

Name: Key  
 UNIT 1

Date: \_\_\_\_\_

LESSON 4

AIM: HOW DO WE DETERMINE THE DIFFERENCE BETWEEN FACTORS AND ROOTS?

Do Now:

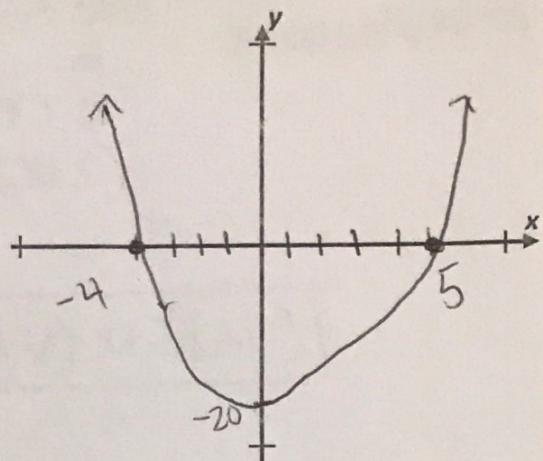
a) Using your graphing calculator, sketch  $f(x) = x^2 - x - 20$  on the coordinate axis below.

b) Factor:  $f(x) = x^2 - x - 20$

$$\begin{array}{l} (x-5)(x+4) \\ \hline x-5=0 \quad | \quad x+4=0 \end{array}$$

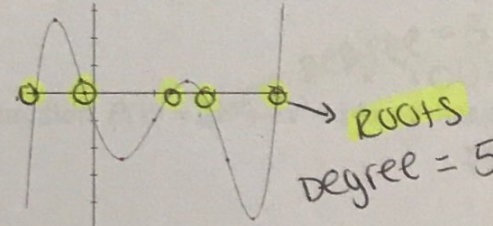
c) Identify the x-intercepts of the function based on the graph.

$$x=5 \quad x=-4$$



d) What similarities do you notice?

\* DISCUSS RELATIONSHIP BETWEEN FACTORS + X-INTERCEPTS

ROOTS	FACTORS
 <ul style="list-style-type: none"> <li>X-intercepts have several words with the same meaning:  <u>ROOTS</u>, <u>SOLUTIONS</u>, <u>ZEROS</u></li> <li>When a function crosses the x-axis, the y-value is <u>zero</u>.</li> <li>When we set a polynomial equal to zero and factor, the answers we find are <u>roots</u> or <u>solutions</u>.</li> <li>Roots are always represented as <u>constants</u>.</li> <li>The <u>degree</u> of a polynomial will always tell us how many roots there are - both real and non-real!</li> </ul>	$x^2 - x - 6 = 0$ <p>Factor: <math>(x-3)(x+2) = 0</math> <b>FACTORS!</b></p> <p>Blobs = 0: <math>x-3 = 0</math> or <math>x+2 = 0</math></p> <p>Solve: <math>\begin{array}{l} +3 +3 \\ \hline x = 3 \end{array}</math> or <math>\begin{array}{l} -2 -2 \\ \hline x = -2 \end{array}</math></p> <p>This "or" is kind of important since x cannot be 3 AND -2 at the same time!</p> <ul style="list-style-type: none"> <li><u>FACTORS</u> break a polynomial into simpler terms such that when the terms are multiplied together, they equal the original polynomial.</li> <li><u>FACTORS</u> are either represented using <u>Binomials</u> or <u>monomials</u>.</li> <li>We set <u>factors</u> equal to zero to find <u>roots</u>.</li> <li>This process is called the <u>zero product property</u>.</li> </ul>

\* play kahoot - FACTORS VS. ROOTS 1st! \*

**EXAMPLES:**

\* If  $(x-2)$  is a factor, there will be no remainder \*

1) Find all the factors of  $f(x) = x^3 + 2x^2 - 5x - 6$  if  $(x-2)$  is a factor.

① Divide

$$\begin{array}{r}
 \overline{) x^3 + 2x^2 - 5x - 6} \\
 \underline{-(x^3 + 2x^2)} \phantom{- 5x - 6} \\
 4x^2 - 5x \phantom{- 6} \\
 \underline{-(4x^2 + 8x)} \phantom{- 6} \\
 3x - 6 \phantom{- 6} \\
 \underline{-(3x + 6)} \\
 0
 \end{array}$$

② Factor

$$\begin{array}{l}
 x^2 + 4x + 3 \\
 (x+3)(x+1)
 \end{array}$$

→ Degree = 3

∴ 3 factors/roots

Factors:  $(x-2)(x+3)(x+1)$

2) The function  $P(x) = 2x^3 + 4x^2 - 14x + 8$  has a root of  $-4$ . Find all real solutions. → ROOTS

