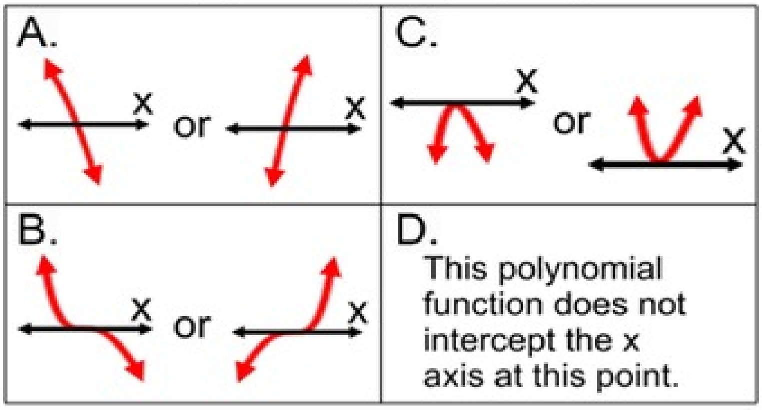
$x = \frac{-2 \pm 2i\sqrt{3}}{8} = \frac{-1 \pm i\sqrt{3}}{4}$

HW: p. 1-3
#1-23 odds
#24-37 all

How does f(x) intercept the x axis at 8?

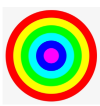
$$f(x)= -2x(x+5)^2(x-8)^3$$

sneak preview of tomorrow



Homework~

WS #1



I can solve polynomial equations by factoring.