Factor:  $(x+4)$

① Divide

$$\begin{array}{r}
 \overline{) 2x^3 + 4x^2 - 14x + 8} \\
 \underline{-(2x^3 + 8x^2)} \phantom{- 14x + 8} \\
 -4x^2 + 4x \phantom{+ 8} \\
 \underline{+4x^2 + 16x} \phantom{+ 8} \\
 2x + 8 \phantom{+ 8} \\
 \underline{-(2x + 8)} \\
 0
 \end{array}$$

② Factor

$$\begin{array}{l}
 2x^2 - 4x + 2 \\
 2(x^2 - 2x + 1) \\
 2(x-1)(x-1) \\
 \begin{array}{c|c}
 x-1=0 & x-1=0 \\
 +1+1 & +1+1 \\
 \hline
 x=1 & x=1
 \end{array}
 \end{array}$$

Roots:  $\{-4, 1, 1\}$

SKIP

3) (Graphing Calculator Practice) What is the quotient of  $\frac{x^2+6x+9}{x+3}$ ?

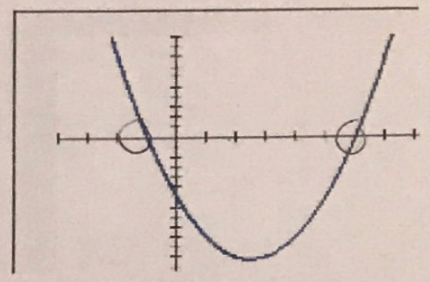
- 1)  $x+3$
- 2)  $x^2+2x+3$
- 3)  $x+2x$
- 4)  $x+5$

$$\begin{array}{r}
 x+3 \overline{) x^2+6x+9} \\
 \underline{-(x^2+3x)} \phantom{+9} \\
 3x+9 \\
 \underline{-(3x+9)} \\
 0
 \end{array}$$

4) For the polynomial function graphed to the right, identify:

a) Its roots:

$x = -1$  and  $x = 6$



b) Its factors:

$(x+1)(x-6)$

c) Its equation:

$y = x^2 - 6x + x - 6$   
 $y = x^2 - 5x - 6$

mult. factors

**PARTNER PRACTICE:**

1) What is the equation of this function?

roots =  $x = -2$   $x = 1$

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

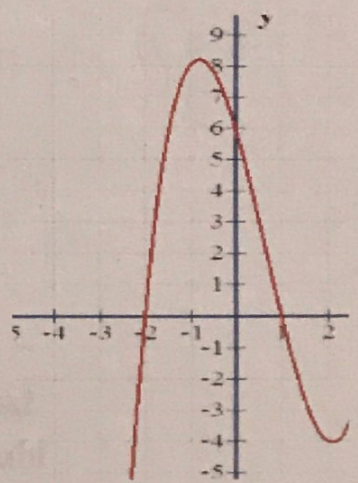
equation =  $y = (x+2)(x-1)$

↳ factored form

$y = x^2 - x - 2$

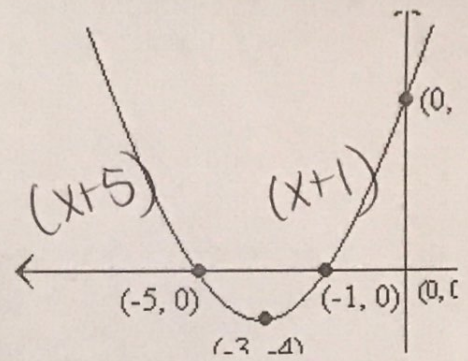
$y = x^2 - x - 2$

↳ standard form



2) What are one of the factors of the parabola on the right?

- ~~A)  $x-5$~~
- B)  $x+3$
- C)  $x+1$**
- D)  $x+4$



3) In the equation,  $y = 2x^4 + 3x^3 - 3x^2 + 2x - 8$ ,

a) What is the degree of the equation? **4**

b) What is the y-intercept? **-8**  
constant ↶

4)  $ax^3 + bx^2 + cx + d = 0$

In the equation above,  $a$ ,  $b$ ,  $c$ , and  $d$  are constants.  
 If the equation has roots  $-1$ ,  $-3$ , and  $5$ , which of the following is a factor of  $ax^3 + bx^2 + cx + d$ ?

- ~~A)  $x-1$~~
- B)  $x+1$**
- ~~C)  $x-3$~~
- ~~D)  $x+5$~~

5)

$x$	$f(x)$
0	3
2	1
<b>4</b>	<b>0</b>
5	-2

Root -  $x=4$   
 Factor -  $(x-4)$

Root = x-intercept.  
 ↵  $\therefore y=0$

The function  $f$  is defined by a polynomial.  
 values of  $x$  and  $f(x)$  are shown in the table.  
 Which of the following must be a factor of

- A)  $x-2$
- B)  $x-3$
- C)  $x-4$**
- D)  $x-5$